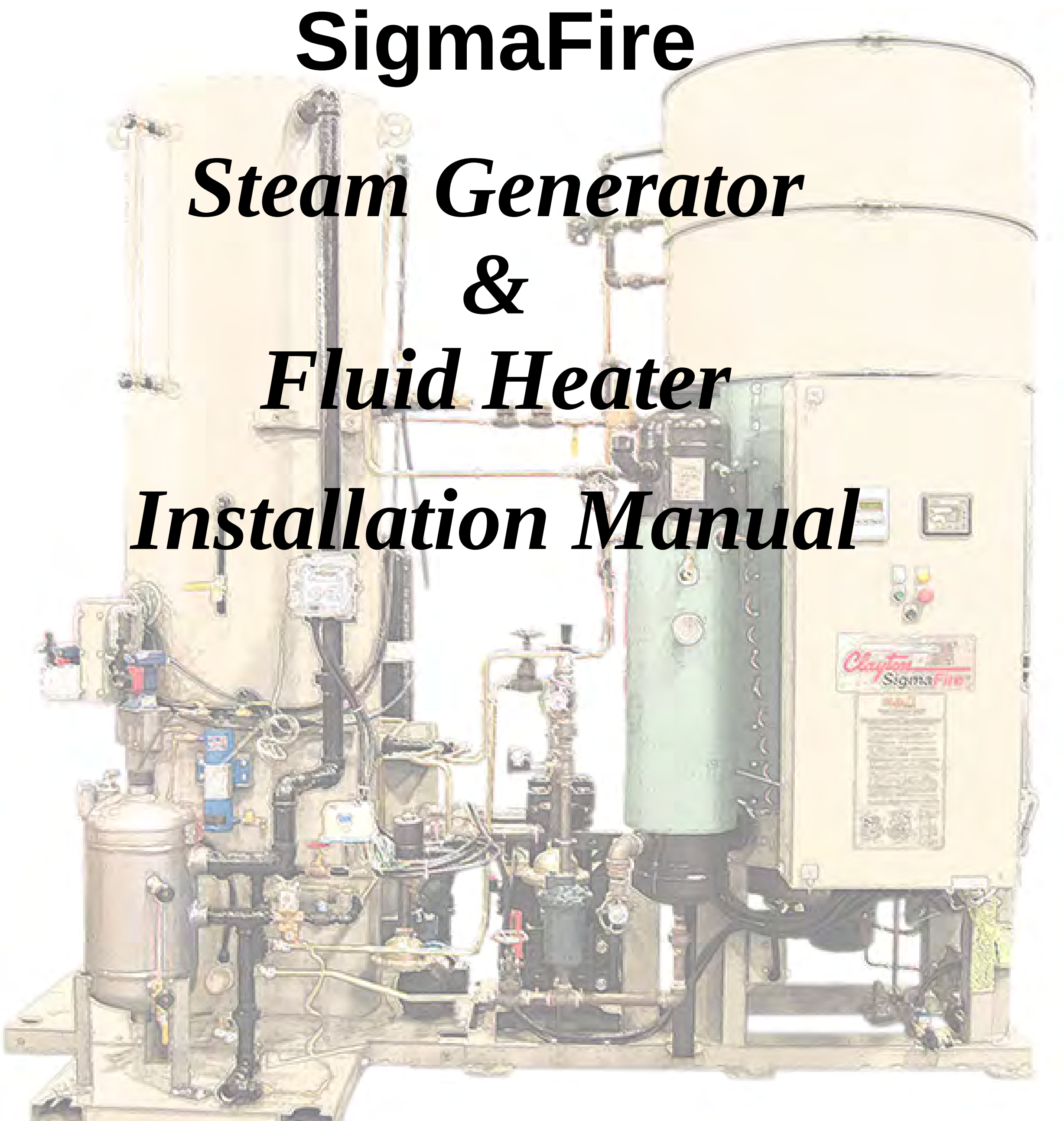
SigmaFire

Steam Generator
&
Fluid Heater

Installation Manual



Clayton Industries
City Of Industry, California
USA

R020932J1
08-2016

For your convenience, enter your unit's specific model and serial number in the space below. The model and serial number are located on the right-hand side of the electronic controls cabinet.

MODEL: ________________________ **SERIAL NUMBER:** ______________________

SigmaFire
Steam Generator
and
Fluid Heater
Installation Manual

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SECTION I - INTRODUCTION

The ***CLAYTON STEAM GENERATOR*** is manufactured in accordance with the American Society of Mechanical Engineers (ASME) Boiler Pressure Vessel Code (BPVC), Section I. Construction and inspection procedures are regularly monitored by the ASME certification team and by the Authorized Inspector (AI) commissioned by the Jurisdiction and the National Board of Pressure Vessel Inspectors (NBBI).

The NBBI is a nonprofit organization responsible for monitoring the enforcement of the various sections of the ASME Code. Its members are the chief boiler and pressure vessel inspectors responsible for administering the boiler and pressure vessel safety laws of their jurisdiction.

The electrical and combustion safeguards on each ***CLAYTON STEAM GENERATOR*** are selected, installed, and tested in accordance with the standards of the Underwriters' Laboratories and such other agency requirements as specified in the customer's purchase order.

NOTE

It is important that the steam generator/fluid heater, feedwater skid, and all installation accessories and options be installed in accordance with ASME/ANSI Codes, as well as, all applicable Federal, State, and local laws, regulations and codes.

NOTE

Clayton startup engineers or service technicians reserve the right to refuse commissioning of any Clayton equipment if Clayton startup/service personnel determines such equipment installation fails to meet the guidelines and requirements outlined in this installation manual.

NOTE

Clayton sales representatives and service technicians *ARE NOT* authorized to approve plant installation designs, layouts, or materials of construction. If Clayton consultation or participation in plant installation design is desired, please have your local Clayton sales representative contact Clayton corporate headquarters for more information and pricing.

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SECTION II - GENERAL INFORMATION

2.1 LOCATION

Give careful consideration to your Clayton equipment investment and the equipment warranty when selecting an installation location. The equipment should be located within close proximity to necessary utilities, such as fuel, water, electricity, and ventilation. General consumption data for each model is provided in Table 1 of Section VI. General equipment layout and dimensions are provided in Table 2 of Section VI. For actual dimensions and consumption information, please refer to the data submitted with each specific order.

NOTE

Clayton's standard equipment is intended for indoor use only. Clayton's equipment must be protected from weather at all times. The steam generator/fluid heater, and any associated water and chemical treatment equipment must be maintained at a temperature above 45° F (7° C) at all times.

Maintain adequate clearance around your Clayton equipment for servicing needs. Maintain a minimum clearance of 60 inches (1.5 m) in front of the equipment, a minimum clearance of 36 inches (1 m) to the left and right sides, and a minimum clearance of 18 inches (0.5 m) to the rear of the equipment. Ample overhead clearance, including clearance for lifting equipment, should be considered in case the coil requires removing. Equipment layout and dimensions are provided in Table 2 of Section VI. Review the Plan Installation drawing supplied with the order for specific dimensions and clearance information.

CAUTION

ALL combustible materials must be kept a minimum of 48 inches (1.2 m) from the front and 18 inches (0.5 m) from the top, rear, and sides of the equipment. A minimum clearance of 18 inches (0.5 m) must also be maintained around the flue pipe. Flooring shall be non-combustible. This equipment must not be installed in an area susceptible to corrosive or combustible vapors.

IMPORTANT

KEEP CLAYTON EQUIPMENT CLEAR OF ALL OBSTRUCTIONS. DO NOT ROUTE ANY NON-CLAYTON PIPING, ELECTRICAL CONDUIT, WIRING, OR APPARATUS INTO, THROUGH, OR UNDER CLAYTON EQUIPMENT. ANY OBSTRUCTIONS CREATED BY SUCH NON-CLAYTON APPARATUS WILL VERY LIKELY INTERFERE WITH THE PROPER OPERATION AND SERVICING OF THE

EQUIPMENT. ALL SUCH INTERFERENCE IS THE SOLE RESPOSIBILITY OF THE CUSTOMER. CLAYTON’S PLAN INSTALLATION DRAWINGS, INCLUDING JOB-SPECIFIC DRAWINGS, ARE FOR VISUAL REFERENCE ONLY.

2.2 POSITIONING AND ANCHORING EQUIPMENT

2.2.1 General Installation Requirements

Lifting instructions are provided in Appendix A. Proper rigging practices and equipment must be applied when lifting this equipment. Forklifts with roll bars can be used for installations with overhead space limitations.

WARNING

DO NOT attach rigging gear to the top coil lifting hook or any part of this equipment other than the main frame.

Proper floor drains must be provided under the generator(s). **MAKE SURE ALL EQUIPMENT IS LEVELED AND ALL ANCHORING POINTS ARE USED.**

Level the equipment using full-size, stainless steel, slotted shims that match the equipment pads designed and provided on the equipment. Clayton recommends full-size slotted shims. If slotted machine shims are used, Clayton requires C-size or larger for pump skids and E-size for generator and water skids. Use full-sized anchors to anchor the equipment. Make sure anchors are strong enough to withstand operating, wind, and seismic loads that exists in the installation location.

To enhance serviceability and accommodate service personnel, Clayton recommends placing its generators, main positive displacement (PD) feedwater pumps, feedwater skids, and water treatment skids on 4–6 inch (10–15 cm) high equipment maintenance pads. These equipment maintenance pads on which the equipment will be installed must be 3–6 inches (8–15 cm) wider and longer than the equipment base plates. Make sure the equipment maintenance pads are properly reinforced and leveled.

Fully grout into place all generators, pumps, and skids, after leveling and anchoring, to provide adequate support and **minimize equipment vibration. Grouting is important, but it does not replace the use of metal shims under each anchor bolt location. Every anchor hole location on the equipment skid(s) requires an anchor bolt.**

It is recommended the mass of the concrete foundation be sufficient to absorb the dynamic and static forces from the operation, wind, or seismic conditions that exist at the specific equipment installation location. **Accepted concrete construction guidelines, for equipment installation, recommends that the concrete foundation be at least 5 1/2” to 7 1/2” (14 cm to 19 cm) thick, depending on soil, underground water, environmental, and seismic conditions.**

If Clayton’s generator, pump, or skid are mounted on a surface other than a concrete foundation, such as a steel structure, then the equipment base frame must be supported on rigid steel beams that are aligned along the length of the equipment base frame. It is strongly recommended that Clayton’s equipment be supported with horizontal and vertical main structural members at all its equipment anchor pads.

Perform stress calculations for the steel structure to confirm it has adequate rigidity to minimize baseplate distortion and vibration during operation. Clayton recommends incorporating vibration isolation on this type of installation.

2.2.2 Equipment Anchoring

To properly secure the equipment base frames to the equipment maintenance pads and foundation, proper anchor bolts are required. The anchor bolt diameter must be fully sized to the anchor bolt holes in Clayton's equipment base frame. For required bolt sizes, see the plan installation drawings for the specific Clayton equipment. The anchor bolt length extending above the foundation should equal the total height of all shimming and leveling devices, 3/4–1 1/2 inch (2–4 cm) grout filler for leveling, the equipment base frame thickness, washer set, anchor bolt nut, and an additional 1/2 inch (1.5 cm) above anchor bolt nut (See Figure 2-1.).

The proper anchor bolt length and its embedded depth must meet all static and dynamic loading from the operation of the equipment, wind loading, and seismic loading.

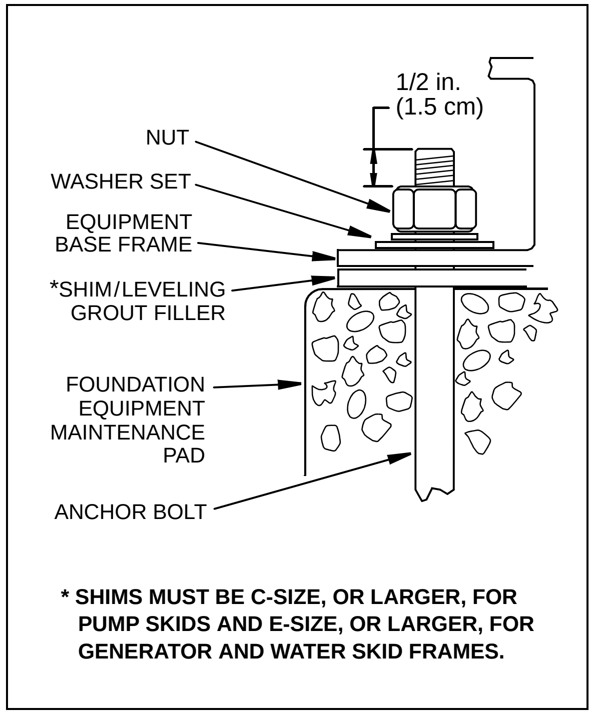


Figure 2-1 Anchor bolt installation

CAUTION

Failure to adequately support Clayton's equipment can lead to excessive vibration, which is detrimental to Clayton's product and component life cycle, especially electrical components.

2.2.3 Grouting

Make sure to grout the entire equipment base frame before making any additional connections to your Clayton equipment. Grouting the equipment base frame to the foundation provides a good and sturdy union between them. Grout is a concrete-type material that is used to fill the gap between the equipment base frame and the foundation. The grout increases the mass of the base to help reduce equipment vibration, which is fundamental to product life. In addition, the grout will fill any voids or imperfections in the foundation surface to increase proper equipment support. When the grout hardens, the equipment base frame and the foundation becomes one solid unit to support the equipment.

2.2.4 Clayton PD Feedwater Pump Placement

Clayton's PD pump placement and its relative position to Clayton's generator is critical for managing pump-induced equipment vibration; therefore, this helps to extend equipment and component life. Substantial hydraulic vibration can develop when pipe runs between the PD feedwater pump(s) and the heating coil inlet are lengthened and/or elevated without additional piping design and component changes.

IMPORTANT

To prevent voiding Clayton's equipment warranty, it is required that any intended relocation of Clayton's PD feedwater pump from the generator be pre-approved by Clayton's engineering group prior the equipment installation design.

DO NOT MOVE OR RELOCATE THE POSITION OF CLAYTON'S MAIN PD FEEDWATER PUMP, RELATIVE TO THE GENERATOR, AS SHOWN ON CLAYTON'S PLAN INSTALLATION DRAWING, WITHOUT FIRST CONSULTING WITH CLAYTON'S ENGINEERING GROUP.

Clayton's service team is restricted from commissioning or starting any Clayton equipment where the main PD feedwater pump(s) has been relocated without prior approval.

2.3 COMBUSTION AIR

A sufficient volume of air must be continuously supplied to the boiler room to maintain proper combustion. **Boiler room fresh air vents must be sized to maintain air velocity less than 400 scfm with less than 1/4 inch water pressure drop. Ventilation openings must be sized at 3 ft^2/100 bhp or larger.** As a guideline, there should be 12 cfm of air per boiler horsepower.[1] This will provide sufficient air for combustion and outer shell cooling. Refer to Table 6.1A and 6.1B of Section VI for the required area of free air intake.

An inlet air duct should be used when there is insufficient boiler room air, when the boiler room air supply is contaminated with airborn material or corrosive vapors, and when noise consideration is required. A suitable inlet weather shroud is required and an air filter should be installed when there is a potential for airborn contaminates. Air inlet filters capable of filtering airborn contaminates down to 3 microns are required for FMB equipped units. If an inlet air duct is used in cold weather climates, it must contain a motor operated damper with a position interlock switch to prevent freezing of the heating coil. The maximum allowable pressure drop in the inlet air duct system is 0.5 inch water column.

2.4 CUSTOMER CONNECTIONS - STEAM GENERATOR

The number, type, and size of required customer connections will vary with equipment size and type of skid package provided. Table 2-1 below identifies the required steam generator customer connections for the various skid packages. The equipment connections and sizes are provided in Tables 6-2 through 6-6 in Section VI.

[1] This guideline is based on an installation at about sea level; high altitude installations require more air.

Additional customer connection tables located in Section III provide detailed descriptions of connections for Clayton water treatment packages.

Steam generator installation guidelines are provided in the following sections. Water treatment component installation guidelines are provided in Section III.

Table 2-1: Customer Connections

Required Customer Connections Include:	EQUIPMENT PACKAGES			
		STEAM GENERATORS WITH		
	Steam Generator only	Hot-well Tank	Water Skid	Generator Skid
Exhaust Stack	X	X	X	X
Separator Steam Outlet	X	X	X	X
Safety Relief Valves Discharge	X	X	X	X
Feedwater Inlet	X	X	X	
Coil Drain(s)	X	X	X	
Separator Drain	X	X	X	
Steam Trap(s) Outlet	X	X	X	
Fuel Inlet	X	X	X	X
Fuel Return (Oil Only)	X	X	X	X
Atomizing Air Inlet (Oil Only)	X	X	X	X
Electrical Connection-Primary	X	X	X	X
Electrical-Generator Skid Interconnect		X	X	
Coil Gravity Drain	X	X	X	X
Fuel Pump Relief Valve (Oil Only)	X	X	X	X

2.5 EXHAUST STACK INSTALLATION

(See Figures 2-2, 2-3, 2-4, 2-5, and 2-6)

2.5.1 Installing Exhaust Stacks

Clayton strongly recommends a barometric damper on all installations. Proper installation of the exhaust stack is essential to the proper operation of the Clayton steam generator. Clayton specified allowable back-pressure of 0.0 to -0.25 w.c.i. must be considered when designing and installing the exhaust stack. The stack installer is responsible for conforming to the stack draft back-pressure requirements. Ninety-degree elbows should be avoided. Forty-five degree elbows should be used when the stack cannot be extended straight up. ***Stacks in excess of 20 feet (6 m) may require a barometric damper. Stacks for all low NOx generators require a barometric damper.***

The material and thickness of the exhaust stack must comply with local code requirements, and be determined based on environmental and operating conditions (exposure to the elements, humidity, constituents of fuel, etc.). The area of free air space between the exhaust stack and building, roof, or flashings must also comply with local codes. The material used for roof flashings must be rated at a minimum of 600° F (315° C). A “weather cap” must be installed on top of the exhaust stack.

IMPORTANT

The specified exhaust stack connection size (shown in Tables 6-2 through 6-5, in Section VI, and in Clayton’s Plan Installation Drawings) is the minimum required for Clayton’s equipment. It is NOT indicative of the required stack size to meet installation requirements or by local codes. All exhaust stack installations must be sized to meet prevailing codes, company and agency standards, and local conditions, as well as, the recommended requirements specified above.

NOTE

Clayton recommends all generators purchased with our integral economizers be installed with stainless steel, insulated, double-walled exhaust stacks. All units operating on light or heavy oil should use stacks constructed with stainless steel. Clayton recommends all heavy oil units use a free-standing, vertical stack, with clean-out access, as shown in Figure 2-3

NOTE

All oil-fired units must have an exhaust gas temperature indicator installed in the stack.

A removable spool piece must be installed at the generator flue outlet to facilitate removal and inspection of the heating coil. To permit sufficient vertical lift, the spool piece should be at least 4 feet (1.2 m) tall. The spool installation should be coordinated with the customer supplied rigging. If operating on any type of fuel oil, an access door must be provided immediately at the generator flue outlet (first vertical section) to provide a means for periodic water washing of the heating coil. The section of the stack located inside the building should be insulated to reduce heat radiation and noise.

Exhaust stacks are to be self-supporting (maximum stack connection load is 50 lbs. {22 kg}) and must extend well above the roof or building, (refer to local building codes). If nearby structures are higher than the building housing the steam generator(s), the stack height should be increased to clear these structures.

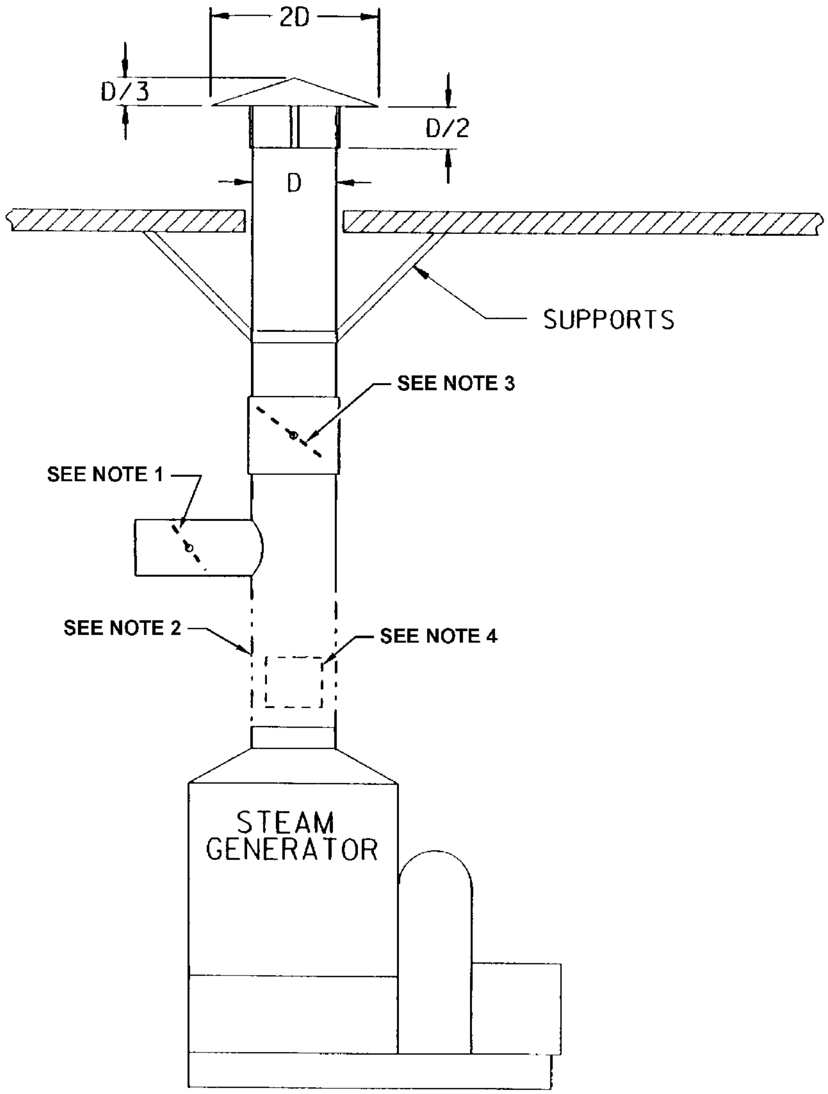
NOTE

It is strongly recommended that a back draft damper (full size and motor operated with position interlock switch) be installed to prevent freeze damage to the heating coil. Machine installations, in cold weather zones, that plan to lay the machine up wet and may encounter freezing conditions must install an air-tight back draft damper in the exhaust stack to prevent down-draft freezing.

Clayton recommends insulating all exhaust stacks to maintain gas temperatures above dew point.

Special consideration should be given to installations in and around residential areas. Depending on the design, some noise and harmonic vibration may emanate from the exhaust stack. The noise/harmonics may bounce off surrounding structures and be offensive to employees and neighbors. If this condition occurs, a stack muffler is recommended. In-line stack mufflers are typically used, installed vertically and above roof level. They may be installed horizontally or closer to the equipment.

See Figures 2-2, 2-3, and 2-4 for stack configurations.



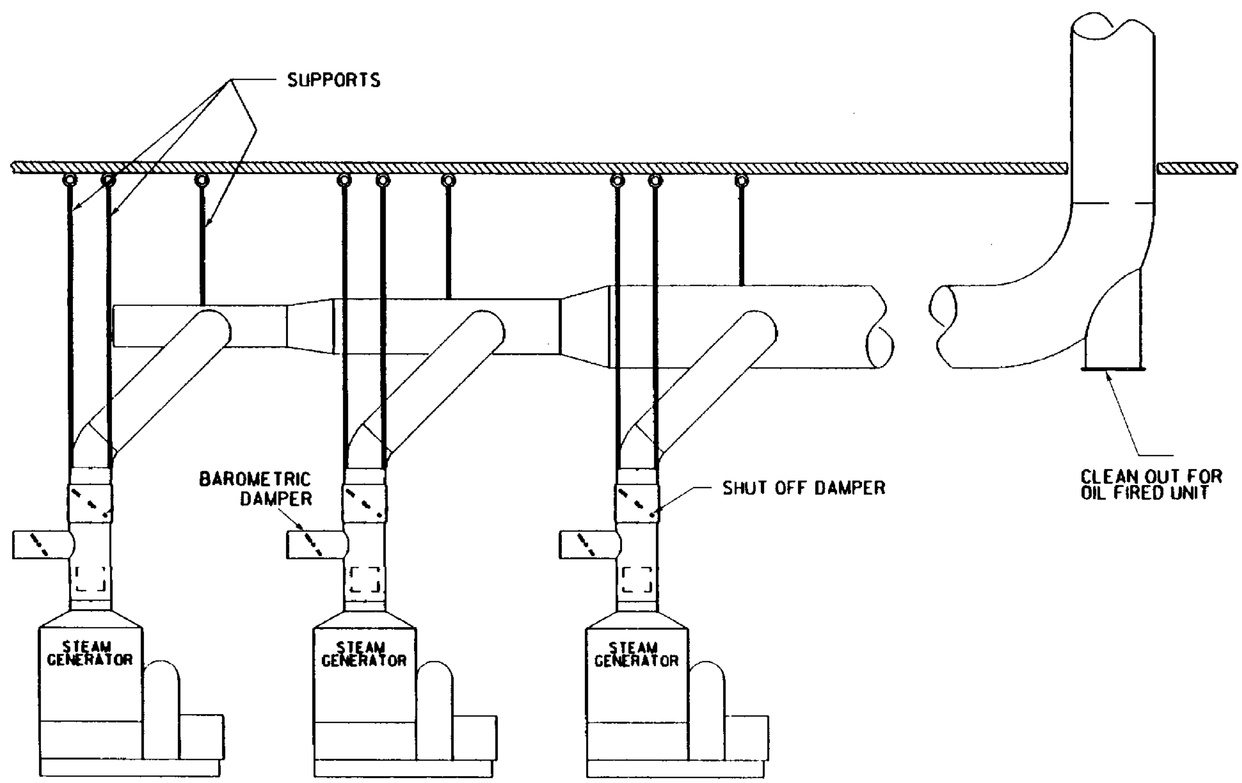
NOTE 1: Barometric dampers are recommended on all installations with stack heights over 20 feet (6 meters) and on any low NOx units.

NOTE 2: A removable, 4 feet (1.2 meters) minimum, stack section is recommended to facilitate steam generator/fluid heater maintenance and repair.

NOTE 3: A backdraft damper must be installed in the exhaust stack for installations in cold weather climates. All backdraft dampers must be air-tight and proof-of-position switches.

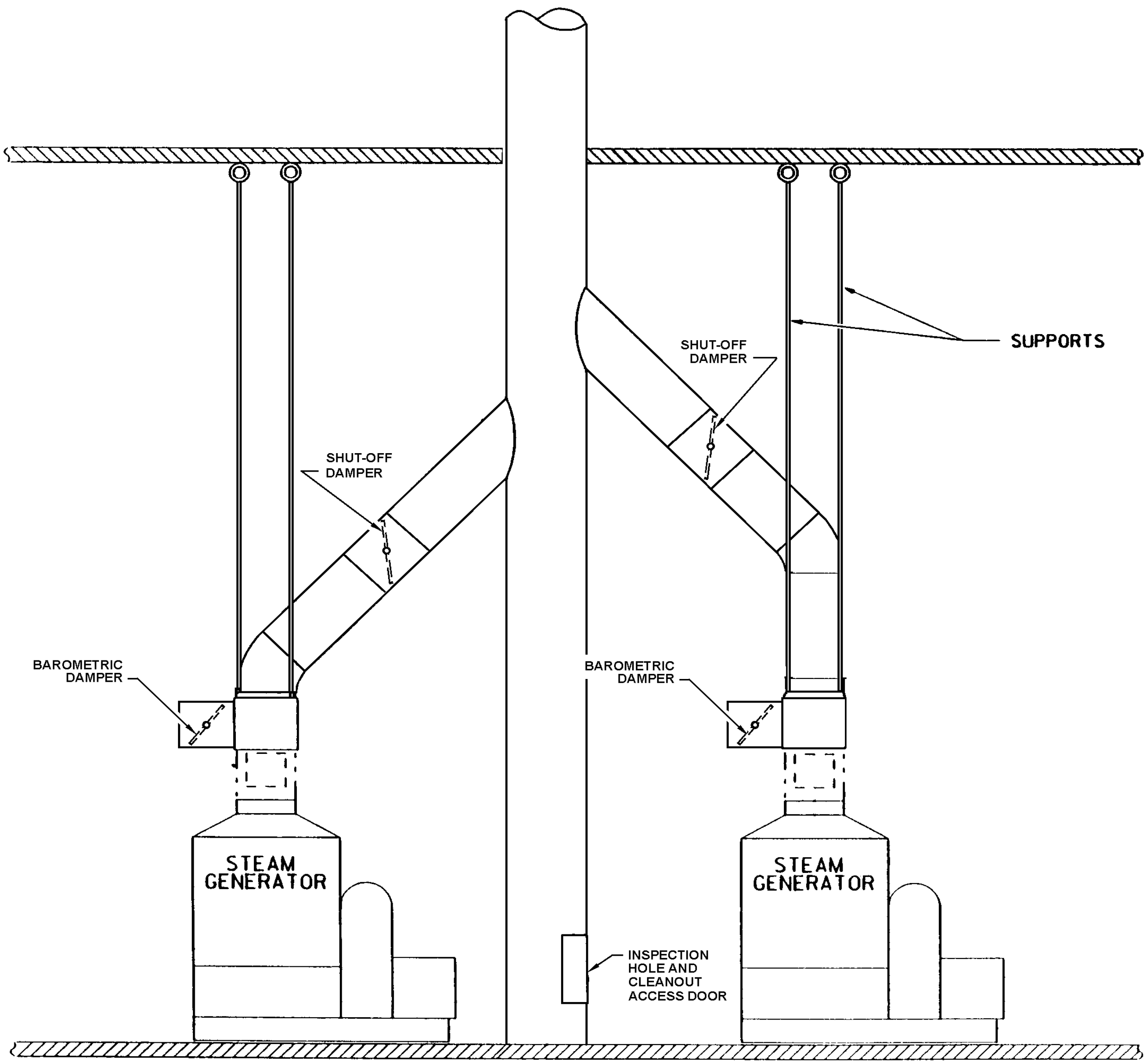
NOTE 4: Oil-fired units require a 2W x 3H feet (0.6W x 0.9H meter) access portal in the stack for inspection and water washing. A floor drain is required at the bottom of the generator under or close to the burner opening.

Figure 2-2 Standard exhaust stack layout for natural gas and light-oil installations only. Not recommended for heavy-oil machines.



***See Notes 1 – 4 in Figure 2-2.**

Figure 2-3 Alternate multi-unit exhaust stack layout for natural gas and light-oil installations only. Not recommended for heavy-oil machines.



*** See Notes 1–4 in Figure 2-2.**

NOTE: Exhaust stacks connecting to a common main stack must be offset from each other.

Figure 2-4 Recommended heavy-oil exhaust stack layout for single or multi-unit installations.

2.5.2 Installing Exhaust Stacks With External Condensing Economizer

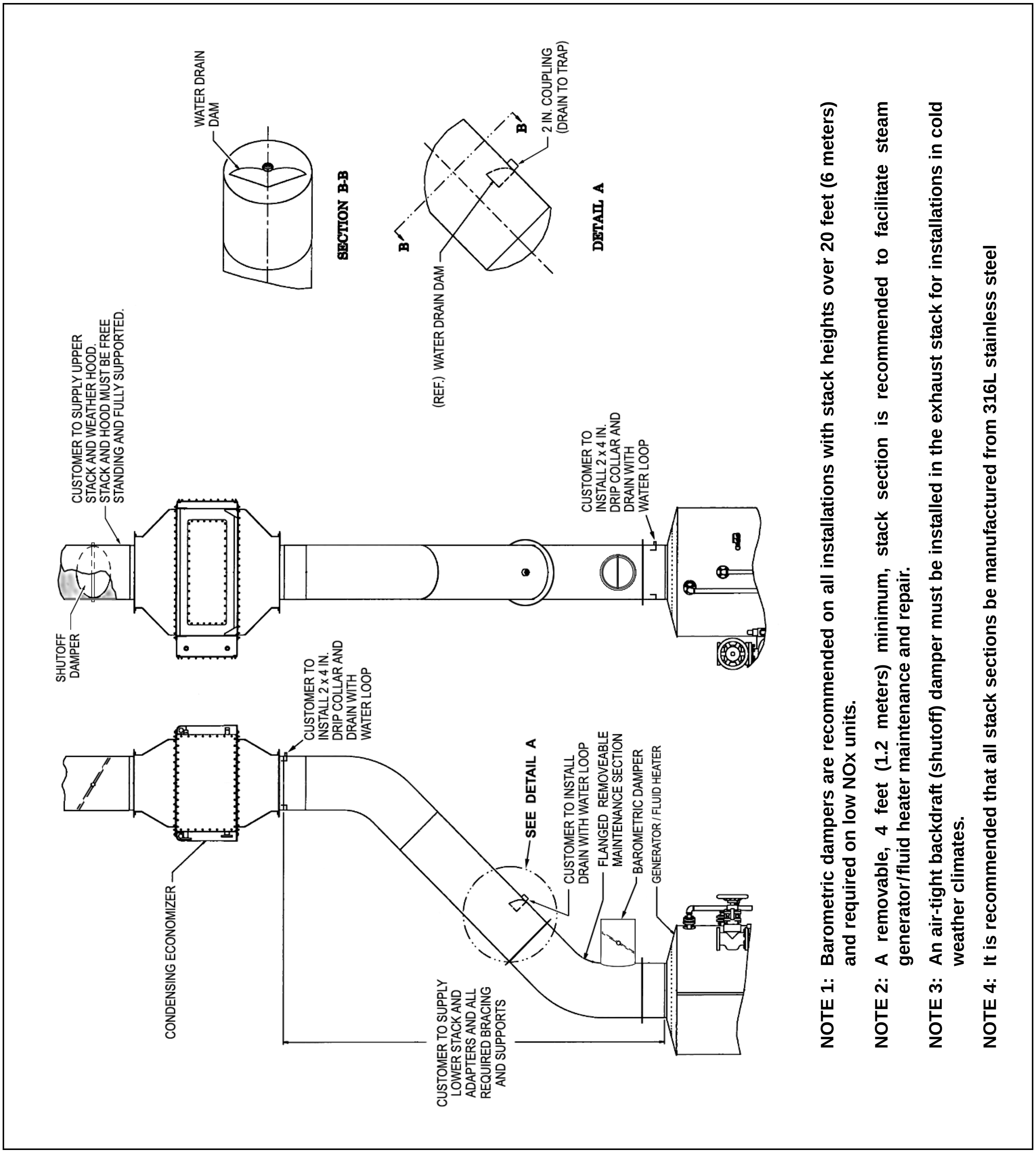
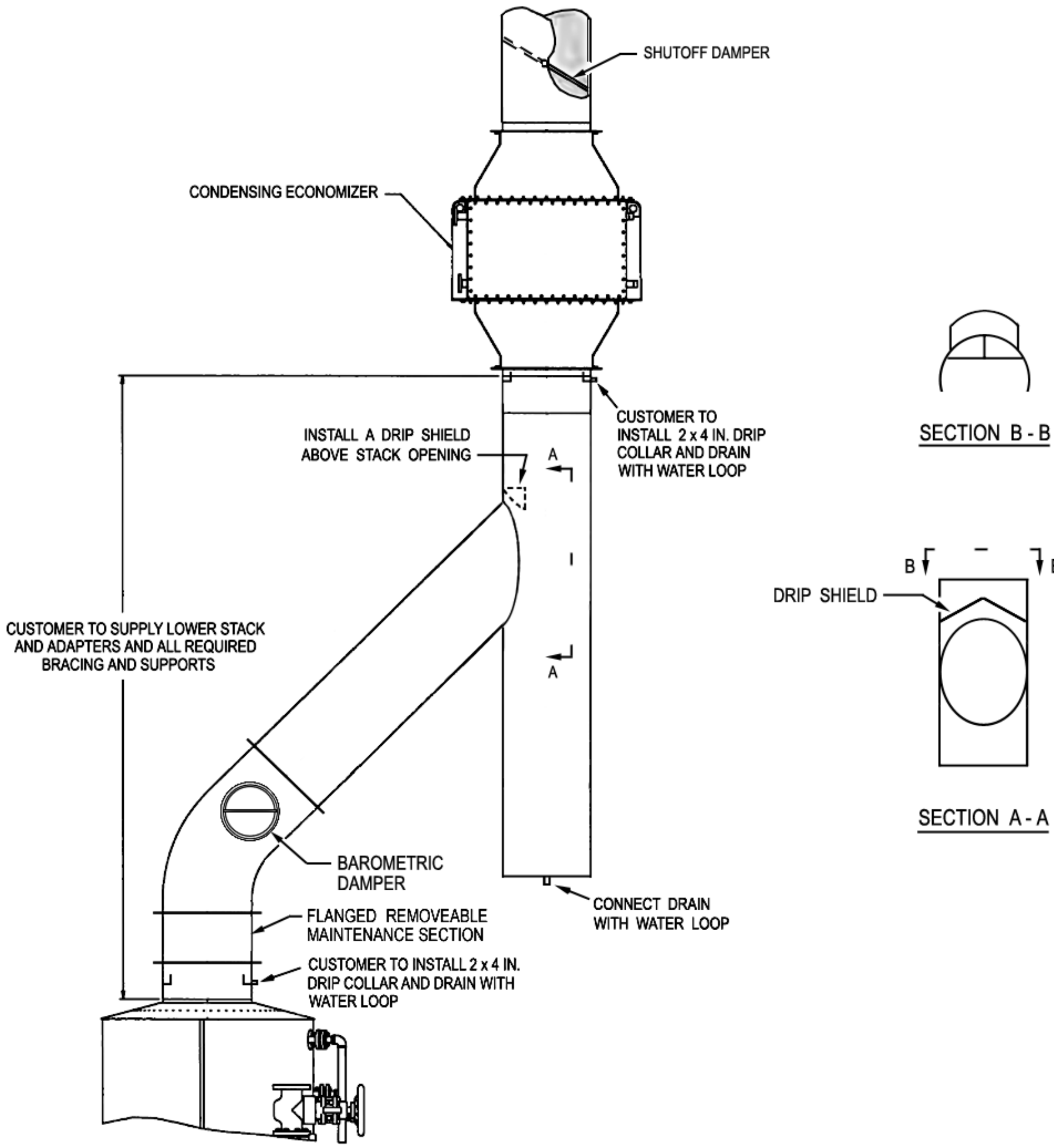


Figure 2-5 OPTION 1: Recommended exhaust stack installation for steam generator/fluid heaters with Clayton condensing economizer.



NOTE 1: **Barometric dampers are recommended on all installations with stack heights over 20 feet (6 meters) and on low NOx units.**

NOTE 2: **A removable, 4 feet (1.2 meters) minimum, stack section is recommended to facilitate steam generator/fluid heater maintenance and repair.**

NOTE 3: **An air-tight backdraft (shut off) damper must be installed in the exhaust stack for installations in cold weather climates.**

NOTE 4: **It is recommended that all stack sections be manufactured from 316L stainless steel**

Figure 2-6 OPTION 2: Recommended exhaust stack installation for steam generator/fluid heaters with Clayton condensing economizer.

2.6 PIPING

2.6.1 General

Make sure no excessive strain or load is placed on any Clayton piping or their connections. Construct secure anchoring and support systems for all piping connected to the steam generator unit and associated water treatment package(s). Make sure anchoring and support systems keep motion and vibration to an absolute minimum. Ensure no extraneous vibrations are transferred to or from Clayton equipment. **DO NOT use Clayton connections as anchor points.**

Spring-loaded pipe hangers are **not** recommended. All customer connections are limited to ±200 pounds (±90 kg) of load and ±150 foot-pounds (±200 N•m) of torque in all directions (X, Y, and Z). Properly designed flex lines and anchoring may be used to meet loading requirements. Fuel, combustion exhaust ducts, and fresh air supply connections are not designed for loads.

Pipe routes must not be obstructive or create any potential safety hazards, such as a tripping hazard. Pipe trenches should be considered for minimizing pipe obstructions. Piping used to transfer a hot fluid medium must be adequately insulated.

Pipe unions or flanges should be used at connection points where it is necessary to provide sufficient and convenient disconnection of piping and equipment.

Steam, gas, and air connections should enter or leave a header from the top. Fluids, such as oil and water, should enter or leave a header from the bottom. A gas supply connection must have a 12–18 inch (30–45 cm) drip leg immediately before Clayton's fuel connection.

Prevent dissimilar metals from making contact with one another. Dissimilar metal contact may promote galvanic corrosion.

Globe valves are recommended at all discharge connections from Clayton equipment that may require periodic throttling, otherwise gate or ball valves should be used to minimize pressure drops.

2.6.2 Systems

Table 2-2 below is for steam generators rated below 250 psig (17.2 bar). It indicates the recommended material to be used for the various piping systems associated with the installation.

Table 2-2: Piping Recommendations

SYSTEM	RECOMMENDED MATERIAL / COMPONENTS
Steam and Condensate System	Steam and condensate system piping should be a minimum Schedule 40 black steel (seamless Grade B preferred). Refer to ASME guidelines for proper pipe schedules. Steam headers should contain a sufficient number of traps to remove condensed steam, and help prevent "water hammer." The separator discharge requires one positive shut off globe valve at the separator discharge flange.
Blowoff/Drain	ASME codes require that all blow-off piping be steel with a minimum Schedule 80 thickness and all fittings be steel and rated at 300 psi. Boiler blow off piping should not be elevated.

Table 2-2: Piping Recommendations

SYSTEM	RECOMMENDED MATERIAL / COMPONENTS
Steam Trap(s) Discharge	Steam trap(s) discharge piping should be Schedule 40 black steel. Pipe size should be the same as that of the separator trap(s) connection up to the first elbow. The pipe size must be increased one pipe size after the first elbow, and again after manifolding with additional units. It is preferable to have the trap return line installed so its entire run is kept below the hot-well tank connection (to assist in wet layup). If this is not possible, then the line must be sloped downward toward the receiver at a rate of 1/8 inch per foot.
Fuel (gas or oil)	Schedule 40 black iron (See Section IV), local agencies/codes may require heavier pipe, and heavier fittings for oil lines.
Atomizing Air (oil only)	Schedule 40 black iron (See Section IV)
Safety Relief Valve Discharge	Safety relief valves must discharge to atmosphere in a direction that will not cause harm to personnel or equipment. The discharge piping must not contain any valves or other obstruction that could in any way hinder the release of steam. A drip pan elbow with appropriate drains should be installed as shown in Figure 2-7.
Back Pressure Regulator	Installing a Back Pressure Regulator (BPR) on all installations is highly recommended by Clayton Industries. A BPR is required for all units sold with Auxiliary Pressure Control (APC), Master Lead-Lag, and automated startup controls. The BPR protects against drying-out and localized over-heating of the heating coil during large steam pressure changes.

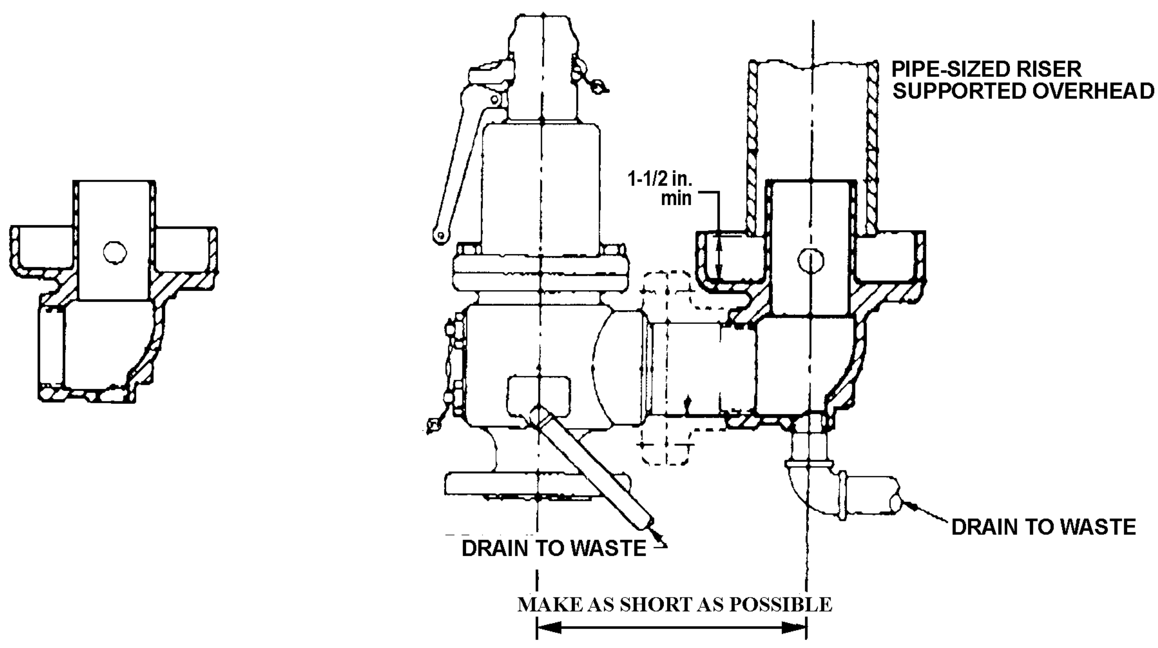


Figure 2-7 Safety Relief Valve Discharge

NOTE

It is the responsibility of the installer to ensure that all piping and fittings are properly rated (material type, thickness, pressure, temperature) for the intended system application. It is also the responsibility of the installing party to design all piping systems so as to ensure that Clayton specified flow and pressure requirements (See Section VI, Table 1) are satisfied.

2.6.3 Atmospheric Test Valve

An important, yet often overlooked, function of a properly installed steam piping system is the ability to perform full load testing of the steam generator(s) when the main steam header is restricted from accepting steam. This is most commonly encountered during the initial start-up when commissioning a steam generator. This condition will also occur when it is necessary to test or tune a steam generator during periods of steam header or end-user equipment repairs, when header pressure must be maintained to prevent cycling the generator off, or when an overpressure condition exists while in manual operation.

To facilitate full load testing of a steam generator, an easily accessible or chain operated, globe-type, atmospheric test valve ***must be installed*** in the steam header (downstream of a back pressure regulator, if so equipped, and upstream of at least one steam header isolation valve). The atmospheric test valve must be capable of passing 100 percent of the generator's capacity.

WARNING

A discharging atmospheric test valve produces extremely high noise levels. Extended exposure to a discharging atmospheric test valve can lead to hearing loss. Installing a silencer is strongly recommended.

2.6.4 Steam Header and Steam Sample Points

Clayton requires appropriately constructed steam header connections, and at least one steam sample point per generator. All steam header connections from and to Clayton's equipment must originate from the steam header vertically upward prior to changing direction toward Clayton's equipment.

Clayton requires all steam sample connections used to measure steam quality, or efficiency, originate from the steam header vertically upward prior to heading to any sample cooler, water quality, or efficiency testing/measuring equipment. Clayton requires the equivalent of three (3) pipe diameters of uninterrupted straight lengths of steam header prior to and after the sample point.

2.7 FEEDWATER TREATMENT

The importance of proper feedwater treatment cannot be over-emphasized. The Clayton steam generator is a forced-circulation, monotube, single pass, watertube-type packaged boiler requiring continuous feedwater treatment and monitoring. The water in the hot-well tank is actually boiler feedwater.

NOTE

It is imperative that proper feedwater treatment chemicals and equipment are in place and operational prior to filling the heating coil.

The Clayton Feedwater Treatment Manual, furnished with each new unit, provides detailed information regarding Clayton feedwater treatment requirements, products, and equipment.

In general, the feedwater supplied to your Clayton steam generator must:

- Hardness: 0 ppm (4 ppm maximum)
- pH 10.5–11.5 (normal range), maximum of 12.5
- Oxygen free with an excess sulfite residual of 50–100 ppm during operation (>100 ppm during wet lay-up)
- Maximum TDS of 8,550 ppm (normal range 3,000–6,000 ppm)
- Maximum dissolved iron of 5 ppm
- Free of suspended solids
- Maximum silica of 120 ppm with the proper OH alkalinity

NOTE

Review the Clayton Industries Feedwater Treatment Reference Manual (P/N: R15216) for additional feedwater quality requirements.

2.7.1 Water Softeners

Refer to the Clayton Water Softener Instruction Manual for detailed information regarding the installation, dimensions, and operation of Clayton water softening equipment. Some general guidelines are provided below.

Cold water piping to the water softener(s), and from the water softeners to the makeup water control valve should be schedule 40 galvanized steel or schedule 80 PVC.

Install anti-siphon device (if required by local health regulations) in the raw water supply line.

2.7.2 Make-up Water Line Sizing

Table 2-3 shows the pipe sizes required from the water softener to hotwell. The supply pressure must be at least 65 psi (450 kPa).

Table 2-3: Makeup water valve and pipe sizes

BHP	Make-up Valve (in.)	Minimum Line Size (in.)	BHP	Make-up Valve (in.)	Minimum Line Size (in.)	BHP	Make-up Valve (in.)	Minimum Line Size (in.)
25	3/4	3/4	150	3/4	1	500	1	1 1/2
35	3/4	3/4	200	3/4	1 1/4	600	1	1 1/2
50	3/4	3/4	250	1	1 1/4	700	2	2
75	3/4	3/4	300	1	1 1/4	1200	1 1/2	2
100	3/4	1	350	1	1 1/4	1600	2	2 1/2
125	3/4	1	400	1	1 1/4	2000	2	3

Note 1: All models use a makeup water solenoid valve.

Note 2: Water flow is based on 44 lb. per hour per bhp (boiler horsepower).

2.8 FEEDWATER SUPPLY REQUIREMENTS

The feedwater supply line sizing will be a minimum of one line size larger than the inlet connection size of the Clayton feedwater pump. Fractional dimensions will be rounded up to the larger whole-sized dimension.

NOTE

Clayton takes advantage of the limited length and lower velocities to minimize its internal line sizes. This common industry practice works well on Clayton's internal piping and pump head designs. The very short equivalent pipe lengths and quickly dividing flows (lower velocities) within our pump designs yields lower velocities and acceleration head.

Unfortunately, the customer and installing contractor experience the reverse when designing their feedwater piping system. They are usually faced with much longer equivalent length pipe runs and/or have to deal with a pipe required to carry more than one generator's flow. Therefore, it is critical for the installation designer to increase supply line sizes to meet Clayton's requirements for velocity and acceleration head. See paragraph 2.8.2 and 2.8.3.

2.8.1 Multi-unit Systems

In a multi-unit installation, Clayton recommends running separate supply lines to each feedwater pump. However, in some situations, it may be impractical to run separate supply lines. If a common supply line is chosen, Clayton suggests the following:

- Make proper calculations to ensure velocities and head acceleration requirements are maintained.
- If two or more pumps operate in parallel, with a common suction line, calculate the acceleration head for the common line by assuming that all pumps are synchronized, acting as one large pump. (The capacities of all pumps are added to determine line velocity.)

- Whenever possible, install the suction line header closer to the booster pumps, rather than closer to the individual feedwater pumps.

2.8.2 Velocity Requirements and Calculation

Clayton requires the feedwater supply line maintain all flow velocities under one feet per second (1 ft/s). Customers must ensure their line sizing calculations clearly show that supply pipe sizes are sufficiently large to maintain the less than 1 ft/s under all operational conditions. Refer to the charts in Figure 2-8 and 2-9 for velocity requirements.

Velocity of a fluid is the amount of fluid **F**low passing through an **A**rea, and the formula is V=F/A. Velocity is required in ft/sec for our use, so we must express our generators water flow in cubic feet and divide that by an area expressed in square feet. Clayton's generator water flows are all based on 44 lbs per boiler horsepower per hour; therefore, we must convert the pounds of water to cubic feet of water, and then convert the hour to seconds.

Let us find the velocity of 3 x 150 bhp generators running at 100% in a common manifold. This can be done by first calculating the total flow of water at the maximum firing rate. Since Clayton wants a minimum of 44 lbs/bhp-hr, the total flow required is:

$$F = (3 \times 150 \text{ bhp} \times 44 \text{ lbs/bhp-hr}) = \underline{19{,}800 \text{ lbs/hr}}$$

Next, we need to convert the flow from lbs/hr to ft^3/hr by multiplying the flow by the conversion factor of 0.01602 **ft^3/lb** of water. The converted flow is:

$$F = 19{,}800 \text{ lbs/hr} \times 0.01602 \text{ ft}^3\text{/lb} = \underline{317.2 \text{ ft}^3\text{/hr}}$$

Then, we need to convert hours to seconds. Since one hour has 3600 seconds, we simply divide the 317.2 ft^3/hr by 3600. The converted flow is:

$$F = (317.2 \text{ ft}^3\text{/hr}) \div (3600 \text{ sec/hr}) = \underline{0.0881 \text{ ft}^3\text{/sec}}$$

Now that we have the flow (F), we need to know the area through which it will flow. Area is calculated by the formula $A = \pi r^2$ were π is a constant equal to 3.14159, and r is the radius of the pipe ID being used. For this example, we will use 3-inch pipe. We will discount the differences between the ID of varying pipe schedules, water temperature, etc., to make this simple for the field. These are not meaningful for a quick check of the installation. To successfully complete the velocity calculation, we need to work with feet, so a conversion from inches to feet is required.

A 3 inch ID pipe has a radius of 1.5 inch. To convert inches to feet, divide the inches by 12 in./ft; therefore, in our example the radius is 1.5 in. ÷ 12 in./ft = 0.125 ft

$$A = \pi r^2 = 3.14159 \times (0.125 \text{ ft})^2 = 0.049 \text{ ft}^2$$

Now that we have both the desired **flow** (0.088 ft^3/sec) and the available **area** (0.049 ft^2) of the 3-inch pipe it must pass through, we can calculate the **velocity**.

$$V = F \div A = (0.0881 \text{ ft}^3\text{/sec}) \div (0.049 \text{ ft}^2) = 1.8 \text{ ft/sec}$$

NOTE: Unfortunately, the velocity (V) in our example exceeds Clayton's maximum ft/sec.

TYPICAL FEEDWATER PIPE VELOCITIES — sheet 1 of 2

SCHEDULE 40/std PIPE — PIPE VELOCITY ft/sec

PIPE SIZE / BHP-->	25	35	50	75	100	125	150	200	250	300	350	400	500	600	650	700	800	1000
3/4"	1.32	1.85	2.64	3.97														
1"	0.82	1.14	1.63	2.45	3.26	4.08												
1-1/4"	0.47	0.66	0.94	1.41	1.89	2.36	2.83	3.77										
1-1/2"	0.35	0.48	0.69	1.04	1.39	1.73	2.08	2.77	3.46	4.16	4.85							
2"	0.21	0.29	0.42	0.63	0.84	1.05	1.26	1.68	2.10	2.52	2.94	3.36	4.20					
2-1/2"		0.21	0.29	0.44	0.59	0.74	0.88	1.18	1.47	1.77	2.06	2.36	2.95	3.53	3.83	4.12		
3"			0.19	0.29	0.38	0.48	0.57	0.76	0.95	1.14	1.34	1.53	1.91	2.29	2.48	2.67	3.05	3.82
3-1/2"			0.14	0.21	0.29	0.36	0.43	0.57	0.71	0.86	1.00	1.14	1.43	1.71	1.85	2.00	2.28	2.85
4"						0.28	0.33	0.44	0.55	0.66	0.78	0.89	1.11	1.33	1.44	1.55	1.77	2.22
5"							0.21	0.28	0.35	0.42	0.49	0.56	0.70	0.85	0.92	0.99	1.13	1.41
6"								0.20	0.24	0.29	0.34	0.39	0.49	0.59	0.63	0.68	0.78	0.98
8"										0.17	0.19	0.22	0.28	0.33	0.36	0.39	0.44	0.55
10"												0.14	0.17	0.21	0.22	0.24	0.28	0.35
12" (.375w)														0.15	0.16	0.17	0.20	0.25

Velocity requirement not satisfied

Velocity requirement satisfied

SCHEDULE 80/XS PIPE — PIPE VELOCITY ft/sec

PIPE SIZE / BHP-->	25	35	50	75	100	125	150	200	250	300	350	400	500	600	650	700	800	1000
3/4"	1.63	2.28	3.26	4.89														
1"	0.98	1.37	1.96	2.94	3.92	4.90												
1-1/4"	0.55	0.77	1.10	1.65	2.20	2.75	3.30	4.40										
1-1/2"	0.40	0.56	0.80	1.20	1.60	2.00	2.39	3.19	3.99	4.79	5.59							
2"	0.24	0.33	0.48	0.72	0.96	1.19	1.43	1.91	2.39	2.87	3.34	3.82	4.78					
2-1/2"		0.23	0.33	0.50	0.67	0.83	1.00	1.33	1.66	2.00	2.33	2.66	3.33	3.99	4.33	4.66		
3"			0.21	0.32	0.43	0.53	0.64	0.85	1.07	1.28	1.49	1.71	2.14	2.56	2.78	2.99	3.42	4.27
3-1/2"			0.16	0.24	0.32	0.40	0.48	0.63	0.79	0.95	1.11	1.27	1.59	1.90	2.06	2.22	2.54	3.17
4"						0.31	0.37	0.49	0.61	0.74	0.86	0.98	1.23	1.47	1.59	1.72	1.96	2.45
5"							0.23	0.31	0.39	0.47	0.54	0.62	0.78	0.93	1.01	1.09	1.24	1.55
6"								0.22	0.27	0.32	0.38	0.43	0.54	0.65	0.70	0.76	0.87	1.08
8"										0.19	0.22	0.25	0.31	0.37	0.40	0.43	0.49	0.62
10" (.500w)												0.15	0.19	0.23	0.25	0.26	0.30	0.38
10" (.593w)												0.16	0.20	0.24	0.26	0.27	0.31	0.39
12" (.500w)														0.16	0.17	0.18	0.21	0.26

Velocity requirement not satisfied

Velocity requirement satisfied

Figure 2-8 Velocity requirements for 25–1,000 bhp

TYPICAL FEEDWATER PIPE VELOCITIES																		sheet 2 of 2
	SCHEDULE 40/std PIPE																	
PIPE	PIPE VELOCITY ft/sec																	
SIZE BHP-->	1200	1300	1400	1500	1600	1800	2000	2100	2200	2400	2500	2600	2700	2800	3000	3200	3600	4000
3"	4.58										Velocity requirement not satisfied							
3-1/2"	3.42	3.71																
4"	2.66	2.88	3.10	3.32	3.54	3.99	4.43											
5"	1.69	1.83	1.97	2.11	2.26	2.54	2.82	2.96	3.10	3.38	3.52	3.67	3.81	3.95	4.23			
6"	1.17	1.27	1.37	1.46	1.56	1.76	1.95	2.05	2.15	2.34	2.44	2.54	2.64	2.73	2.93	3.12	3.51	3.91
8"	0.66	0.72	0.77	0.83	0.88	0.99	1.10	1.16	1.21	1.32	1.38	1.43	1.49	1.54	1.65	1.76	1.98	2.21
10" (.365w)	0.43	0.46	0.50	0.54	0.57	0.64	0.72	0.75	0.79	0.86	0.89	0.93	0.97	1.00	1.07	1.14	1.29	1.43
12" (.375w)	0.30	0.32	0.35	0.37	0.40	0.45	0.50	0.52	0.55	0.60	0.62	0.65	0.67	0.70	0.75	0.80	0.90	1.00
12" (.406w)	0.30	0.33	0.35	0.38	0.40	0.45	0.50	0.53	0.55	0.60	0.63	0.66	0.68	0.71	0.76	0.81	0.91	1.01
14" (.375w)					0.33	0.37	0.41	0.43	0.45	0.49	0.51	0.53	0.55	0.57	0.61	0.65	0.74	0.82
14" (.438w)					0.33	0.38	0.42	0.44	0.46	0.50	0.52	0.54	0.56	0.58	0.63	0.67	0.75	0.83
	Velocity requirement satisfied																	
	SCHEDULE 80/XS PIPE																	
PIPE	PIPE VELOCITY ft/sec																	
SIZE BHP-->	1200	1300	1400	1500	1600	1800	2000	2100	2200	2400	2500	2600	2700	2800	3000	3200	3600	4000
3"	5.12										Velocity requirement not satisfied							
3-1/2"	3.81	4.13																
4"	2.94	3.19	3.43	3.68	3.93	4.42												
5"	1.86	2.02	2.17	2.33	2.48	2.79	3.10	3.26	3.41	3.72	3.88	4.03	4.19	4.34	4.65			
6"	1.30	1.41	1.51	1.62	1.73	1.95	2.16	2.27	2.38	2.60	2.71	2.81	2.92	3.03	3.25	3.46	3.90	4.33
8"	0.74	0.80	0.86	0.93	0.99	1.11	1.24	1.30	1.36	1.48	1.54	1.61	1.67	1.73	1.85	1.98	2.22	2.47
10" (.500w)	0.45	0.49	0.53	0.57	0.60	0.68	0.76	0.79	0.83	0.91	0.94	0.98	1.02	1.06	1.13	1.21	1.36	1.51
10" (.593w)	0.47	0.51	0.55	0.59	0.63	0.71	0.79	0.82	0.86	0.94	0.98	1.02	1.06	1.10	1.18	1.26	1.41	1.57
12" (.500w)	0.31	0.34	0.36	0.39	0.42	0.47	0.52	0.55	0.57	0.62	0.65	0.68	0.70	0.73	0.78	0.83	0.94	1.04
12" (.687w)	0.33	0.36	0.39	0.42	0.44	0.50	0.55	0.58	0.61	0.67	0.69	0.72	0.75	0.78	0.83	0.89	1.00	1.11
14" (.500w)					0.34	0.38	0.42	0.45	0.47	0.51	0.53	0.55	0.57	0.59	0.64	0.68	0.76	0.85
14" (.750w)					0.37	0.41	0.46	0.48	0.51	0.55	0.57	0.60	0.62	0.64	0.69	0.74	0.83	0.92
	Velocity requirement satisfied																	

Figure 2-9 Velocity requirements for 1,200–4,000 bhp

The more relevant issue for this example is what size pipe manifold, as a minimum, do the 3 x 150 bhp generators need to meet Clayton's 1 ft/sec maximum flow velocity. This can be calculated using the same velocity equation V = F÷A. To find and area, we solve the equation for A (area), which is done by multiplying both sides of the equation by A, and dividing both sides of the equation by V; therefore, the area is equal to the flow divided by the velocity, or A = F÷V.

From our example above, we know that the flow is 0.0881 ft^3/sec, and the maximum velocity Clayton requires is 1 ft/sec; therefore, we simply divide them get the area.

$$A = F \div V = 0.0881\ ft^3/sec \div 1\ ft/sec = 0.0881\ ft^2$$

But we want a pipe size so we must convert an area in ft^2 backwards to a diameter in inches. To accomplish this we simply work the area of a circle backwards. From above we learned that the area of a pipe ID is $A = \pi r^2$ so to find the r (radius) we simply divide both side by π, and then take the square root of the result, $r = \sqrt{(A \div \pi)}$.

$$R = \sqrt{(A \div \pi)} = \sqrt{(.0881\ ft^2 \div 3.14159)} = \sqrt{0.028} = 0.1675\ ft$$

Remember this is a radius in feet, so we need to convert it to a diameter by multiplying by 2 and converting feet to inches for pipe sizes.

$$\text{Pipe diameter size in feet} = 0.1675\ ft \times 2 = 0.3349\ ft$$

Now feet to inches:

$$0.3349\ ft \times 12\ in./ft = 4.02\ \text{inch pipe}$$

This shows that the 3 x 150 bhp generators require at least a 4-inch pipe size to manifold all 3 x 150s and meet Clayton's maximum flow velocity of 1 ft/sec. Remember that this must be done for each leg of the entire supply piping system using the specific flows in each leg.

2.8.3 Acceleration Head (H_a) Requirements

On feedwater supply runs longer than 15 feet (4.5 m), or with multiple pump sets, customers must complete acceleration head loss calculations to show acceleration head losses are less than 0.75 foot/foot of equivalent pipe run for open hotwell systems (water temperatures less than 210° F {99° C}), and less than 0.5 foot/foot of equivalent pipe run for deaerator or semi-closed systems (water temperatures over 212° F {100° C}). UNDER NO CIRCUMSTANCES SHOULD THE IMPACT FROM H_a TO $NPSH_A$ BE IGNORED (See paragraph 2.11.1.).

NOTE

All water flow calculations must be based on 44 lb. per hour per boiler horsepower adjusted for feedwater temperature.

2.9 FLEXIBLE FEEDWATER HOSE CONNECTION AND CONNECTION SIZING

A two-foot flexible hose is required for connecting directly to the inlet of a Clayton reciprocating PD pump from the feedwater supply line. In some cases, a two-foot flexible hose may also be required at the reciprocating PD pump discharge outlet. The flexible section must be appropriately rated to satisfy pressure and temperature requirements.

2.9.1 Supply Side Connections

Clayton's reciprocating PD pumps require that the connection made directly to the pump's inlet be a flexible hose section. This hose section should be a bellows-type hose protected by a stainless steel wire mesh sleeve. It must have at least a 24 inch (61 cm) length with a minimum 18 inch (45.5 cm) long-live length. This flexible hose section must be appropriately rated to meet the pressure and temperature requirements of the feedwater supply system. The supply-side piping system must include a pipe anchor directly at the inlet (hotwell/DA) side of the flexible connector.

2.9.2 Discharge Side Connections

A flexible hose section is required at the reciprocating PD pump discharge outlet whenever it is relocated from its original, factory-designed, installation location. This hose section should be a bellows-type hose protected by a stainless steel wire mesh sleeve. It must have at least a 24 inch (61 cm) length with a minimum 18 inch (45.5 cm) long-live length. Because Clayton's mono-flow heating coil design usually increases feedwater discharge pressures from Clayton's reciprocating PD pump, this flexible hose section must be appropriately rated to meet the pressure and temperature requirements of the reciprocating PD pump output. The flexible hose rating requirements for the discharge will differ from the rating requirements for the inlet flexible hose section. Contact Clayton Engineering for the feedwater pressure of the specific generator model.

2.10 PUMP SUCTION AND DISCHARGE PIPING SYSTEM DESIGN

The suction piping system is a vital area of the piping supply system. Therefore, its design requirements deserves more careful planning.

2.10.1 General Layout Guidelines

- Lay out piping so no high points occur where vapor pockets may form. Vapor pockets reduce the effective flow area of the pipe and consequently make pump priming and operation difficult. Vent any unavoidable high points and provide gauge and drain connections adjacent pump.
- Install eccentric-type pipe reducers when required. Make sure these reducers are installed with the flat side up.
- Keep piping short and direct.
- Keep the number of turns to a minimum.
- Keep friction losses to a minimum by incorporating smooth fluid flow transitions in the piping layout. This can be accomplished with long radius elbows, two 45^{o} elbows, or 45^{o} branch laterals instead of tees.

- DO NOT use Clayton equipment for pipe support or pipe anchoring. It is the responsibility of the installation contractor and the customer to provide adequate and proper pipe supports and anchors. Clayton recommends all steam/fluid heaters, PD feedwater pumps, and water treatment skid pipe supports and anchors use floor-mounted structural steel.

2.10.2 Pipe Sizing Guidelines

2.10.2.1 Suction Piping

Clayton tends to follow the guidelines set forth by the Hydraulic Institute (HI) for positive displacement piston pumps. Equivalent pipe lengths for pipe fittings (elbows, tees, etc.) can be found in the HI reference charts.

NOTE

While Clayton cannot assume responsibility for the piping system into which our pump is installed, we can provide valuable guidelines for designing a piping system properly.

Suction line sizing is a major factor in the successful operation of any pump. Many pump problems result from a suction line that is too small in diameter, or too long. A properly designed piping system can prevent problems, such as:

- Fluid flashing—Entrained fluid gases effuse when pressure in piping or pump falls below fluid vapor pressure.
- Cavitation—Free gases in a fluid being forced back into the fluid. These implosions cause severe pressure spikes that pit and damage pump internal parts.
- Piping vibration—This can result from improper piping support, cavitation, or normal reciprocating pump hydraulic pulses.
- Noisy operation—Most present when pump is cavitating.
- Reduced capacity—Can result from fluid flashing. If it is, this is an indication that the pumping chambers are filling up with gases or vapors.

These problems can reduce a pump's life and are a potential hazard to associated equipment and personnel. It is possible to fracture piping and damage the pump components with high pressure surges occurring when fluid is flashing or cavitating.

Suction piping must be a minimum of one size larger than the pump suction connection. The actual line sizes will depend on meeting flow velocity maximums (see Figure 2-8 and 2-9 on page 2-19 and 2-20, respectively), acceleration head calculations (see paragraph 2.11.3), and NPSH requirements (see Table 2-4 on page 2-26).

2.10.2.2 Discharge Piping

Normally, discharge pipe sizing is not an issue for a standard Clayton generator installation. But, when floor space is limited at the installation site, Clayton's close-coupled reciprocating PD pump will require relocating from its originally-designed location. In these cases, certain precautionary changes must be made to the pipe runs between the reciprocating PD pump and the heating coil inlet. Clayton recommends contacting a factory engineer to discuss any piping changes and obtain the generator's necessary feedwater pressure requirement.

The required piping changes are as follows:

- Connect a flexible hose section directly to the reciprocating PD pump's discharge outlet. (See paragraph 2.9.2 for flexible hose section requirements.)
- Keep discharge lines as short and direct as possible, well supported, and firmly anchored. This will ensure minimal pipe vibration, whether hydraulic or mechanical, that can be detrimental to the pump and generator. Avoid "dead ends" and abrupt direction changes as much as possible.
- Always incorporate 45^o angles in the discharge pipe runs by using lateral tees and 45^o elbows. DO NOT connect the pump's discharge piping directly to a 90^o tee/elbow pipe, or other acute-angled piping. These types of connections will create "standing wave" or "bounce-back," either audible or sub-audible, that causes excessive vibration and noise.
- Use laterals in place of tees with the bottom of the Y facing the direction of pumped water flow. Use long radius elbows, or two 45^o elbows, throughout the discharge piping system from the flexible hose discharge connection to the heating coil inlet connection.
- Increase the pipe sizes by at least one full size over the PD feedwater pump's discharge connection (i.e.: a 1 1/2 or 2 inch discharge requires an increase to 3 inches minimum).
- Use of butt-weld pipe with weld-neck flange construction throughout the discharge pipe run is recommended.
- Discharge flow velocities must be maintained below 5 ft/sec. maximum.
- DO NOT install angle valves, globe valves, reduced port regular opening valves, restricting plug valves, flow restriction orifices, or small ventures in the discharge pipe run.
- DO NOT install any quick-closing valves, which can cause hydraulic shock (water hammering) in the discharge piping run.
- Connect the pressure relief valve and pressure gauge with snubber ahead of any block valve so that the pump discharge pressure is always reflected at the relief valve. The relieving capacity of the valve must exceed the full capacity of the pump to avoid excessive pressure while relieving flow. Use only full-sized relief line design with no restrictions.
- Should the Clayton reciprocating PD pump's pressure relief valve be removed, it must be replaced with a properly sized and correctly set pressure relief valve. Relief valve discharge must not be piped to reciprocating PD pump's suction line.
- Install a 2-inch NPTF weld couplet vertically upward, as close as possible, to the reciprocating PD pump's discharge connector to allow the addition of nitrogen-filled pulsation dampeners.
- All discharge pipe and pipe fittings must be at minimum Schedule 80.

2.11 NET POSITIVE SUCTION HEAD (NPSH)

NPSH relates to the pressure (generally in terms of "head" of water, or psi) that a pump needs to prevent flashing or cavitation <u>within the pump, primarily in the suction check-valve area</u>. Flashing and cavitation will reduce necessary flow rates and cause damage to the internal pump components and coil.

NPSH is divided into two important aspects: what is available ($NPSH_A$) from the suction vessel and piping, and what is required by the pump ($NPSH_R$).

2.11.1 $NPSH_A$

Pump $NPSH_A$ is the usable pressure (usually expressed in feet of water column or psi) available at the inlet of the pump. For Clayton systems that typically operate with near-boiling water, $NPSH_A$ is determined by the elevation difference between the operating hot-well tank water level and the inlet to the pump, minus frictional losses and minus acceleration head losses.

NOTE

If a hot-well tank cannot be sufficiently elevated to supply the required $NPSH_A$, a booster pump will be required. To convert booster pump pressure (psi) to foot of head, use the following formula: psi (2.3067) = ft of water.

Booster pumps should be placed adjacent to the feedwater supply (suction) vessel. The total suction system's $NPSH_A$ must be greater than the booster pump's $NPSH_R$. The discharge head of the booster pump must be sufficient to provide a pressure of at least 25% greater than Clayton's reciprocating PD pump's $NPSH_R$, plus pipe friction losses, plus acceleration head losses, and plus 2.5 ft. Velocity and acceleration head design requirements are specified in paragraphs 2.8.2, page 2-18, and 2.8.3, page 2-21, and velocity charts in Figures 2-8 and 2-9, pages 2-19 and 2-20, respectively.

1) Suction System: $NPSH_A$ = Receiver Elevation Head or Booster Pump Head – Friction Loss – Acceleration Head Loss – Pump Head Elevation (Typically 2.5 ft. [0.76 m] above ground.)

2) $NPSH_R$ = Clayton Feedwater Pump Net Positive Suction Head Required (See Table 2-4.).

3) $NPSH_A$ must be at least 25% greater than $NPSH_R$. ($NPSH_A > 1.25\ NPSH_R$)

NOTE: $NPSH_A$ is increased by increasing receiver head, booster pump head, or line size.

A suction pulsation dampener or stabilizer directly adjacent to the Clayton feedwater pump connection is required.

2.11.2 $NPSH_R$

Pump $NPSH_R$ is the pressure (usually expressed in feet of water column or psi) required at the inlet of the pump that will enable the pump to operate at rated capacity without loss of flow due to flashing or cavitation in the pump. The $NPSH_R$ is relative to the pump inlet (suction) connection. The $NPSH_R$ number for a Clayton pump was determined experimentally by Clayton (see Table 2-4).

Table 2-4: Clayton's NPSH height requirements[a]

Model	Feet	Meters	Model	Feet	Meters
SF-25	7	2.1	SF-100	10	3.0
SF-35	7	2.1	SF-125	10	3.0
SF-50	7	2.1	SF-150	18	5.5
SF-75	10	3.0	SF-200	13	4.0

[a] Requirements shown are based on Clayton's standard reciprocating PD pump usage. Alternate pumps that require higher $NPSH_R$ are used on some generators. Check Clayton's P & I D drawing for specific requirements.

NOTE

Water flow is based on 44 lb. per hour per bhp. $NPSH_R$s shown are for 150 psi design steam pressure. Higher steam pressures could change these numbers.

2.11.3 Acceleration Head (H_a)

Unlike centrifugal pumps that provide a smooth continuous flow, positive displacement pumps (typically used by Clayton) cause an accelerating and decelerating fluid flow as a result of the reciprocating motion and suction valves opening and closing. This accelerated and decelerated pulsation phenomenon is also manifested throughout the suction pipe. The energy required to keep the suction pipe fluid from falling below vapor pressure is called acceleration head. For installations with long piping sections, this becomes a significant loss to overcome and must be carefully considered. If sufficient energy is absent, then fluid flashing, cavitation, piping vibration, noisy operation, reduced capacity, and shortened pump life can occur.

To calculate the H_a required to overcome the pulsation phenomenon, use the following empirical equation:

$$H_a = \frac{LVNC}{gk}$$

where:

H_a = Head in feet (meters) of liquid pumped to produce required acceleration

L = Actual suction pipe length in feet (meters)

V = Mean flow velocity in suction line in feet per second (m/s) (See Figure 2-8 and 2-9, page 2-19 and 2-20, respectively.)

N =Pump speed in rpm (See Table 2-5, below.)

C = Pump constant factor of ...

0.400 for simplex single acting

0.200 for duplex single acting (J2 pump)

0.066 for triplex single acting

0.082 for quadplex single acting (J4 pump) g = Acceleration of gravity = 32.2 ft/s^2 (9.8 m/s^2)

k = Liquid factor of ...

1.5 for water

1.4 for deaerated water

1.3 for semi-closed receiver water

Table 2-5: Clayton Pump Speeds

Generator	SF25	SF35	SF50	SF75	SF100	SF125	SF150	SF200
Pump Speed (RPM)	336	294	330	372	330	384	432	288

Since this equation is based on ideal conditions of a relatively short, non-elastic suction line, calculated values of H_a should be considered as approximations only.

NOTE

As pump speed (N) is increased, mean flow velocity (V) also increases. Therefore, acceleration head (H_a) varies as the square of pump speed.

NOTE

Acceleration head varies directly with actual suction pipe length (L).

IMPORTANT

ACCELERATION HEAD IS A SUCTION PIPING SYSTEM FACTOR THAT MUST BE ACCOUNTED FOR BY THE PIPING SYSTEM DESIGNER. MANUFACTURERS CANNOT ACCOUNT FOR THIS IN THEIR DESIGNS BECAUSE OF THE LARGE VARIETY OF APPLICATIONS AND PIPING SYSTEMS PUMPS ARE INSTALLED IN.

NOTE

If acceleration head is ignored or miscalculated, significant pump and piping system problems (suction and discharge) may result.

Clayton recommends placing a suction pulsation dampener or stabilizer adjacent to the positive displacement reciprocating pump suction connection. This will help to protect the booster pump from the pulsating fluid mass inertia of the positive displacement reciprocating pump and to reduce the effect of acceleration head.

2.12 GENERAL INSTALLATION CONCERNS

2.12.1 Charge Pumps

Charge (booster) pumps should be sized to 150% of rated Clayton pump volume. Charge pumps must be centrifugal-type pumps—not positive displacement pumps.

2.12.2 Charge Pumps Are Not A Substitute

Charge pumps are not a good substitute for short, direct, oversized, suction lines. They are also not a substitute for the computation of available NPSH, acceleration head (H_a), frictional head (H_F), vapor pressure, and submergence effects being adequately considered.

2.12.3 Multiple Pump Hookup

The preferred configuration for connecting two or more reciprocating pumps in a system is to provide each pump with their own piping system. This will ensure each pump is isolated from the effects of another pump's cyclical demands.

Connecting two or more reciprocating pumps to a common suction header IS NOT recommended. Designing such a pump system can frequently cause severe pump pounding, vibration, and premature check-valve and diaphragm failure. In addition, attempting to analyze the operation of multiple pumps connected to a common suction header through mathematical calculations becomes impossible.

2.12.4 Pumphead Cooling Water System (Clayton Feedwater Pumps)

Clayton feedwater pumps require pumphead cooling water in the following applications:

- high coil feed pressures - for pump discharge pressures above 500 psi (34.5 bar)
- high-temperature supply water - supply water from a DA, SCR, or receiver with temperatures above 210° F (98° C)

The cooling water temperature must be below 75° F (24° C). The supplied water pressure should be 35–65 psi (2.4–4.5 bar) with a flow rate of 1.5 gpm (5.7 lpm) minimum.

2.13 ELECTRICAL

All customer-supplied electrical wiring must be properly sized for the voltage and amperage rating of the intended application. Full load amperage (FLA at 460V) requirements for each model are provided in Table 6-1 of Section VI. Use the appropriate multiplier, provided in the table below, to determine the full load amperage requirements for other voltages (FLA at 460V times the multiplier).

VOLTAGE	MULTIPLIER
208	2.2
230	2.0
380	1.1
575	0.8

A fused disconnect switch (customer furnished) must be installed in accordance with NEC 430 and should be located within view of the steam generator. The switch should be easily accessible to operating personnel. Clayton provides a set of terminals in the steam generator electrical control cabinet for wiring an emergency stop device (customer furnished).

NOTE

Additional access holes are located in the bottom of the electronics control cabinet. DO NOT make any holes in the sides or top of the electrical cabinet(s).

Clayton strongly recommends surge protection for all its equipment. Isolation transformers are recommended for areas subject to electrical variations due to weather, weak or varying plant power, or old systems.

Isolation transformers are required on all electrical systems that are based on delta distribution systems. Clayton recommends electrical connections be made through a grounded wire system only.

Clayton electronics cabinet devices are rated to function properly at typical boiler room temperatures not exceeding 120° F (49° C). For boiler room installations where temperatures are expected to rise above 120° F (49° C), installation of a Clayton electronics cabinet cooler is required. This cooler requires a supply of clean, dry compressed air at 40 scfm (1.13 m^3/min.) at 100 psi (6.9 bar).

2.14 ELECTRICAL GROUNDING

Clayton's steam generator, fluid heater, and water skid installations must have an electrical grounding network with a resistance no higher than 2 Ohms to earth ground when measured at its control box(es). Clayton requires a separate, direct earth ground at each of its unit installations.

Grounding wires must be routed directly with electrical power supply wiring and sized according to the connected amperage, but never less than 8 awg. A separate ground wire must be run to each steam generator/fluid heater frame and water skid frame

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SECTION III - CLAYTON FEEDWATER SYSTEMS

3.1 GENERAL

Clayton steam generator feedwater systems are designed with an open (hotwell), deaerator (DA), or Semi-Closed Receiver (SCR). The selection of the proper feedwater system is determined by the steam generator's application, the installation environment, and other factors. Each system is discussed in detail in later paragraphs in this section.

The feedwater system's pipes, as well as the heating coil, are susceptible corrosion if proper feedwater treatment is neglected. Corrosion in the pipes are due to three fundamental factors—dissolved oxygen content, low pH, and temperature. Oxygen is required for most forms of corrosion. The dissolved oxygen content is a primary factor in determining the severity of the corrosion. Removing oxygen, and carbon dioxide, from the feedwater is essential for proper feedwater conditioning. Temperature and low pH affects the aggressiveness of the corrosion.

Deaerators are designed to remove most of the corrosive gases from the feedwater. Deaeration can be defined as the mechanical removal of dissolved gases from a fluid. There are many types of Deaerators; however, the ones most commonly used for deaerating boiler feedwater are the open (atmospheric), pressurized jet spray, and tray type. To effectively release dissolved gases from any liquid, the liquid must be kept at a high temperature. Deaerators are pressurized above atmospheric pressure (typically 3–15 psig) to maintain the feedwater at a higher boiling point. The increased pressure and temperature releases the dissolved gases from the feedwater and those gases are vented to atmosphere.

There are four skid package options available depending on the feedwater system (all options are not available for all models - contact your Clayton Sales Representative). The systems, skid package options, and required customer connections are described below.

3.2 SKID PACKAGES

A. Individual Components The steam generator unit and all water treatment components are furnished separately. Placement of each component and its assemblies and interconnections are determined by the installer.

B. Feedwater Receiver Skid A separate skid consisting of the feedwater receiver, booster pump(s), and electrical control box mounted on a common frame is provided along with the steam generator. Interconnecting piping between the feedwater receiver and booster pump(s), if applicable, and feedwater receiver trim component mounting, are included. If applicable (>200 bhp), electrical connections between the water level control, makeup water valve, and skid electrical control box are also included. No other water treatment components or interconnections are provided on this skid.

C. Water Treatment Skid All water treatment components are mounted on a skid and provided along with the steam generator. Components include receiver, softeners, chemical pumps, blowdown tank, control box, and booster pumps if applicable. Skid piping and electrical interconnections between the skid components are included.

NOTE

All Clayton-supplied water skids must be fully grouted in place once leveling and anchoring are complete.

D. Generator Skid The steam generator(s) and water treatment components as listed in “C” above, are all mounted on a single skid. Skid piping and electrical interconnections between components are included.

NOTE

On SCR system skids, the SCR is mounted and piped, but removed for shipment for reassembly by the installing contractor.

NOTE

Clayton reserves the right to ship loose any equipment that cannot be safely shipped in installed. Some skid components may require re-installation on site.

NOTE

All Clayton-supplied water skids must be fully grouted in place once leveling and anchoring are complete.

3.3 CUSTOMER CONNECTIONS

The required customer connections for the typical water treatment components included with open and deaerator feedwater receiver systems are identified in Tables 3-1 and 3-2 below. The type and size of each is provided on supplemental drawings and instructional literature.

Table 3-1: Hotwell (Open) and Deaerator Systems

Customer Connection / **Skid Type**	Feedwater[a] Outlet	Vent	Drain	Overflow	Overflow/ Drain	Condensate Returns	Traps Returns	Steam Heating	Chemical Injection	Makeup Water
None	X	X	X	X		X	X	X	X	X
Condensate Skid	X	X	X	X		X	X	X	X	X
Water Skid	X	X			X	X	X	X	X	X
Generator Skid		X			X	X		X		X

[a] Feedwater outlet connections apply only on Condensate and Water Skids without Booster Pumps.

Table 3-2: Hotwell (Open) and Deaerator Systems

Customer Connections / Skid Type	Booster Pump(s)			Water Softener(s)			Blowdown Tank				DA ONLY		
	Inlet	Outlet	Recirc	Inlet	Outlet	Drain	Inlet	Outlet	Vent	Cooling Water Inlet	Safety Valve Out	BPR Outlet	PRV Inlet
None	X	X	X	X	X	X	X	X	X	X	X	X	X
Condensate Skid		X		X	X	X	X	X	X	X	X	X	X
Water Skid				X		X		X	X		X	X	X
Generator Skid				X		X		X	X		X	X	X

3.4 OPEN SYSTEM

(Refer to P&ID drawing R-19477.)

In an open system, the makeup water, condensate returns (system and separator trap returns), chemical treatment, and heating steam are blended in an atmospheric feedwater receiver tank, (vented to atmosphere - under no pressure). Open feedwater receiver systems are sized to provide the necessary volume of feedwater and sufficient retention time for the chemical treatment to react. Condensate, separator trap returns and feedwater treatment chemicals are injected at the opposite end of the tank as the feedwater outlet connection. This helps to avoid potential feedwater delivery problems to the booster or feedwater pump(s), and to provide sufficient reaction time for the chemical treatment.

Installation guidelines for the feedwater receiver are provided below. Descriptions for the other water treatment and accessory components, shown in R-19477, are provided in Section VII (Optional Equipment) and/or in the Clayton Feedwater Treatment Manual.

NOTE

All piping to and from the feedwater receiver must remain the same or larger size as the tank connection and not reduced. See Table 3-3 below for connection requirements.

Table 3-3: Feedwater Receiver Connections

Feedwater Outlet	This is the supply connection for properly-treated feedwater to the booster pump(s) or feedwater pump(s). Depending on the tank size, this connection may be either on the bottom or on the side of the tank. A valve and strainer (0.125 mesh) must be installed in the feedwater supply piping at the inlet to each pump (shipped loose if Clayton furnished - except on Skids). Follow the guidelines outlined in Section 2.8 through 2.12. **Feedwater line must be constructed to provide the required NPSH, velocity under 1 ft/s, and acceleration head losses less than 0.75 ft/ft to the feedwater pump inlet.** Restrictions in this line will cause water delivery problems that may result in pump cavitation and water shortage problems in the heating coil.
Gravity Fill	Install a pipe tee in the feedwater outlet line just below the feedwater outlet connection. On an elevated receiver system, this pipe tee provides a connection for the gravity fill plumbing coming from the heating coil.
Vent	Vent piping must be installed so as not create back pressure on the hotwell. The vent pipe should be as short as possible, contain no valves or restrictions, and run straight up and out. Ninety degree elbows are to be avoided. A 45^{o} offset should be provided at the end of the vent line to prevent system contamination during severe weather conditions and/or during shutdown periods.
Chemical Injection	One common feedwater chemical injection connection is provided into which all feedwater treatment chemicals are introduced. A check-valve must be installed in the discharge line of each chemical pumping system.
Overflow	No valves are to be installed in the overflow piping. Overflow piping must be plumbed to the blowdown tank discharge piping at a point prior to the temperature valve sensor. The overflow line must be full size, not reduced. Clayton recommends installing a “P-trap” on all overflow lines.
Drain	A valve must be provided in the drain line. As indicated above, the drain line can be tied into the overflow line as long as the line size downstream of the merge remains at least the size of the overflow connection on the tank.

NOTE

The feedwater receiver drain and overflow lines (run independently or tied together) may contain up to 212° F water and must be routed to the Blowdown Tank discharge piping at a point prior to the temperature valve sensor.

Condensate Returns, Temperature Control & Sparger Tube(s)	The condensate return connection is the point where all system condensate returns, separator trap discharge, and heating steam are introduced. The hotwell may use one or two condensate return connections, depending on the tank size and return volume. This injection point is located below the water line and connected to a sparger tube(s). Introducing the steam and hot condensate below the water line in conjunction with using the sparger tube reduces the velocity and turbulence created at the injection point, while minimizing flash steam losses and noise. On tanks containing two condensate return connections one is used for system condensate returns, the other is used for the separator trap discharge and heating steam. In all cases, a check-valve must be installed in the condensate return and steam supply lines to prevent back-feeding. The check-valve must be located as close to the feedwater tank as possible. When installing a sparger tube(s) it must be installed so that the holes are in a horizontal position. This is confirmed on Clayton manufactured hot-wells (up to 200 bhp) by visual verification that the “X” stamping on the external section is in the “12 o’clock” position. Refer to drawing R-19477 for the proper temperature control valve configuration.

NOTE

Clayton feedwater receivers are sized for proper flow and chemical mixture. If a customer's condensate system creates large surges in returns at start up or while in operation, it may cause the feedwater receiver to overflow. Proper evaluation of the condensate return system and final feedwater receiver sizing is the customer's responsibility.

3.5 DEAERATOR (DA)

Effective control of the pressure in the deaerator is essential to proper performance and operation of the Clayton steam generator system. Most deaerators have high and low pressure condensate return inlet connections. The high temperature condensate should be introduced into the DA through a sparger tube. Condensate returns affect the pressure and water temperature in the DA. Introducing condensate return increases the pressure in the DA and, conversely, reducing the amount of condensate return decreases the pressure in the DA.

CAUTION

When the quantity of condensate return is insufficient to maintain the desired water level in the D/A, relatively cool makeup water is admitted. This results in a pressure drop (sometimes sudden) in the D/A. This distorts the saturation pressure-temperature relationship causing the high temperature water in the D/A to flash, releasing steam. Some amount of the water in the supply line to the feedwater pump also flashes. This condition may result in cavitation of the feedwater pump, impeding feedwater delivery to, and resulting in an overheat condition of the heating coil.

On the other hand, if the water in the DA is overheated due to an excessive amount of condensate return, some of this heat is vented off as steam to prevent over-pressurizing the DA.

Pressure regulating valves, PRV/BPR, are used to maintain a stable pressure in the DA. A Pressure Regulating Valve (PRV) is used to inject steam into the DA when a pressure drop is sensed. The PRV for this service is typically pilot operated. The downstream sensing line should be connected to the deaerator head rather than the PRV downstream pipe line. This will prevent any control variations due to the pressure loss in the line. A Back Pressure Regulator (BPR) is used to vent steam during periods of overpressure. When large amounts of hot condensate are returned, an amount of steam will be released momentarily—this is normal. Clayton uses a separator with dual steam traps on deaerator applications to minimize this condition. With intermittent conditions of condensate returns at different temperatures and cold makeup, it may not be possible to absorb all the heat from the hot condensate. Deaerator pressure fluctuations should be controlled to within 2-3 psig maximum.

The deaerator should be installed horizontally. The higher the DA can be elevated above the booster pump(s) the less sensitive the feedwater delivery system will be to pressure variations. Other factors, such as friction loss in the feedwater supply line and the Net Positive Suction Head (NPSH) characteristics of the booster pump(s), should be considered when planning the deaerator installation. Clayton requires booster pumps for most DA installations. The deaerator can be insulated to maximize heat retention.

Descriptions for the water treatment and accessory components are provided in Section VII (Optional Equipment) and in the Clayton Feedwater Treatment Manual.

NOTE

All piping to and from the deaerator must remain the same size or larger than the tank connection. Always check feedwater pump pipe size requirements and follow the larger pipe size. See Table 3-4 below and the feedwater supply requirements and pipe sizing guidelines discussed in Sections 2.8, 2.9, 2.10, and 2.11.

Table 3-4: Deaerator Connections

Feedwater Outlet	This connection is used to deliver properly treated feedwater to the booster pump(s) it is typically on the bottom of the tank. A valve and strainer must be provided in the feedwater supply piping at the inlet to each pump. The feedwater line must be constructed so as to provide the required NPSH to the feedwater pump inlet. Restrictions in this line will cause water delivery problems that result in pump cavitation and water shortage problems in the heating coil. **Feedwater line must be constructed to provide the required NPSH, velocity under 1 ft/s, and acceleration head losses less than 0.5 ft/ft to the feedwater pump inlet.** ***Do not insulate this line. Cooling in the pump suction line is beneficial during periods of fluctuating pressure in the deaerator.*** See Section 2.10.
Gravity Fill	A pipe tee should be installed in the feedwater outlet line just below the feedwater outlet connection. On an elevated DA System, this pipe tee provides a connection for the gravity fill plumbing. On a receiver system which uses Booster Pumps, install a pipe plug in the gravity fill tee connection.
Vent	The deaerator must vent the liberated gases to be effective. Some steam is always vented with these gases.
Chemical Injection	One common feedwater chemical injection connection is provided into which all feedwater treatment chemicals are introduced. A check valve must be installed in the discharge line of each chemical pumping system.
Overflow Trap	No valves are to be installed in the overflow trap piping. The overflow trap piping must be plumbed to the blowdown tank discharge piping at a point prior to the temperature valve sensor.
Drain	A drain valve must be provided in the drain line. As indicated above, the drain line can be tied into the overflow line as long as the line size downstream of the merge remains at least the size of the overflow connection on the tank.

Table 3-4: Deaerator Connections

NOTE

The deaerator drain and overflow lines (run independently or tied together) typically contain water at >230° F and must be routed to a blowdown tank discharge piping at a point prior to the temperature valve sensor.

Condensate Returns & Sparger Tube	Most deaerators have a high and low pressure condensate return connection. The high pressure condensate return connection is where all system condensate return and separator trap discharge is introduced. Low pressure returns are typically pumped from a condensate collection tank to the low pressure return connection. The high pressure condensate return connection(s) is located below the water line with a sparger tube installed internally. Introducing the steam and hot condensate below the water line in conjunction with using the sparger tube reduces the velocity and turbulence created at the injection point, while minimizing flash steam losses and noise. In all cases, a check valve must be installed, as close to the DA as possible, in the steam heat and condensate return lines to prevent back-feeding. When installing a sparger tube(s) it must be installed so that the holes are in a horizontal position.
Pressure Regulating Valve	Steam is injected into the high pressure side of the tank to maintain the desired operating pressure. A Pressure Regulating Valve (PRV) is used for pressure regulation.
Safety Relief Valve	Each deaerator is equipped with a safety relief valve to prevent overpressurizing of the tank. This valve is typically rated at 50 psi. The safety relief valve must discharge to atmosphere and in a direction that will not cause harm to personnel or equipment. The discharge piping must not contain any valves or other obstructions that could hinder the release of steam.
Back Pressure Regulation Valve	A back pressure regulator is used to help maintain a steady operating pressure in the DA. This valve is set below the safety valves and will vent during minor periods of over pressurization.

NOTE

BPR sensing line must be plumbed directly to DA pressure sensing port at the gauge connection on top of the DA tank.

3.6 SEMI-CLOSED RECEIVER (SCR)

Semi-Closed Receiver (SCR) systems are used only in applications that return a large amount (typically > 50%) of high pressure, high temperature, condensate. The SCR is a pressurized vessel that is maintained at a pressure that will minimize venting (wasting) of the excess system heat contained in the hot condensate returns. Feedwater outlet line sizing is critical. See Section 2.10.

Each SCR system is unique and requires individual attention to ensure proper application, installation and operation.

Due to the nature and selected use of SCR systems, the system details are addressed in Supplement I - SCR, pages SI-1 through SI-4.

3.7 SCR SKIDS

These skids must be shipped with the SCR tank loose. Tank and interconnecting piping must be assembled by the installer. See Supplement I - SCR (pages SI-1 through SI-4) for detailed information.

3.8 HEAD TANK

A 10-gallon head tank is required when proper receiver tank elevation is unavailable. A head tank provides the necessary positive coil feed pressure during wet layup. The tank must be installed at least two (2) feet above the steam generator coil inlet connection.

SECTION IV - FUEL SYSTEM

4.1 GENERAL

Clayton's SigmaFire steam generators are designed to fire on natural gas, propane, or No. 2 distillate light fuel oil. On combination natural/propane gas and fuel oil machines, each fuel type requires its designated burner manifold to operate. These burner manifolds must be exchanged, manually, to match the fuel-type desired. Characteristics of, and installation guidelines for, both gas and oil fuel systems are described in detail in the following paragraphs.

The SigmaFire models SF-25 and SF-35 steam generators/fluid heaters are step-fired combustion machines only. The SigmaFire models SF-50 through SF-200 steam generators/fluid heaters are step-fired as standard, but ordered as modulating on gas combustion and step-fired on oil combustion.

NOTE

The installing contractors are responsible for ensuring that all piping and fittings are rated for the intended system installation (material type, thickness, pressure, temperature). The installing contractors are also responsible for ensuring the steam system design meets the flow and pressure requirements of a Clayton steam generator (see Section VI, Table 1).

4.2 NATURAL GAS

Clayton's SigmaFire steam generators are built in accordance with ANSI/ASME CSD-1, (C)UL [(Canada) Underwriters Laboratories], FM (Factory Mutual) guidelines, and IRI (Industrial Risk Insurers)/GEGAP compliance. High and low gas pressure switches (with manual reset) are standard on all gas trains.

Unless otherwise stated (liquid petroleum and other gas operation requires engineering evaluation), the standard Clayton gas burner is designed for operation using pipeline-quality natural gas. Gas supply connection sizes and rated gas flows for each model are provided in Tables 1and 2 of Section VI. The gas supply line must be sized to provide both the supply pressure ***and*** full rated flow indicated in Table 1 of Section VI without "sagging" (pressure drop). The gas supply pressure must not vary more than $\pm$5% of Clayton's required supply pressure.

NOTE

All gas supply piping must include a minimum 12-inch drip leg immediately before Clayton's gas train connection, and be fully self-supporting.

Gas pressure regulation is required. A regulated minimum of 2 psi gas pressure is required at the inlet to the gas train. Pressure regulators should be sized to pass 25% excess gas at full open position with minimal pressure drop. One-eighth inch vent lines are needed for both the high and low gas pressure switches.

NOTE

Refer to local codes regarding vent manifolding.

4.3 OIL

4.3.1 General

Clayton SigmaFire oil-fired steam generators are step-fired and designed with pressure atomizing-type oil burners. A 0.5–10 psig fuel oil pressure is required at the inlet to the fuel oil pump.

NOTE

All Clayton liquid fuel systems require a fuel return line in addition to the fuel supply line. Clayton recommends fuel return lines have no isolation valve, or only valves with position open locking mechanisms.

NOTE

It is the customer's responsibility to implement and meet state, local and EPA code requirements for fuel oil storage.

4.3.2 Light Oil

The Clayton light-oil burner is designed for operation with No. 2 distillate light fuel oil as defined by ASTM D 396 - Standard Specifications for fuel oils.

NOTE

A fusible-link-actuated shutoff valve is required in the fuel oil supply line when a machine is installed within FM (Factory Mutual) jurisdiction. This is not within the Clayton scope of supply and must be provided by the installer.

A Clayton step-fired light-oil fuel system uses a direct-fire ignition.

SECTION V - TRAP SEPARATORS

5.1 GENERAL

Clayton Steam Generators require the same basic boiler feedwater treatment as any other water-tube or fire-tube boiler. All require soft water with little or no dissolved oxygen, a sludge conditioner, and a moderate to high pH. The water supplied from the Condensate Receiver should meet these conditions.

The primary distinction between a Clayton Steam Generator and drum type boiler is how and where the desired pH levels are achieved. The feedwater in the Feedwater Receiver is boiler water for the Clayton but similar to makeup water for the drum type boiler. Conventional boilers concentrate the boiler feedwater in the drum and maintain Total Dissolved Solids (TDS) levels and pH through blowdown. A system consisting of only Clayton Steam Generators uses the Feedwater Receiver much the same way conventional boilers use drums except that blowdown is taken off the separator trap discharge. Typically, drum type boilers cannot tolerate the higher pH levels that must be maintained in the Feedwater Receiver to satisfy Clayton feedwater requirements. Both systems work well independently, however feedwater chemical treatment problems arise when the two are operated in tandem with a common feedwater receiver - Clayton with conventional boiler(s).

The Clayton Trap Separator was designed to remedy the boiler compatibility problem. Using a Trap Separator allows both the Clayton and conventional boiler(s) to operate together while sharing the same Feedwater Receiver. Each system receives feedwater properly treated to suit its respective operating requirements. If a Trap Separator is not used, pH is either too high for the conventional boiler(s) or too low for the Clayton.

5.2 OPERATION

The separator trap returns from the Clayton Steam Generator(s) contain a high concentration of Total Dissolved Solids (TDS). This high concentration of TDS is undesirable to conventional boilers because the blowdown rate would have to be increased (and could not be increased enough if the feedwater TDS level was over 3000 ppm). By routing the separator trap returns to the Trap Separator, rather than to the common Feedwater Receiver, the high concentration of TDS in the trap returns is isolated to the Clayton system. This not only eliminates the conventional boiler blowdown problems, but also satisfies the higher pH requirement of the Clayton Feedwater. The construction of a Trap Separator is very similar to that of a Blowdown Tank. Separator trap return enters tangentially creating a swirling action. Flash steam is vented out the top and low pressure condensate is fed to the Booster Pump(s) from the outlet.

This relatively small amount of concentrated water blends with the larger volume of less concentrated feedwater being supplied from the Feedwater Receiver (ideally, the chemical treatment for both systems is injected into the Feedwater Receiver) to produce a mixture of properly treated feedwater entering the Clayton Heating Coil(s). The other boiler(s) receive feedwater containing the pH and TDS levels they require.

5.3 INSTALLATION

(Refer to Figures 5-1, 5-2, and 5-3.)

5.3.1 General

As shown on Figures 5-3 three sizes of trap separators have been designed to handle a broad range of boiler horsepowers. Typical dimensions for each trap separator are provided in Figure 3. Line sizes for the trap separator connections are provided and should be kept full size (no reductions). The trap separator and connected piping must be properly supported. The trap separator is maintained at the same pressure and water level as the feedwater receiver and should be installed at an elevation that puts the water level midpoint in the sight glass.

5.3.2 Trap Separator Vent

The trap separator vent line must be large enough to handle the flash steam with little or no pressure drop and without affecting the water level. Proper vent line sizes for specific horsepower ranges are indicated on Figures 5-1 and 5-2 and must not be reduced. On deaerator (DA) applications the vent flash steam should be introduced into the same section of the deaerator as the Pressure Regulating Valve (PRV) steam injection. On open system applications, the vent line should be introduced to the top of the feedwater receiver. Refer to Figure 5-1.

The trap separator outlet is tied into the booster pump(s) feedwater supply line from the common feedwater receiver. The outlet piping should be constructed so as to provide the required NPSH to the booster pump(s) inlet. (any frictional loss subtracts from the available NPSH). The outlet piping should contain a minimum number of elbows and fittings, and no valves or check valves.

5.3.3 Feedwater Receiver Supply Lines

Provisions should be made for the feedwater receiver to have independent feed lines for the Clayton and conventional boiler feedwater supply. If not isolated, there is a potential for the larger feedwater pumps of the conventional boiler system to draw the water out of the trap separator and away from the Clayton feedwater supply system. This disrupts the chemical treatment in both systems and may cause water shortage and pump cavitation problems in the Clayton system. If independent feed lines are not possible, a swing check valve must be installed in the feedwater supply line to prevent backflow away from the Clayton system. (Refer to Figure 5.1)

SPECIFICATIONS: TRAP SEPARATOR - ALL GENERATORS

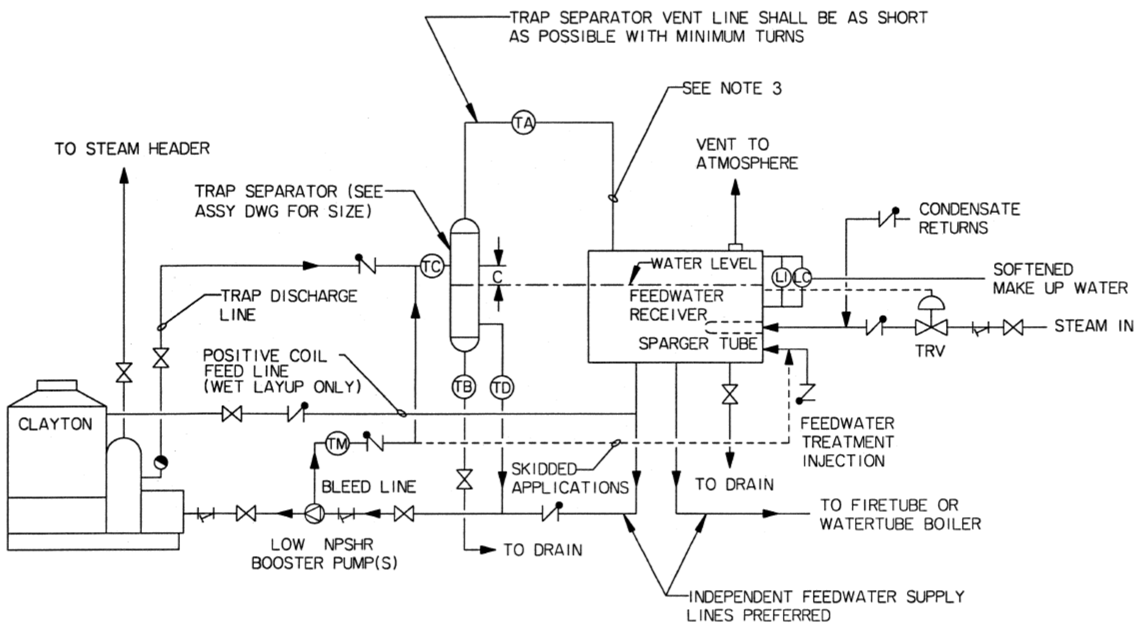


DIAGRAM OF CLAYTON TRAP SEPARATOR HOOKUP W/ OTHER BOILER AND COMMON FEEDWATER RECEIVER

LINE SIZES		
LETTER	DESCRIPTION	P/N UH33572 UP TO 300 BHP
TC	TRAP RETURN	2" FLG.
TA	TRAP SEPARATOR VENT	3" FLG.
TD	FEEDWATER LINE TO CLAYTON	2" FLG.
TB	TRAP SEPARATOR DRAIN	1-1/2" FPT.
TM	BLEED LINE	1/4" FPT.

NOTES:

1. LOCATE TRAP SEPARATOR AS CLOSE AS POSSIBLE TO THE HOTWELL TO SUSTAIN COMMON WATER LEVEL CONTROL AND PRESSURE EQUILIBRIUM.
2. TRAP SEPARATOR USES HEAT FROM CLAYTON TRAP RETURNS TO ISOLATE HIGH TDS CONCENTRATIONS TO THE CLAYTON FEEDWATER CIRCUIT ONLY.
3. HOTWELL MAY REQUIRE AN ADDITIONAL VENT CONNECTION.

R020202

Figure 5-1 Trap separator hookup with hotwell

SPECIFICATIONS: TRAP SEPARATOR - ALL GENERATORS

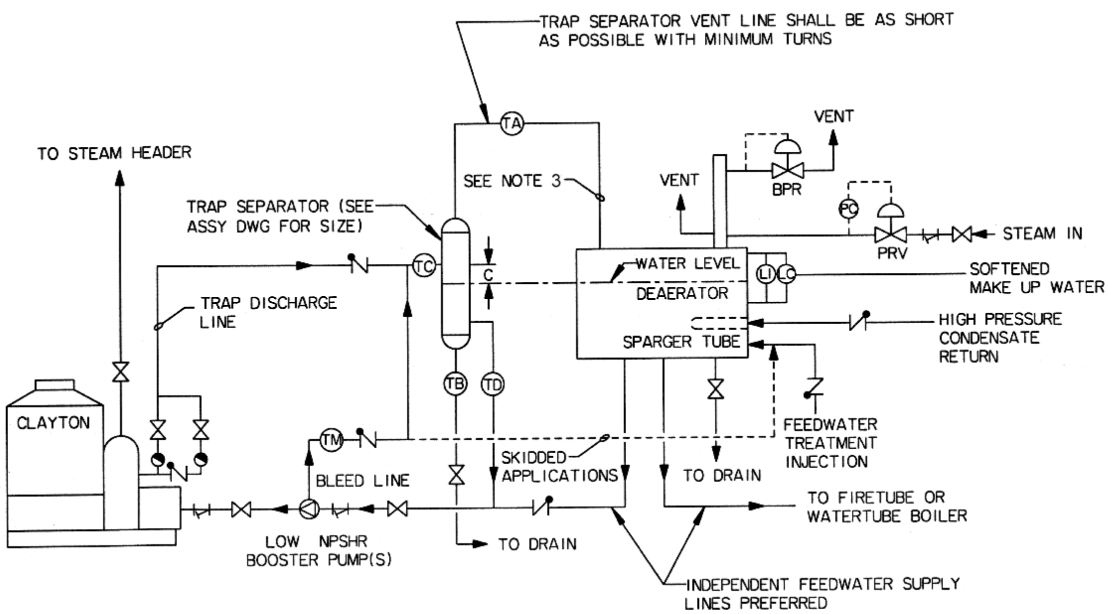


DIAGRAM OF CLAYTON TRAP SEPARATOR HOOKUP W/ OTHER BOILER AND COMMON DEAERATOR

LINE SIZES		
LETTER	DESCRIPTION	P/N UH33572 UP TO 300 BHP
TC	TRAP RETURN	2" FLG.
TA	TRAP SEPARATOR VENT	3" FLG.
TD	FEEDWATER LINE TO CLAYTON	2" FLG.
TB	TRAP SEPARATOR DRAIN	1-1/2" FPT.
TM	BLEED LINE	1/4" FPT.

NOTE:

1. LOCATE TRAP SEPARATOR AS CLOSE AS POSSIBLE TO DEAERATOR TO SUSTAIN COMMON WATER LEVEL CONTROL AND PRESSURE EQUILIBRIUM.
2. TRAP SEPARATOR USES HEAT FROM CLAYTON TRAP RETURNS TO ISOLATE HIGH TDS CONCENTRATIONS TO THE CLAYTON FEEDWATER CIRCUIT ONLY.
3. DEAERATOR MAY REQUIRE AN ADDITIONAL VENT CONNECTION.

R020202

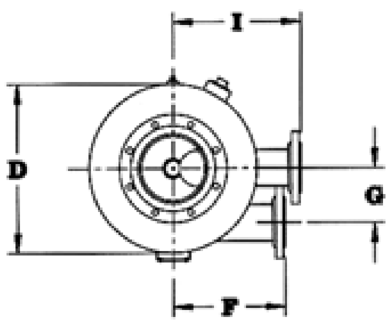
Figure 5-2 Trap separator hookup with deaerator

SPECIFICATION: TRAP SEPARATOR - ALL GENERATOR

TA - (TRAP SEPARATOR VENT)
TB - (CLEANOUT)
TC - (TRAP SEPARATOR INLET)
TD - (TRAP SEPARATOR DRAIN)
TE - (INSPECTION PORT)
TF - (GAUGE GLAS CONNECTION)

NOTE: ALL FLANGES ARE 150# R.F.

BHP	0-300
OPERATING VOLUME	12 GAL
FULL VOLUME	18 GAL
PART #	UH33572
A	27.94
B	13.19
C	9.88
D	14.00
E	9.63
F	12.38
G	5.06
H	29.75
I	12.38
J	19.88
K	15.00



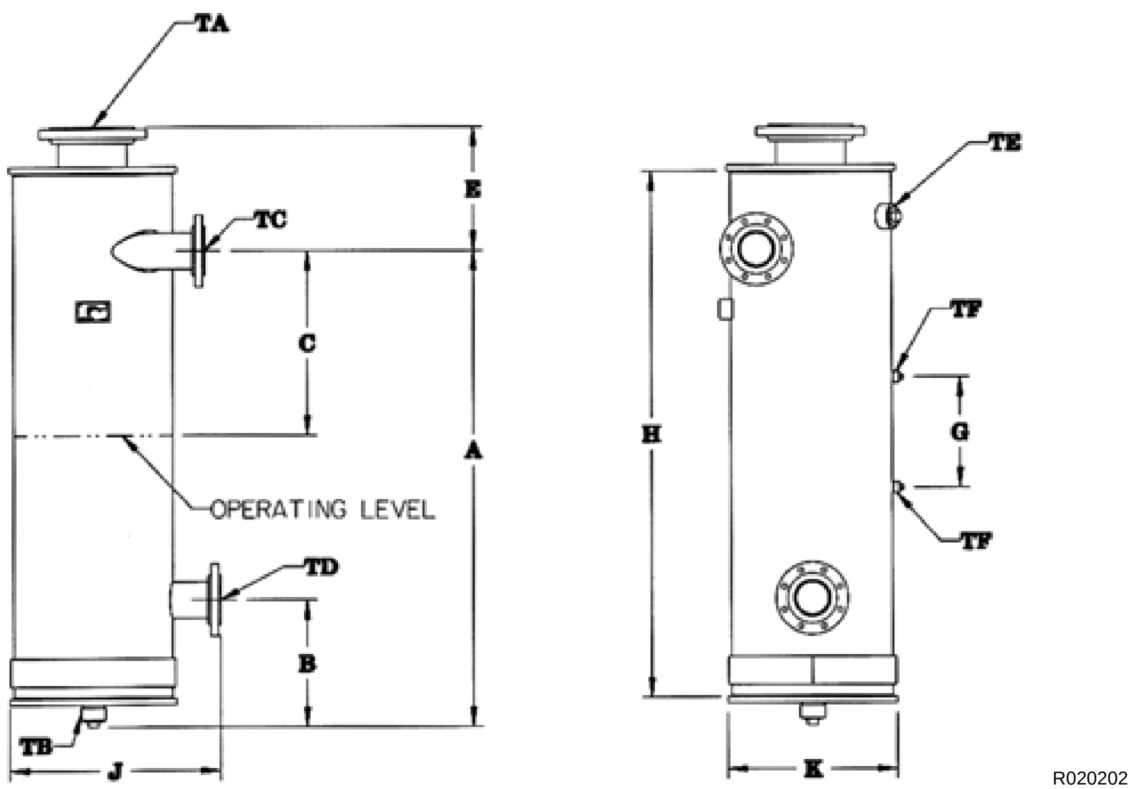


Figure 5-3 Trap separator dimensions

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SECTION VI - TECHNICAL SPECIFICATIONS

6.1 GENERAL

The following pages contain Tables with general reference information intended to assist in the installation of your Clayton SigmaFire steam generator. The information is provided only for standard Clayton thermal products. Specially designed equipment, such as Clayton Steam Generators with Low NOx Burners, are addressed in Supplemental Instructions.

6.2 AGENCY APPROVALS

All standard SigmaFire steam generators are designed and built to meet ANSI, ASME, Boiler Pressure Vessel Code Section I, ASME CSD-1, IRI/GEGAP, FM, UL, CUL, and CRN requirements.

The marine listings ABS, USCG, DNV, and CCG, are available.

6.3 CONSTRUCTION MATERIALS

Only high quality materials are used in the manufacturing of the Clayton Steam Generator.

The Heating Coil in the generator is manufactured by Clayton using ASME SA178 or SA192 steel tubing. All welds are performed by Clayton ASME certified welders. The coil is then hydrostatically tested to 1.5 times the design pressure or 750 psig (52 bars) which ever is greater. The coil is encased in a mild steel jacket that contains all combustion gases.

The steam separator shell is constructed of SA53 seamless black pipe. The heads are made of ASME SA 285 carbon steel. The separator also has openings for steam safety relief valves.

6.4 FLAME SAFEGUARD

Combustion safety control is accomplished by an Electronic Safety Control (ESC) flame monitoring system. The ESC is a microprocessor-based, burner management, control system designed to provide proper burner sequencing, ignition, and flame monitoring protection. In conjunction with limit and operating controls, it programs the Burner, Blower Motor, ignition, and fuel valves to provide for proper and safe burner operation. The control monitors both pilot and main flames. It also provides current operating status and lockout information in the event of a safety shutdown.

The programmer module, a component of the ESC, provides functions such as pre-purge, recycling interlocks, high-fire proving interlock, and trial for ignition timing of the pilot and main flame. Burner flame is monitored by a flame sensor mounted in the Burner Manifold Assembly. The flame signal is sent to the amplifier module in the ESC. An optional display module may be added to provide readouts of main fuel operational hours and the flame signal.

6.5 SAFETY CONTROLS

In addition to the combustion safety control, the following safety devices are continuously monitored during the Steam Generator operation.

6.5.1 Temperature Control Devices

There are three temperature control devices that continuously monitor the machine. The first device monitors the temperature of the steam to prevent against a superheat condition. The second and third temperature devices are a dual element thermocouple that provides continuous monitoring of the coil face temperature in the combustion chamber.

6.5.2 Regulator Approvals

Fuel systems are designed to comply with ANSI/ASME CSD-1, Underwriters Laboratory, FM approval, and IRI/GEGAP.

6.5.3 Steam Limit Pressure Switch

A steam limit pressure switch protects against an over-pressure condition.

6.5.4 Combustion Air Pressure Switch

A combustion air pressure switch is used to prove that sufficient air is present for proper combustion.

6.5.5 Pressure Atomizing Oil Nozzles

The SigmaFire step-fired fuel system uses pressure atomizing oil nozzles—no pressurized air supply required.

6.5.6 Pump Oil Level Switch

A switch is available that monitors the Clayton feedwater pump crankcase oil level for both a high and low oil level condition.

6.5.7 Overcurrent Protection

The electrical circuits (primary and secondary) and all motors are protected against an overcurrent condition.

6.6 EQUIPMENT SPECIFICATIONS

6.6.1 Modulating and step-fired SigmaFire steam generators/fluid heaters.

Table 6-1a

MODEL SPECS	SF-25	SF-35	SF-50	SF-75
A. Net heat output (Btu/hr)	836,875	1,171,625	1,673,750	2,510,625
B. Gross steam output (lb/hr)	863	1,207	1,725	2,587
Design pressure (psi)	65–500	15–500	15–500	15–500
Steam operating pressure (psi)	60–450	12–450	12–450	12–450
C. Thermal efficiencies at 100% firing rate, w/o SE (%): Oil	81	81	82	82
Gas	80	80	80	80
D. Motor sizes (up to -3 design)				
Blower (hp)	2	2	3	5
Feedwater Pump (hp)	1	1	2	3
E. Full load amperage (FLA) (up to -3 design, w/o SE)	10 amps @ 460 V	10 amps @460 V	9 amps @460 V	20 amps @460 V
F. Oil consumption, w/o SE (gph)	7.3	10.2	14.5	21.8
G1. Natural gas consumption, w/o SE (ft^3/hr)	1,046	1,465	2,092	3,138
G2. Gas supply pressure (psig)	2	2	2	2
H. Water supply (gph)	106	212	265	398
Area of free air intake (sq. ft.)	2	2	2	3
Exhaust Stack diameter, o.d. (in.)	8	10	12	12

Table 6-1b

MODEL SPECS	SF-100	SF-125	SF-150	SF-200
A. Net heat output (Btu/hr)	3,347,500	4,184,375	5,021,250	6,695,000
B. Gross steam output (lb/hr)	3,450	4,312	5,175	6,900
Design pressure (psi)	15–500	15–500	15–500	15–500
Steam operating pressure (psi)	12–450	12–450	12–450	12–450
C. Thermal efficiencies at 100% firing rate, w/o SE (%): Oil	82	82	82	82
Gas	80	80	80	80
D. Motor sizes (up to -3 design)				
Blower (hp)	5	7.5	7.5	10
Feedwater Pump (hp)	3	5	5	7.5
E. Full load amperage (FLA) (up to -3 design, w/o SE)	13 amps @ 460 V	25 amps @ 460 V	30 amps @ 460 V	35 amps @ 460 V
F. Oil consumption, w/o SE (gph)	29.1	36.3	43.6	58.1
G1. Natural gas consumption, w/o SE (ft^3/hr)	4,184	5,230	6,277	8,369
G2. Gas supply pressure (psig)	2	2	2	2
H. Water supply (gph)	530	662	795	1,065
Area of free air intake (sq. ft.)	3	4	4.5	6
Exhaust Stack diameter, o.d. (in.)	12	12	18	18

6.6.2 Table 6-1a and 6-1b Supplemental Information

NOTE

All values are rated at maximum continuous firing rate.

A. Net heat output is calculated by multiplying boiler horsepower by 33,475 Btu/hr. Net heat input can be calculated by dividing net heat output by the rated efficiency.

B. Gross steam output, from and at 212^{o} F, is calculated by multiplying boiler horsepower by 34.5 lb/hr.

C. Thermal efficiencies are based on high heat or gross caloric (Btu) values of the fuel. Efficiencies shown are nominal. Small variations may occur due to manufacturing tolerances. Consult factory for guaranteed values.

D. Consult factory for motor horsepowers for units with design pressures above 300 psi.

E. Except where noted, indicated full load amperage (FLA) is for 460 VAC primary voltage supply. See paragraph 2.7, Section II, to obtain FLA for other voltages. Consult factory for FLA for Units with design pressures above 300 psi.

F. Oil consumption based on 140,600 Btu/gal. of commercial standard grade No. 2 oil (ASTM D396).

$$\text{Oil Consumption} = \left(\frac{33{,}475\ \text{Btu/hr}}{\text{bhp}}\right)(\text{bhp})\left(\frac{100}{\text{efficiency}}\right)\left(\frac{1\ \text{gal.}}{140{,}600\ \text{Btu}}\right)$$

G. Natural Gas consumption based on 1000 Btu/ft^3 gas. Use the following formula to determine gas consumption for gases with other heat values:

$$\text{Gas Consumption} = \left(\frac{33{,}475\ \text{Btu/hr}}{\text{bhp}}\right)(\text{bhp})\left(\frac{100}{\text{efficiency}}\right)\left(\frac{1\ \text{ft}^3}{1{,}000\ \text{Btu}}\right)$$

H. Water supply is based on 44 lb/hr per boiler horsepower.

6.7 EQUIPMENT LAYOUT AND DIMENSIONS

NOTE

The steam generator layouts and dimensions given in this section are approximate. The illustration in each figure is a general outline that depicts multiple steam generator models. Refer to the corresponding tables that follow each figure for the specific steam generator model dimensions.

6.7.1 SigmaFire Steam Generators – Step-fired and Modulating

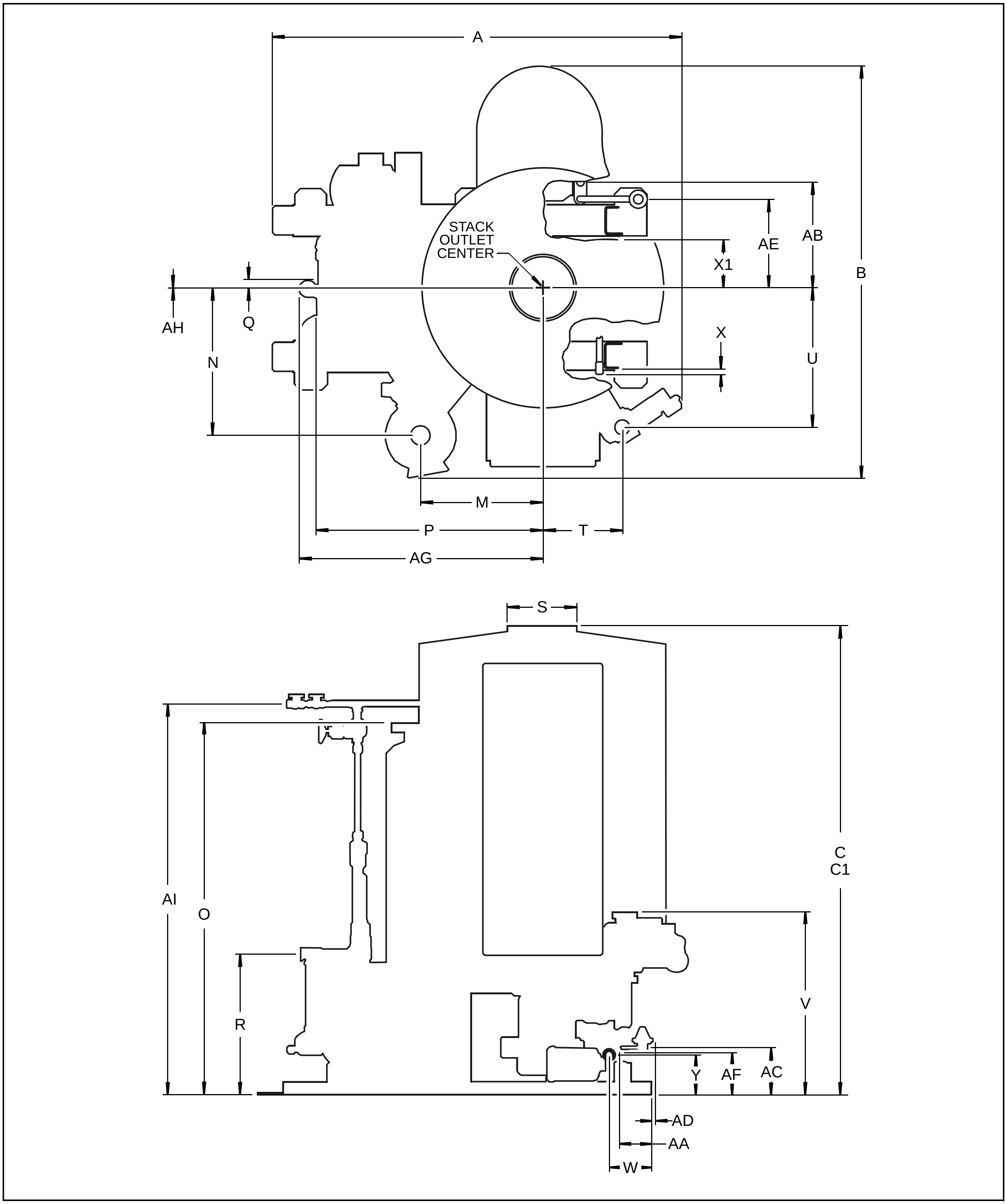


Figure 6-1 SigmaFire steam generator equipment dimensions (typical)

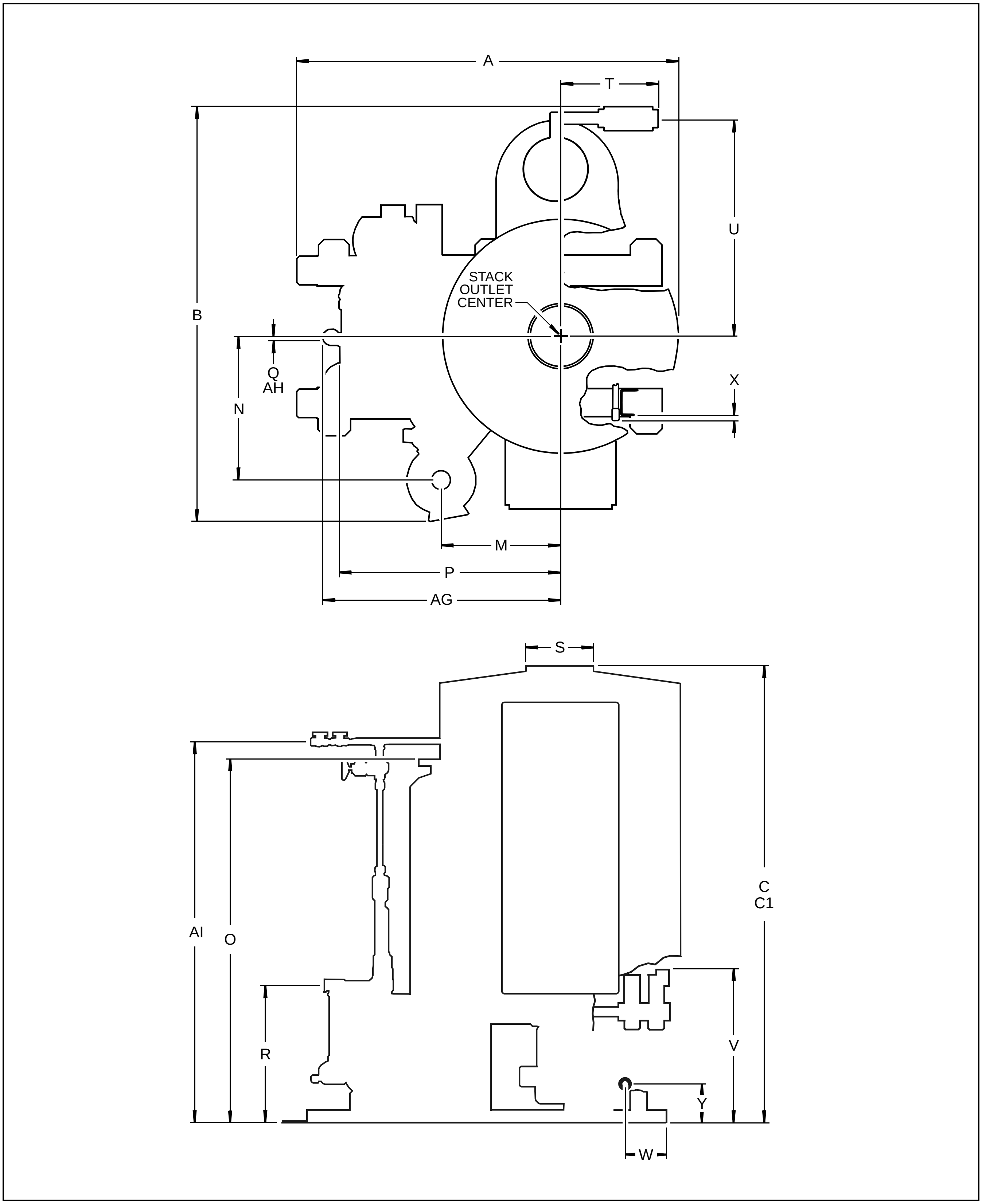


Figure 6-2 SigmaFire steam generator equipment dimensions, FMB (typical)

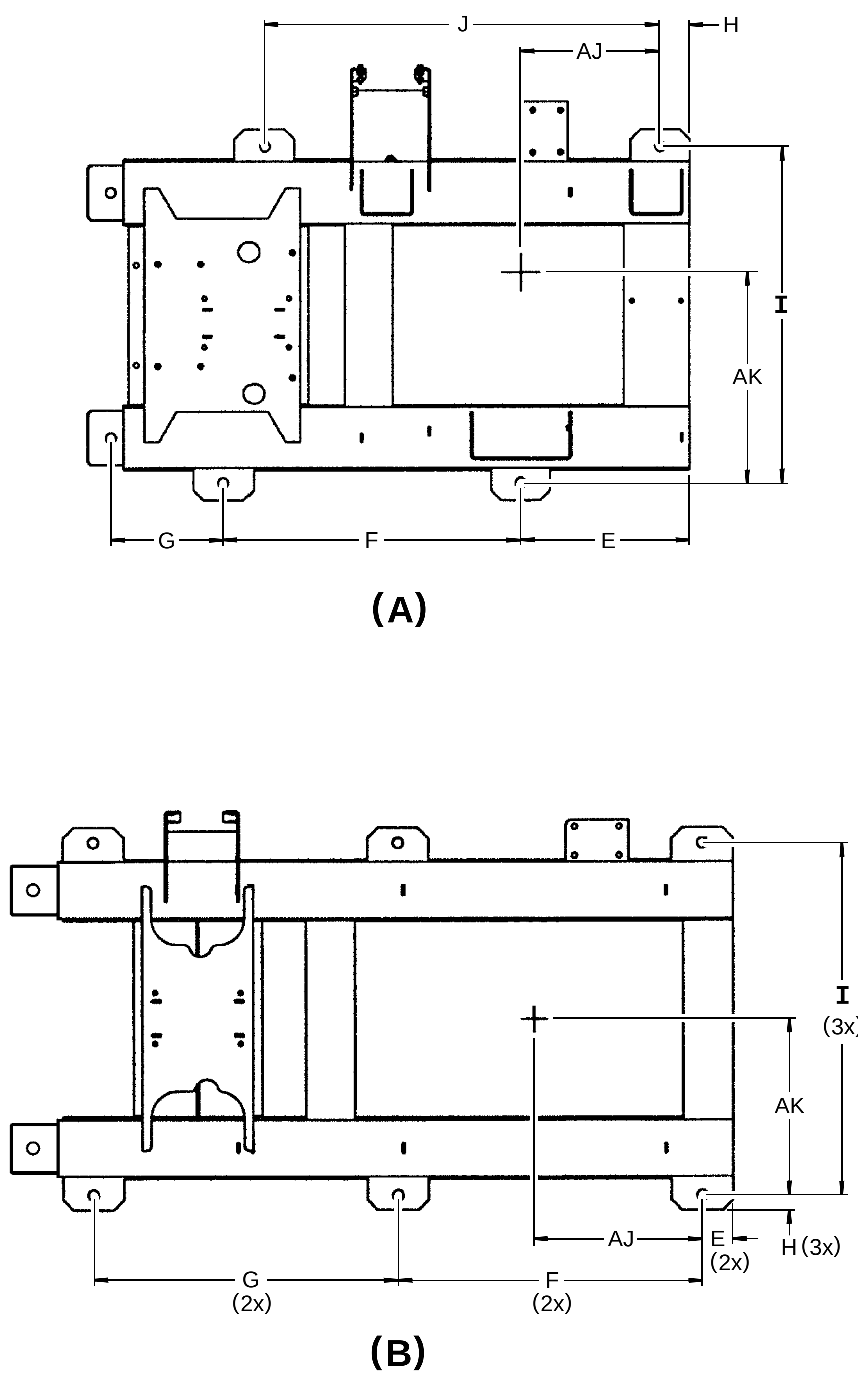


Figure 6-3 SigmaFire frame mounting dimensions, (a) SF25-75 (b) SF100-200 (typical)

Table 6-2 - Equipment layout dimensions for SigmaFire Steam Generators. (Refer to Figures 6-1, 6-2, and 6-3 for corresponding item call-outs.)

			Model							
	Item	**Description**	**SF-25M**		**SF-35M**		**SF-50M**		**SF-75M**	
Layout & Dimensions	A	Generator width, overall - in. (cm)	55.46	(140.9)	55.46	(140.9)	66	(167.6)	68.13	(173.1)
	B	Generator length/depth, overall - in. (cm)	57.74	(146.7)	57.74	(146.7)	62.5	(158.8)	62.5	(158.8)
	C	Generator height - in. (cm)	70.63	(179.4)	70.63	(179.4)	74.88	(190.0)	85.75	(217.8)
	C1	Generator height, w/ SE - in. (cm)	n/a	n/a	n/a	n/a	85.75	(217.8)	97.88	(248.6)
	D	Coil removal height - in. (cm) (See Note 1.)	84	(213.4)	84	(213.4)	84	(213.4)	94.87	(241.0)
	D1	Coil removal height, w/ SE - in. (cm) (See Note 1.)	n/a	n/a	n/a	n/a	94.87	(241.0)	100	(259.1)
	E	Frame mounting - in. (cm)	16.5	(41.9)	16.5	(41.9)	16.75	(74.9)	16.75	(74.9)
	F	Frame mounting - in. (cm)	25	(63.5)	25	(63.5)	29.5	(42.5)	29.5	(42.5)
	G	Frame mounting - in. (cm)	11.25	(28.6)	11.25	(28.6)	9.88	(99.7)	9.88	(99.7)
	H	Frame mounting - in. (cm)	3	(7.6)	3	(7.6)	3	(7.6)	3	(7.6)
	I	Frame mounting - in. (cm)	33.38	(84.8)	33.38	(84.8)	33.5	(85.1)	33.5	(85.1)
	J	Frame mounting - in. (cm)	39.5	(100.3)	39.5	(100.3)	39.25	(84.8)	39.25	(84.8)
	K	Frame mounting - in. (cm)	4.56	(11.6)	4.56	(11.6)	4.5	(11.4)	4.5	(11.4)
	L	Frame mounting - in. (cm)	24.5	(62.2)	24.5	(62.2)	24.5	(62.2)	24.5	(62.2)
	M	Steam discharge outlet - in. (cm)	17.14	(43.5)	17.14	(43.5)	18.63	(47.3)	19	(48.3)
	N	Steam discharge outlet - in. (cm)	20.43	(51.9)	20.43	(51.9)	22.13	(56.2)	22.63	(57.5)
	O	Steam discharge outlet, std (99%) - in. (cm)	48.88	(124.2)	48.88	(124.2)	48.75	(123.8)	63.5	(161.3)
	O1	Steam discharge outlet, high-eff. (99.5%) - in. (cm)	53.53	(136)	53.53	(136)	n/a	n/a	n/a	n/a
	P	Feedwater inlet - in. (cm)	33.93	(86.2)	33.93	(86.2)	39.13	(99.4)	32.75	(83.2)
	Q	Feedwater inlet - in. (cm)	1.5	(3.8)	1.5	(3.8)	2.25	(5.7)	6	(15.2)
	R	Feedwater inlet - in. (cm)	28.06	(71.3)	28.06	(71.3)	20.38	(51.8)	26.13	(66.4)
	S	Flue diameter, o.d. - in. (cm)	8	(20.3)	10	(25.4)	12	(30.5)	12	(30.5)
	T	Main gas inlet - in. (cm)	12.79	(32.5)	12.79	(32.5)	15.13	(38.4)	15.13	(38.4)
	U	Main gas inlet - in. (cm)	12.79	(32.5)	12.79	(32.5)	15.13	(38.4)	15.13	(38.4)
	V	Main gas inlet - in. (cm)	29.4	(74.7)	29.4	(74.7)	26.25	(66.7)	29.75	(75.6)
	W	Pilot gas inlet - in. (cm)	10.88	(27.6)	10.88	(27.6)	11	(27.9)	11	(27.9)
	X	Pilot gas inlet - in. (cm)	.75	(1.9)	.75	(1.9)	3	(7.6)	3.38	(8.6)
	Y	Pilot gas inlet - in. (cm)	8.25	(21)	8.25	(21)	8.5	(21.6)	8.5	(21.6)
	Z	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	AA	Oil inlet - in. (cm)	n/a	n/a	n/a	n/a	0.38	(1.0)	0.5	(1.3)
	AB	Oil inlet - in. (cm)	n/a	n/a	n/a	n/a	2.38	(6.0)	11.38	(28.9)
	AC	Oil inlet - in. (cm)	n/a	n/a	n/a	n/a	5.75	(14.6)	6.38	(16.2)
	AD	Oil return - in. (cm)	n/a	n/a	n/a	n/a	0.38	(1.0)	2.88	(7.3)
	AE	Oil return - in. (cm)	n/a	n/a	n/a	n/a	0.5	(1.3)	8.5	(21.6)
	AF	Oil return - in. (cm)	n/a	n/a	n/a	n/a	5.75	(14.6)	6.38	(16.2)
	AG	Gravity Fill - in. (cm)	39.56	(100.5)	39.56	(100.5)	32.25	(81.9)	36.63	(93.0)
	AH	Gravity Fill - in. (cm)	0	0.0	0	0.0	0	0.0	0	0.0
	AI	Gravity Fill - in. (cm)	64.7	(164.3)	64.7	(164.3)	67	(170.2)	67	(170.2)
	AJ	Stack outlet, center - in. (cm)	n/a	n/a	n/a	n/a	13.63	(34.6)	13.63	(34.6)
	AK	Stack outlet, center - in. (cm)	n/a	n/a	n/a	n/a	21	(53.3)	21	(53.3)

n/a: not available

Note 1: The additional clearance required for hoisting apparatus is not included in this dimension.

Table 6-3 - Equipment layout dimensions for SigmaFire Steam Generators. (Refer to Figures 6-1, 6-2, and 6-3 for corresponding item call-outs.)

			Model									
	Item	Description	SF-100S		SF-100M[a]		SF-100M[b]		SF-100M[c]		SF-100-FMB	
Layout & Dimensions	A	Generator width, overall - in. (cm)	75.5	(191.8)	75.5	(191.8)	75.5	(191.8)	75.5	(191.8)	72.75	(184.8)
	B	Generator length/depth, overall - in. (cm)	78.63	(199.7)	78.63	(199.7)	78.63	(199.7)	78.63	(199.7)	92.38	(234.7)
	C	Generator height - in. (cm)	76.75	(195)	76.75	(195)	76.75	(195)	76.75	(195)	92.25	(234.3)
	C1	Generator height, w/ SE - in. (cm)	91.75	(233)	91.75	(233)	91.75	(233)	91.75	(233)	n/a	
	D	Coil removal height - in. (cm) (Note 1)	83.25	(211.5)	83.25	(211.5)	83.25	(211.5)	83.25	(211.5)	93.25	(236.9)
	D1	Coil removal height, w/ SE - in. (cm) (Note 1)	95.5	(242.6)	95.5	(242.6)	95.5	(242.6)	95.5	(242.6)	n/a	
	E	Frame mounting - in. (cm)	3	(7.6)	3	(7.6)	3	(7.6)	3	(7.6)	3	(7.6)
	F	Frame mounting - in. (cm)	29.38	(74.6)	29.38	(74.6)	29.38	(74.6)	29.38	(74.6)	29.13	(74.0)
	G	Frame mounting - in. (cm)	29.38	(74.6)	29.38	(74.6)	29.38	(74.6)	29.38	(74.6)	29.25	(74.3)
	H	Frame mounting - in. (cm)	1.75	(4.4)	1.75	(4.4)	1.75	(4.4)	1.75	(4.4)	1.38	(3.5)
	I	Frame mounting - in. (cm)	33.5	(85.1)	33.5	(85.1)	33.5	(85.1)	33.5	(85.1)	33.63	(85.4)
	J	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	M	Steam discharge outlet - in. (cm)	22.75	(57.8)	22.75	(57.8)	22.75	(57.8)	22.75	(57.8)	22.5	(57.2)
	N	Steam discharge outlet - in. (cm)	27.13	(68.9)	27.13	(68.9)	27.13	(68.9)	27.13	(68.9)	26.88	(68.3)
	O	Steam discharge outlet - in. (cm)	75.13	(190.8)	50.75	(128.9)	75.13	(190.8)	75.13	(190.8)	86.88	(220.7)
	P	Feedwater inlet - in. (cm)	32.5	(82.6)	32.5	(82.6)	32.5	(82.6)	32.5	(82.6)	44.38	(112.7)
	Q	Feedwater inlet - in. (cm)	5.75	(14.6)	5.75	(14.6)	5.75	(14.6)	5.75	(14.6)	0.25	(0.6)
	R	Feedwater inlet - in. (cm)	26	(66)	26	(66)	26	(66)	26	(66)	20.88	(53.0)
	S	Flue diameter, o.d. - in. (cm)	12	(30.5)	12	(30.5)	12	(30.5)	12	(30.5)	12	(30.5)
	T	Main gas inlet - in. (cm)	13.63	(34.6)	14.38	(36.5)	14.38	(36.5)	14.38	(36.5)	20.13	(51.1)
	U	Main gas inlet - in. (cm)	23.5	(59.7)	24.88	(63.2)	24.88	(63.2)	24.88	(63.2)	47.75	(121.3)
	V	Main gas inlet - in. (cm)	31.5	(80)	31.5	(80)	31.5	(80)	31.5	(80)	20.63	(52.4)
	W	Pilot gas inlet - in. (cm)	7.25	(18.4)	7.25	(18.4)	7.25	(18.4)	7.25	(18.4)	7.25	(18.4)
	X	Pilot gas inlet - in. (cm)	1.69	(4.3)	1.69	(4.3)	1.69	(4.3)	1.69	(4.3)	0.5	(1.3)
	Y	Pilot gas inlet - in. (cm)	6.5	(16.5)	6.5	(16.5)	6.5	(16.5)	6.5	(16.5)	9.5	(24.1)
	Z	---	---	---	---	---	---	---	---	---	---	---
	AA	Oil inlet - in. (cm)	2.63	(6.7)	2.63	(6.7)	2.63	(6.7)	2.63	(6.7)	n/a	
	AB	Oil inlet - in. (cm)	20.75	(52.7)	20.75	(52.7)	20.75	(52.7)	20.75	(52.7)	n/a	
	AC	Oil inlet - in. (cm)	5.5	(14)	5.5	(14)	5.5	(14)	5.5	(14)	n/a	
	AD	Oil return - in. (cm)	2.75	(7)	2.75	(7)	2.75	(7)	2.75	(7)	n/a	
	AE	Oil return - in. (cm)	18.63	(47.3)	18.63	(47.3)	18.63	(47.3)	18.63	(47.3)	n/a	
	AF	Oil return - in. (cm)	3.25	(8.3)	3.25	(8.3)	3.25	(8.3)	3.25	(8.3)	n/a	
	AG	Gravity Fill - in. (cm)	36.5	(92.7)	36.5	(92.7)	36.5	(92.7)	36.5	(92.7)	38.88	(98.8)
	AH	Gravity Fill - in. (cm)	0	0.0	0	0.0	0	0.0	0	0.0	0.25	(0.6)
	AI	Gravity Fill - in. (cm)	68.75	(174.6)	68.75	(174.6)	68.75	(174.6)	68.75	(174.6)	69.38	(176.2)
	AJ	Stack outlet, center - in. (cm)	16	(40.6)	16	(40.6)	16	(40.6)	16	(40.6)	16.13	(41.0)
	AK	Stack outlet, center - in. (cm)	16.75	(42.5)	16.75	(42.5)	16.75	(42.5)	16.75	(42.5)	16.88	(42.9)

[a] Standard “flathead” separator
[b] High-efficiency separator
[c] Low pressure separator
n/a: not available
Note 1: The additional clearance required for hoisting apparatus is not included in this dimension.

Table 6-4 - Equipment layout dimensions for SigmaFire Steam Generators. (Refer to Figures 6-1, 6-2, and 6-3 for corresponding item call-outs.)

			Model									
	Item	Description	SF-125S		SF-125M[a]		SF-125M[b]		SF-125M[c]		SF-125-FMB	
Layout & Dimensions	A	Generator width, overall - in. (cm)	74.63	(189.5)	74.63	(189.5)	74.63	(189.5)	74.63	(189.5)	72.75	(184.8)
	B	Generator length/depth, overall - in. (cm)	78.63	(199.7)	78.63	(199.7)	78.63	(199.7)	78.63	(199.7)	92.38	(234.7)
	C	Generator height - in. (cm)	91.75	(233.1)	91.75	(233.1)	91.75	(233.1)	91.75	(233.1)	92.25	(234.3)
	C1	Generator height, w/ SE - in. (cm)	106.75	(271.1)	106.75	(271.1)	106.75	(271.1)	106.75	(271.1)	n/a	
	D	Coil removal height - in. (cm) (Note 1)	95.5	(242.6)	95.5	(242.6)	95.5	(242.6)	95.5	(242.6)	93.25	(236.9)
	D1	Coil removal height, w/ SE - in. (cm) (Note 1)	110.5	(280.7)	110.5	(280.7)	110.5	(280.7)	110.5	(280.7)	n/a	
	E	Frame mounting - in. (cm)	3	(7.6)	3	(7.6)	3	(7.6)	3	(7.6)	3	(7.6)
	F	Frame mounting - in. (cm)	29.38	(74.6)	29.38	(74.6)	29.38	(74.6)	29.38	(74.6)	29.13	(74.0)
	G	Frame mounting - in. (cm)	29.38	(74.6)	29.38	(74.6)	29.38	(74.6)	29.38	(74.6)	29.25	(74.3)
	H	Frame mounting - in. (cm)	1.75	(4.4)	1.75	(4.4)	1.75	(4.4)	1.75	(4.4)	1.38	(3.5)
	I	Frame mounting - in. (cm)	33.5	(85.1)	33.5	(85.1)	33.5	(85.1)	33.5	(85.1)	33.63	(85.4)
	J	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	M	Steam discharge outlet - in. (cm)	22.75	(57.8)	22.75	(57.8)	22.75	(57.8)	22.75	(57.8)	22.5	(57.2)
	N	Steam discharge outlet - in. (cm)	27.13	(68.9)	27.13	(68.9)	27.13	(68.9)	27.13	(68.9)	26.88	(68.3)
	O	Steam discharge outlet - in. (cm)	75.13	(190.8)	50.75	(128.9)	75.13	(190.8)	75.13	(190.8)	86.88	(220.7)
	P	Feedwater inlet - in. (cm)	32.5	(82.6)	32.5	(82.6)	32.5	(82.6)	32.5	(82.6)	44.38	(112.7)
	Q	Feedwater inlet - in. (cm)	5.75	(14.6)	5.75	(14.6)	5.75	(14.6)	5.75	(14.6)	0.25	(0.6)
	R	Feedwater inlet - in. (cm)	26	(66)	26	(66)	26	(66)	26	(66)	20.88	(53.0)
	S	Flue diameter, o.d. - in. (cm)	12	(30.5)	12	(30.5)	12	(30.5)	12	(30.5)	12	(30.5)
	T	Main gas inlet - in. (cm)	13.63	(34.6)	14.38	(36.5)	14.38	(36.5)	14.38	(36.5)	20.13	(51.1)
	U	Main gas inlet - in. (cm)	23.5	(59.7)	24.88	(63.2)	24.88	(63.2)	24.88	(63.2)	47.75	(121.3)
	V	Main gas inlet - in. (cm)	40	(101.6)	32.38	(82.3)	32.38	(82.3)	32.38	(82.3)	20.63	(52.4)
	W	Pilot gas inlet - in. (cm)	7.25	(18.4)	7.25	(18.4)	7.25	(18.4)	7.25	(18.4)	7.25	(18.4)
	X	Pilot gas inlet - in. (cm)	1.69	(4.3)	1.69	(4.3)	1.69	(4.3)	1.69	(4.3)	0.5	(1.3)
	Y	Pilot gas inlet - in. (cm)	6.5	(16.5)	6.5	(16.5)	6.5	(16.5)	6.5	(16.5)	9.5	(24.1)
	Z	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	AA	Oil inlet - in. (cm)	2.63	(6.7)	2.63	(6.7)	2.63	(6.7)	2.63	(6.7)	n/a	
	AB	Oil inlet - in. (cm)	20.75	(52.7)	20.75	(52.7)	20.75	(52.7)	20.75	(52.7)	n/a	
	AC	Oil inlet - in. (cm)	5.5	(14)	5.5	(14)	5.5	(14)	5.5	(14)	n/a	
	AD	Oil return - in. (cm)	2.75	(7)	2.75	(7)	2.75	(7)	2.75	(7)	n/a	
	AE	Oil return - in. (cm)	18.63	(47.3)	18.63	(47.3)	18.63	(47.3)	18.63	(47.3)	n/a	
	AF	Oil return - in. (cm)	3.25	(8.3)	3.25	(8.3)	3.25	(8.3)	3.25	(8.3)	n/a	
	AG	Gravity Fill - in. (cm)	36.5	(92.7)	36.5	(92.7)	36.5	(92.7)	36.5	(92.7)	38.88	(98.8)
	AH	Gravity Fill - in. (cm)	0	0.0	0	0.0	0	0.0	0	0.0	0.25	(0.6)
	AI	Gravity Fill - in. (cm)	68.75	(174.6)	68.75	(174.6)	68.75	(174.6)	68.75	(174.6)	69.38	(176.2)
	AJ	Stack outlet, center - in. (cm)	16	(40.6)	16	(40.6)	16	(40.6)	16	(40.6)	16.13	(41.0)
	AK	Stack outlet, center - in. (cm)	16.75	(42.5)	16.75	(42.5)	16.75	(42.5)	16.75	(42.5)	16.88	(42.9)

[a] Standard “flathead” separator
[b] High-efficiency separator
[c] Low pressure separator
n/a: not available
Note 1: The additional clearance required for hoisting apparatus is not included in this dimension.

Table 6-5 - Equipment layout dimensions for SigmaFire Steam Generators. (Refer to Figures 6-1, 6-2, and 6-3 for corresponding item call-outs.)

	Item	Description	Model							
			SF-150M		SF-150M-FMB		SF-200M		SF-200M-FMB	
Layout & Dimensions	A	Generator width, overall - in. (cm)	87	(221)	101.25	(257.2)	95.88	(243.5)	101.25	(257.2)
	B	Generator length/depth, overall - in. (cm)	82.38	(209.2)	85.25	(216.5)	82.38	(209.2)	85.25	(216.5)
	C	Generator height - in. (cm)	93.13	(236.6)	93.13	(236.6)	100	(254)	105.38	(267.7)
	C1	Generator height, w/ SE - in. (cm)	108.13	(274.6)	n/a	n/a	109.13	(277.2)	110.13	(279.7)
	D	Coil removal height - in. (cm) (Note 1)	105	(267)	98.13	(249.3)	114	(289.6)	110.25	(280)
	D1	Coil removal height, w/ SE - in. (cm) (Note 1)	120	(305)	n/a	n/a	120	(304.8)	115.13	(292.4)
	E	Frame mounting - in. (cm)	3	(7.62)	3	(7.62)	3	(7.62)	3	(7.62)
	F	Frame mounting - in. (cm)	30.88	(78.4)	32.5	(82.6)	30.88	(78.4)	32.5	(82.6)
	G	Frame mounting - in. (cm)	31	(78.4)	32.5	(82.6)	31	(78.4)	32.5	(82.6)
	H	Frame mounting - in. (cm)	1.75	(4.4)	1.75	(4.4)	1.75	(4.4)	1.75	(4.4)
	I	Frame mounting - in. (cm)	33.5	(85.1)	33.5	(85.1)	33.5	(85.1)	33.5	(85.1)
	J	Frame mounting - in. (cm)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	M	Steam discharge outlet - in. (cm)	23	(58.4)	23	(58.4)	23	(58.4)	23	(58.4)
	N	Steam discharge outlet - in. (cm)	27.38	(69.5)	27.38	(69.5)	27.38	(69.5)	27.38	(69.5)
	O	Steam discharge outlet - in. (cm)	82.88	(210.5)	83.88	(213.1)	82.88	(210.5)	83.88	(213.1)
	P	Feedwater inlet - in. (cm)	35.5	(90.2)	50.25	(127.6)	50.75	(128.9)	50.25	(127.6)
	Q	Feedwater inlet - in. (cm)	4.63	(11.7)	5.25	(13.3)	5.5	(14)	5.25	(13.3)
	R	Feedwater inlet - in. (cm)	26	(66)	28.5	(72.4)	28.63	(72.7)	28.5	(72.4)
	S	Flue diameter, o.d. - in. (cm)	18	(46)	18	(46)	18	(46)	18	(46)
	T	Main gas inlet - in. (cm)	21.63	(54.9)	24.38	(62)	21.63	(54.9)	24.38	(62)
	U	Main gas inlet - in. (cm)	20.63	(52.4)	55.88	(142)	20.63	(52.4)	55.88	(142)
	V	Main gas inlet - in. (cm)	41.88	(106.4)	25.63	(65.1)	36.75	(93.3)	25.63	(65.1)
	W	Pilot gas inlet - in. (cm)	7.25	(18.4)	8.25	(21)	7.25	(18.4)	8.25	(21)
	X	Pilot gas inlet - in. (cm)	.5	(1.3)	.75	(2)	.5	(1.3)	.75	(2)
	Y	Pilot gas inlet - in. (cm)	6.88	(17.5)	6.63	(16.8)	6.88	(17.5)	6.63	(16.8)
	Z	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	AA	Oil inlet - in. (cm)	4.88	(12.4)	n/a	n/a	4.88	(12.4)	n/a	n/a
	AB	Oil inlet - in. (cm)	20.13	(51.1)	n/a	n/a	20.13	(51.1)	n/a	n/a
	AC	Oil inlet - in. (cm)	5.25	(13.3)	n/a	n/a	5.25	(13.3)	n/a	n/a
	AD	Oil return - in. (cm)	.5	(1.3)	n/a	n/a	.5	(1.3)	n/a	n/a
	AE	Oil return - in. (cm)	18	(45.7)	n/a	n/a	18	(45.7)	n/a	n/a
	AF	Oil return - in. (cm)	3.13	(7.9)	n/a	n/a	3.13	(7.9)	n/a	n/a
	AG	Gravity Fill - in. (cm)	46.88	(119.1)	39.75	(101)	46.88	(119.1)	39.75	(101)
	AH	Gravity Fill - in. (cm)	0	0	0	0	0	0	0	0
	AI	Gravity Fill - in. (cm)	80.88	(205.4)	83.88	(213.1)	80.88	(205.4)	82	(208.3)
	AJ	Stack outlet, center - in. (cm)	16	(40.6)	19.5	(49.5)	16	(40.6)	19.5	(49.5)
	AK	Stack outlet, center - in. (cm)	16.75	(42.5)	16.75	(42.5)	16.75	(42.5)	16.75	(42.5)

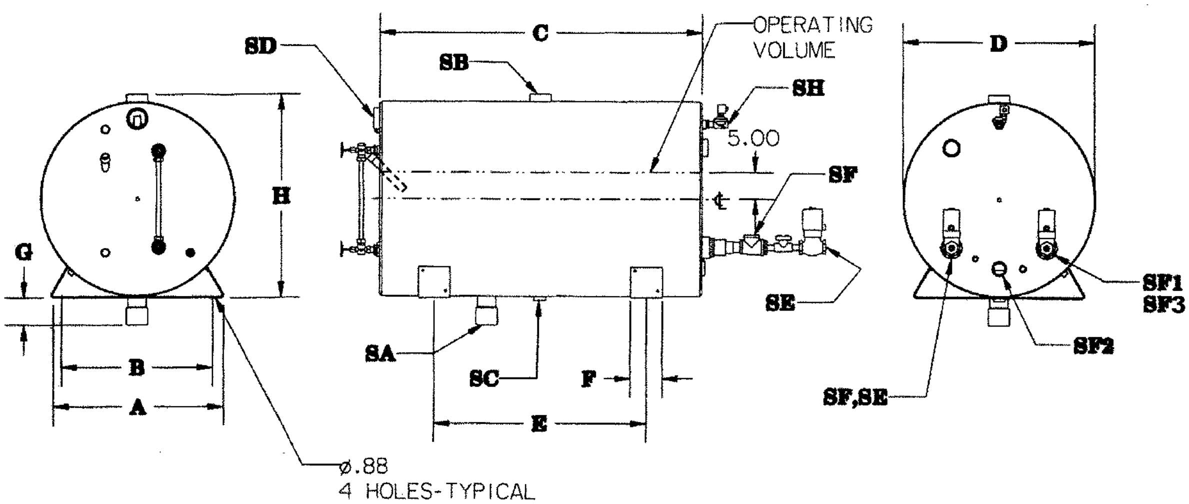
[a] Standard “flathead” separator
[b] High-efficiency separator
[c] Low pressure separator
n/a: not available
Note 1: The additional clearance required for hoisting apparatus is not included in this dimension.

Table 6-6 - SigmaFire Steam Generator customer connection sizes.

Connection Sizes — Description	Model: SF-25	SF-35	SF-50	SF-75	SF-100[a]	SF-100[b]	SF-100[c]
Separator discharge outlet; in.	1.25	1.25	2.00	2.00	2.50[d]	2.50[e]	3.00[d]
Standpipe discharge outlet (flgd); in.							
Safety relief valve outlet (FPT); in.	(See Plan Installation Drawing for valve connection sizes.)						
Feedwater inlet (FPT); in.	1.50	1.50	2.00	2.00	2.00	2.00	2.00
Steam trap discharge outlet (FPT); in.	0.50	0.50	1.00	1.00	1.00	1.00	1.00
Separator drain/blowdown (FPT); in.	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Standpipe drain/blowdown (FPT); in							
Coil drain, w/o SE (FPT); in.	1.00	1.00	1.00	1.00	1.25	1.25	1.00
Coil blowdown drain, w/ SE (FPT); in.							
Pump relief valve outlet (FPT); in.	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Gravity fill inlet (FPT); in.	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Main gas inlet (MPT); in.	0.75	0.75	1.00	1.00	2.50	2.50	1.50
Pilot gas inlet (FPT); in.	0.50	0.50	0.50	0.50	0.38	0.38	0.38
(Gas) Bleed valve outlet (FPT); in.					1.25	1.25	0.75
Continuous blowdown outlet (FPT); in.					0.38	0.38	0.38
Coil blowdown (backflow) drain (FPT); in.	0.75	0.75	0.75	0.75	1.00	1.00	1.00
Light oil inlet (FPT); in.	0.50	0.50	0.50	0.50	0.50	0.50	0.75
Light oil return (FPT); in.	0.50	0.50	0.50	0.50	0.50	0.50	0.38
Atomizing air inlet–oil units (FPT); in.	0.50	0.50	0.50	0.50	0.38	0.38	0.38
Description	**SF-100-DZ**	**SF-125[a]**	**SF-125[c]**	**SF-125-DZ**	SF-150	SF-200	
Separator discharge outlet; in.		2.00[d]	3.00[d]		3.00	3.00	
Standpipe discharge outlet (flgd); in.	2.00			2.00			
Safety relief valve outlet (FPT); in.	(See Plan Installation Drawing for valve connection sizes.)						
Feedwater inlet (FPT); in.	2.00	2.00	2.00	2.00	2.00	2.00	
Steam trap discharge outlet (FPT); in.		1.00	1.00		1.00	1.00	
Separator drain/blowdown (FPT); in.		1.00	1.00		1.00	1.00	
Standpipe drain/blowdown (FPT); in	1.25			1.25			
Coil drain, w/o SE (FPT); in.		1.00	1.00		1.50	1.50	
Coil blowdown drain, w/ SE (FPT); in.							
Pump relief valve outlet (FPT); in.	0.50	0.50	0.50	0.50	0.50	0.50	
Gravity fill inlet (FPT); in.	0.50	0.50	0.50	0.50	0.50	0.50	
Main gas inlet (MPT); in.	2.50	1.50	1.50	1.50	1.50	1.50	
Pilot gas inlet (FPT); in.	0.38	0.50	0.38	0.50	0.50	0.50	
(Gas) Bleed valve outlet (FPT); in.	1.25	1.25	0.75	1.25	0.75	0.75	
Continuous blowdown outlet (FPT); in.		0.38	0.38		0.38	0.38	
Coil blowdown (backflow) drain (FPT); in.	1.00	0.75	0.75	0.75	0.75	0.75	
Light oil inlet (FPT); in.	0.50	0.50	0.50	0.50	0.38	0.38	
Light oil return (FPT); in.	0.50	0.50	0.50	0.50	0.25	0.25	
Atomizing air inlet–oil units (FPT); in.	0.38	0.38	0.50	0.50	0.38	0.38	

	SF-25	SF-35	SF-50	SF-75	SF-100
Generator shipping weight, non-SE; lb (kg)	1,920 (871)	2,070 (939)	3,700 (1,678)	3,800 (1,724)	3,960 (1,796)
Generator shipping weight, SE; lb (kg)	2,070 (939)	2,220 (1,007)	3,930 (1,783)	4,030 (1,828)	4,330 (1,964)
	SF-100-FMB	**SF-125**	**SF-125-FMB**	**SF-150**	**SF-200**
Generator shipping weight, non-SE; lb (kg)	4,040 (1,833)	4,300 (1,950)	4,380 (1,987)	4,600 (2,087)	4,750 (2,155)
Generator shipping weight, SE; lb (kg)	4,410 (2,000)	4,670 (2,118)	4,750 (2,155)	4,975 (2,257)	5,150 (2,336)

[a] Standard “flathead” separator
[b] High-efficiency separator
[c] Low pressure separator
[d] FPT
[e] Raised flange
n/a: not available



BHP	250	350	750	900	1600
Operating Volume	180 GAL.	250 GAL.	425 GAL.	551 GAL.	757 GAL.
Full Volume	266 GAL.	372 GAL.	667 GAL.	865 GAL.	1,135 GAL.
Part No.	UH31909	UH32701	UH32791	UH32377	UH33814
A	31.33	31.33	41.12	41.12	48.00
B	28.34	28.34	36.00	36.00	44.00
C	60.83	84.69	93.12	120.62	145.12
D	36.36	36.36	46.36	46.50	63.00
E	40.00	40.00	60.00	84.00	101.00
F	6.00	6.00	6.00	6.00	6.00
G	5.09	5.16	3.29	6.48	3.80
H	37.92	37.83	51.98	53.48	68.52

SA - Feedwater Outlet
SB - Vent
SC - Drain
SE - Steam Heat
SF - Trap Return
SH - Make Up Return

SF1 - Condensate Return
SF2 - Low Pressure Condensate Return
SF3 - Optional HP condensate return, w/ sparger tube for 50% or higher return

Note: 1) Refer to applicable P&ID drawing for hotwell trim connections.
2) Sparger tube for SF1 optional. Recommended for condensate returns over 50%.

R019740

Figure 6-4 Horizontal hotwell dimensions and specifications

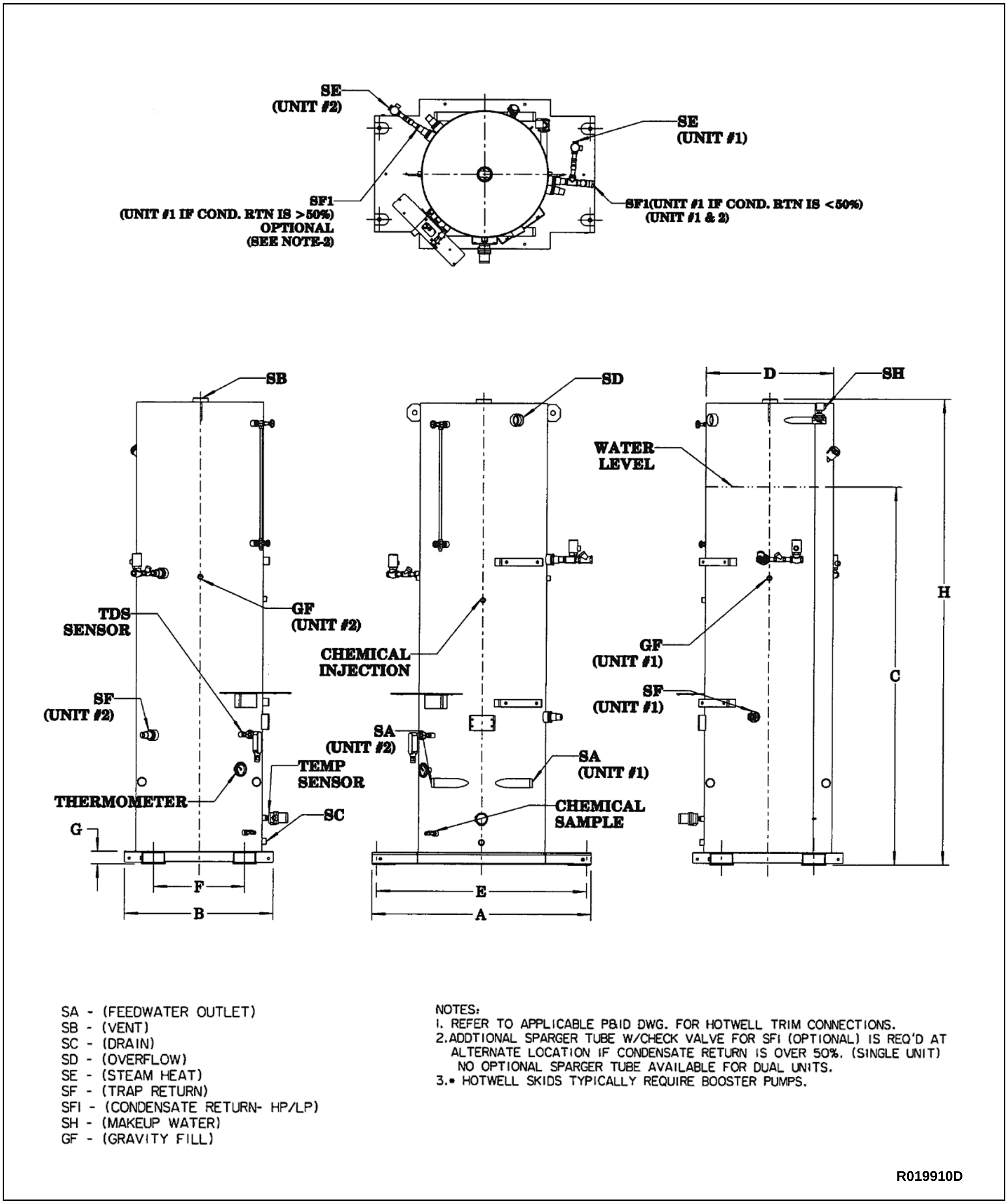


Figure 6-5 Vertical hotwell dimensions and specifications

Table 6-7 - Specifications for Vertical Hotwell w/ Booster Pump

BHP	50	75–100 (SHORT)	75–100 (TALL)	125–200 (SHORT)	125–200 (TALL)	400 (SHORT)	400 (TALL)
Operating Volume	134 gal.	193 gal.	276 gal.	270 gal.	412 gal.	420 gal.	588 gal.
Full Volume	162 gal.	250 gal.	330 gal.	345 gal.	487 gal.	536 gal.	716 gal.
Part Number	UH33780	UH33784	UH33698	UH33758	UH33753	UH34132	UH33770
A	35"	53"	35"	60.25"	60.25"	68.25"	68.25"
B	35"	35"	35"	40"	40"	48"	48"
C	73.90"	71.18"	101.18"	73"	101"	73"	101"
D	22.38"	28"	28"	34"	34"	42.36"	42.36"
E	32.5"	50.5"	32.5"	56.50"	56.50"	64.50"	64.50"
F	24.5"	24.5"	24.5"	24.5"	24.5"	24.5"	24.5"
G	3.29"	3.29"	3.29"	3.29"	3.29"	3.29"	3.29"
H	95.61"	93.63"	123.62"	93.81"	123.8"	93.62"	123.8"

6.7.2 Blowdown Tanks

PART #	UH35841
FULL VOLUME	11 GALLON
MODEL	SF25 / 200
BHP RATING	25 BHP 200 BHP
DRY WEIGHT	123 LBS.
A	16.44
B	10.00
C	8.00
D	8.25
E	19.63
F	24.94
G	25.75
H	27.69
I	38.56
J	31.08
K	Ø 12.75
L	5.00
M	7.00
N	8.01
P	7.19
R	45°
S	30°
T	45°
U	Ø 18.50

TA = VENT

TB = DRAIN

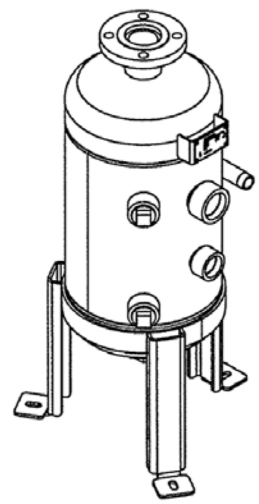
TC = HOTWELL OVERFLOW - NOT APPLICABLE

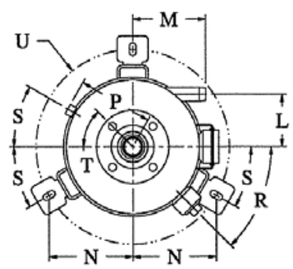
TD = WATER OUTLET

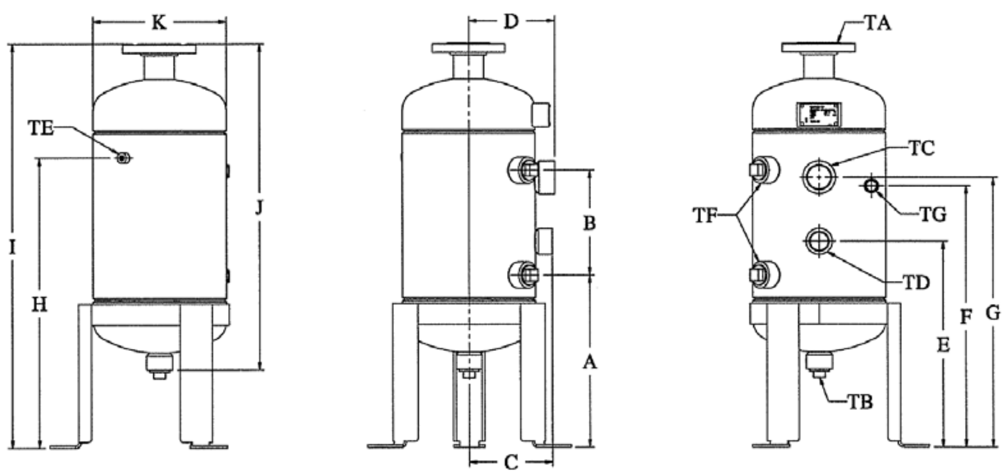
TE = WATER COOLER SAMPLE INLET

TF = INSPECTION

TG = BLOWOFF INLET







NOTES:

1. ALL FLANGES ARE 150# R.F.

2. ASME SECTION VIII, DIV I. ("U" STAMP)

3. MAWP TEST = 100 PSI @ 338° F MAX. / 0° MIN.

4. HYDROSTATIC TESTED @ 150 PSI.

Figure 6-6 Blowdown tank dimensions and specifications

SECTION VII - OPTIONAL EQUIPMENT

7.1 BOOSTER PUMP(S)

Booster pumps are required on an open system when the required NPSH to the feedwater pump cannot be achieved from an elevated hot-well. In a deaerator (D/A) system, booster pumps are required for most installations. Due to the low NPSH characteristics of these pumps, they are less sensitive to feedwater delivery problems caused by fluctuating pressure in the D/A than the Clayton feedwater pump(s).

Booster pumps must be sized to provide 150 percent of the total system water flow at 150 percent of the total system head pressure. Total system head pressure includes the Clayton feedwater pump $NPSH_R$, plus calculated pipe losses, and plus acceleration head loss.

Most systems use two pumps. One of the two pumps is a standby pump, or the usage of the two pumps are alternated to balance operating hours. Only booster pumps with mechanical seals rated at a *minimum* of 250° F (121° C) should be used. The booster pumps cannot be rated at a discharge pressure that is lower than the system operating pressure

NOTE

Each booster pump must have a 1/4 inch (6 mm) recirculation line, with a check-valve, piped from the discharge side of the pump back to the condensate receiver. This prevents overheating during "dead head" conditions. Clayton recommends using this return line to facilitate chemical injection at a common manifold on the condensate receiver.

7.2 BLOWDOWN SYSTEM

7.2.1 Blowdown Tank

The Occupational Safety and Health Administration (OSHA) requires that high temperature discharges be cooled to a temperature below 140° F (60° C) prior to entering a drainage system. A blowdown tank is performs this function. All blowdown and high temperature drain lines are to be piped to the blowdown tank. A capillary tube-type temperature sensor, mounted in the blowdown tank discharge line, actuates a temperature control valve, also mounted in the discharge line, to inject cooling water into the hot fluid. The temperature control valve can be adjusted to achieve the desired discharge fluid temperature. The blowdown tank vent should be a straight run of full size iron or steel pipe.

7.2.2 Automatic TDS Controller

Total dissolved solids can be controlled automatically. This is accomplished by installing a TDS (conductivity) sensing probe in the feedwater line, this is connected to the Clayton Boiler Master controller that, in turn, controls a dump valve installed in the trap discharge line. The discharge from the dump valve is then piped to the blowdown tank. Refer to Drawing R016099. Feedwater testing is still required per the Clayton Feedwater Manual.

7.2.3 Continuous Blowdown Valve

The continuous blowdown valve, if used, is installed in the trap discharge line. It consists of a needle valve that is throttled for the proper flow rate to keep TDS within parameters. Refer to Drawing R016099.

7.3 VALVE OPTION KIT

The valve option kit consists of a separator drain valve, coil gravity drain valve, coil blowdown valve, and separator-trap discharge valve. The valve kit also includes the required hardware, such as nuts, bolts, gaskets, and pipe nipples, for the valve installation. With the exception of generator skids and the steam trap discharge valve, all valves are shipped loose for customer installation. If the valve option kit is not supplied by Clayton, it is the customers responsibility to provide these valves. All these valves are required for proper installation and operation.

7.4 SOOT BLOWER ASSEMBLY

For steam generators that burn oil, a provision for steam soot blowing is required. Clayton Industries can provide an optional steam pipe spool piece with all piping and valves required for the proper removal of accumulated soot. If this item is not purchased the customer must supply a valved line from the steam header to the soot blow inlet for this purpose.

7.5 PRESSURE REGULATING VALVES (BPR/PRV)

7.5.1 Back Pressure Regulators

Back Pressure Regulators (BPR), in the separator discharge piping, are required when the system requirements exceed the capacity of the steam generator/fluid heater, where there are cycling loads, such as those created from a fast-acting motorized valve, or on steam generators/fluid heaters that are started remotely or automatically, such as master lead-lag or auxiliary pressure control systems. BPRs are recommended on all Clayton installations. The BPRs assure that sufficient pressure is maintained in the steam generator/fluid heater to protect the heating coil from a possible overheat condition.

Pilot operated BPRs are meant to be mounted at the steam header top elevation, immediately next to the steam stop valves above Clayton’s (remote) separator. They are not meant to be floor mounted. Pilot lines must be trapped to prevent liquid lockout. Customers who desire mounting BPRs at floor level must use pilotless electro-pneumatic BPRs.

7.5.2 Pressure Regulating Valves

Pressure Regulating Valves (PRV) control the pressure in the feedwater supply vessel, either D/A or Semi-closed Receiver (SCR) Systems. These valves ensure positive pressure is maintained on these vessels. The PRV receives steam from the main header and injects steam into the tank when a drop in pressure is detected. A check-valve must be installed in this line to protect the system in the event of flooding the tank.

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SUPPLEMENT I - SCR

1.1 SEMI-CLOSED RECEIVER SYSTEMS (SCR)

1.1.1 Requirements

A Semi-closed Receiver (SCR) system is used when condensate can be returned at relatively high pressure and temperature. The pressure of the receiver tank is determined by the condensate return system. When the system is warm and operating at its normal “balanced pressure” the back pressure regulator and pressure regulating valve may be set. The SCR systems typically operate between 50–125 psi and must be at least 50 psi below the anticipated steam pressure. Because of these higher operating pressures/temperature (feedwater will be between 300°–350° F) feedwater chemical treatment is reduced but not eliminated. Because of the elevated feedwater temperature, cooling water is circulated over the pump heads in the feedwater pump. This helps keep the pump diaphragms cool thereby extending the life. The pump head cooling water does not have to be softened water unless it is returned to the hot-well. Installation of cooling water lines to the pump head connections is the responsibility of the installing contractor.

1.1.2 Components of an SCR System refer to Drawing R-16596

The SCR must be sized to a total capacity of 1.5 gallons per boiler horsepower. Multiple generators may be operated from one receiver if the installation is operating at a common pressure. The receiver tank must comply with the ASME Section VIII Code specifications for unfired pressure vessels. There must also be a large valved drain line in the bottom of the receiver to permit periodic draining and flushing of the tank.

NOTE

Receiver must be installed to provide sufficient NPSH to the feedwater pump(s). See Section 2.11.

1.1.3 Water Level Gauge Glass

A sight glass must be mounted on the receiver for visual verification of the operating water level. This glass must be rated for the operating pressure/temperature and be at least one foot long.

1.1.4 Steam Trap

An overflow steam trap is required to control the maximum water level, when above normal amounts of condensate are being returned. The trap inlet must have a priming drip leg at least eighteen inches long. The trap discharge must be piped to the make-up tank.

1.1.5 Vent

The receiver must have a vent to discharge non-condensible gases from the feedwater. The Clayton vent most often provided is a 3/4 inch orifice union with a 1/8 inch orifice. This will continuously vent a small amount of steam with the gases.

1.1.6 Level Control

A liquid level controller is mounted on the receiver to control the make-up water pump. This control starts and stops the make-up pump as required. The differential between the high and low levels is a narrow band (2 to 3 inches). The water level should be maintained approximately one quarter from the top of the tank, and at the proper height for the required NPSH of the generator feedwater pump.

1.1.7 Steam Relief Valve

The SCR must have a steam safety relief valve with a setting not greater than the design pressure of the tank. This valve must comply with all safety codes and must be capable of relieving at least 25 percent of the connected generator steaming capacity at the SCR operating pressure. The discharge from this valve must be piped to atmosphere and in a direction that will not cause harm to equipment or personnel.

1.1.8 Sparger Tube

The high pressure condensate returns must be injected into the SCR through a sparger tube. The sparger tube inlet must be 8–12 inches below the lowest water level so the heat will be transferred from the condensate to the liquid in the SCR with the least possible noise and vibration. The trap returns from the Clayton separator should also be piped into the sparger tube.

1.1.9 Back Pressure Regulator

A Back Pressure Regulator (BPR) must be installed on the receiver to help control the tank pressure during large load swings, or in the event of system traps malfunction. The BPR should be set at 3–5 psi above the normal operating pressure.

1.1.10 Pressure Reducing Valve

A Pressure Regulating Valve (PRV) must be installed on the SCR to maintain a preset pressure. The PRV senses the SCR pressure and injects steam (above the water level) from the header in the event of a reduction in the tank pressure. The PRV should be set at 1–2 psi below the normal operating pressure. The PRV design flow must be equal to 25 percent of the maximum steam production rate. If low pressure steam is to be drawn from the receiver for other uses, this capacity must be considered when sizing the PRV. A check-valve must be installed between the PRV and the receiver to prevent backflow in the event of a flooded condition in the receiver.

NOTE

The PRV and BPR are not options. They must be installed to ensure the effective and efficient operation of the Clayton Semi-closed Receiver System.

1.1.11 Make-up Tank

A make-up tank is required to collect low pressure condensate and fresh softened make-up water. Steam is introduced to the make-up tank through a temperature control valve. The make-up tank temperature should be maintained between 190°–200° F. The make-up tank must be sized for the total boiler horsepower rating of the system. The make-up tank must also have sufficient elevation to provide the required NPSH of the make-up.

1.1.12 SCR Transfer Pump

An SCR transfer pump is required to transfer water from the make-up tank to the SCR (regenerative turbine type preferred). This pump must have a capacity that is at least equal to the total boiler feedwater pump capacity. The make-up pump must have a discharge head not less than 25 percent higher than the maximum receiver operating pressure. The discharge from this pump must enter the SCR below the minimum water level.

NOTE

A check-valve must be installed in the make up pump discharge line as close to the SCR as possible. This will prevent exposing the pump seal to excessive fluid temperatures.

1.1.13 Chemical Treatment

Feedwater Chemical Treatment is injected into the SCR below the water level. Feedwater treatment Chemicals are also be injected into the make-up tank to help protect the make up against corrosion. Both of these chemical injection lines must have a check-valve installed to prevent back feeding into the chemical pumps. Chemical pump output pressure must be greater than SCR pressure.

1.1.14 Hook-up

The feedwater line between the SCR and the generator feedwater water pump must have an inside diameter of 2 times that of the SCR discharge connection and the feedwater pump inlet connection. The pipe run to Clayton's positive displacement (PD) feedwater pump must be as short as possible (absolute minimum), and the elbows and restrictions must be kept at a minimum. A flex section (2 feet minimum) must be installed on the feedwater pump inlet. A port for a thermometer and a feedwater sampling port must be as close to the feedwater pump inlet as possible.

The pipe run from the SCR to Clayton's PD feedwater pump must be held as level as possible. No u-shaped pipe sections (either up or down) are allowed. This pipe run must be a continuous 2°–3° rise from Clayton's PD feedwater pump back up to the SCR discharge connection. All reducers must be eccentric with the flat side up.

1.1.15 System Steam Traps

The steam traps in the system must be rated for the system pressure, and sized for the difference between the steam system and the receiver. This usually requires the traps be one size larger than on an open system. The steam traps in the system must be properly maintained for the system to function normally. If there are traps “blowing by,” the SCR will be pressurized above the BPR set point and steam will be needlessly vented to atmosphere.

1.1.16 A General Statement

Because of the uniqueness of an SCR system, the requirements put forth here must be closely followed to ensure trouble free operation. If properly installed and maintained the Clayton Semi-closed Receiver System will operate with a high degree of reliability and economic benefits.

SUPPLEMENT II - FLUID HEATER

2.1 FLUID HEATERS

The Clayton Fluid Heater is provided with an off frame mounted steam separator. This type of unit carries a “DZ” model designation. A stand pipe with ASME safety valve remains on the main frame of the fluid heater. This type of equipment layout requires remote mounting of the fluid separator with interconnecting piping between the main shut off valve, mounted on the stand pipe, and the inlet of the separator. The piping between the stand pipe mounted main steam shut off valve, and the inlet to the fluid heater should be run full size with a minimum of elbows.

The remote mounted separator is available without legs, for mounting in the steam header, or with legs/skirt for floor mounting close to the fluid heater.

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Appendix A

Steam Generator

Lifting Instructions

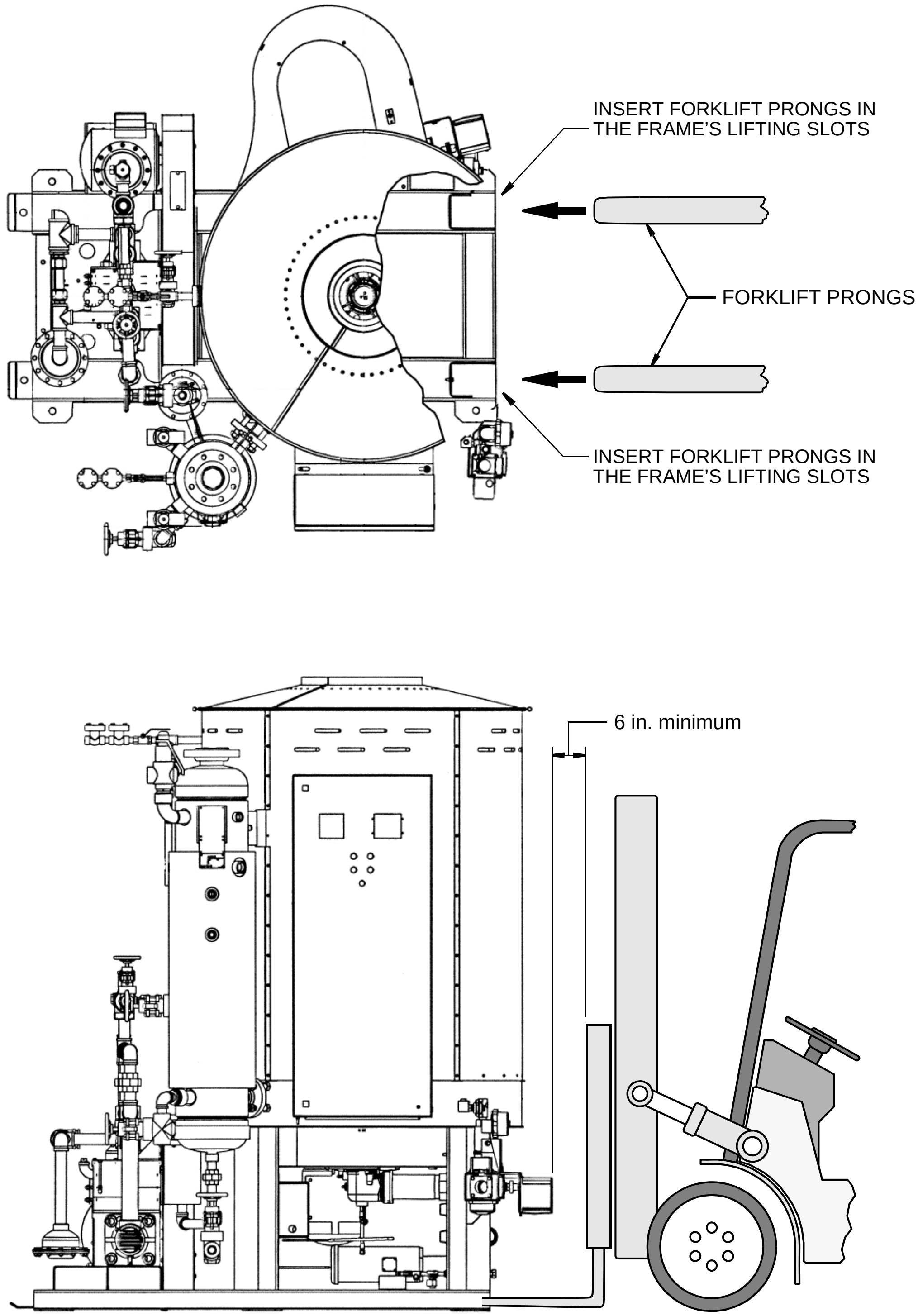

Fig. 1 - Use a forklift truck to for moving SigmaFire Steam Generators

Lifting Instructions (See Fig. 1 above.)

1. Use appropriate-sized forklift truck for lifting and moving a SigmaFire Steam Generator/Fluid Heater.
2. Lift unit from heating coil side.
3. Insert forklift prongs in the lifting slots in the frame of the unit.

CAUTION

DO NOT lift from any other part of the unit except from the lifting slots!

4. Maintain a minimum clearance of six inches between the forklift and any component of the unit.

NOTES

Appendix B

Saturated Steam Pressure-Temperature Table

GAUGE PRESSURE PSIG	TEMP F	GAUGE PRESSURE kPa	TEMP C	GAUGE PRESSURE PSIG	TEMP F	GAUGE PRESSURE kPa	TEMP C	GAUGE PRESSURE PSIG	TEMP F	GAUGE PRESSURE kPa	TEMP C
60	308	413.6	153	270	413	1,861.5	211	600	489	4,136.8	254
70	316	482.6	158	280	416	1,930.5	213	650	497	4,481.6	259
80	324	551.5	162	290	419	1,999.4	215	725	509	4,998.7	265
90	331	620.5	166	300	422	2,068.4	217	750	513	5,171.1	267
100	338	689.4	170	310	425	2,137.3	218	775	517	5,343.4	269
110	344	758.4	173	320	428	2,206.3	220	800	520	5,515.8	271
120	350	827.3	177	330	431	2,275.2	222	825	524	5,688.2	273
130	356	896.3	180	340	433	2,344.2	223	850	527	5,860.5	275
140	361	965.2	183	350	436	2,413.2	224	875	531	6,032.9	277
150	366	1,034.2	186	360	438	2,482.1	226	900	534	6,205.3	279
160	370	1,103.2	188	370	441	2,551.1	227	925	537	6,377.7	281
170	375	1,172.1	191	380	443	2,620.0	229	950	540	6,550.0	282
180	380	1,241.0	193	390	445	2,689.0	230	975	543	6,722.4	284
190	384	1,310.0	196	400	448	2,757.9	231	1000	546	6,894.8	286
200	388	1,378.9	198	410	450	2,826.9	233	1050	552	7,239.5	289
210	392	1,447.9	200	420	453	2,895.7	234	1100	558	7,584.2	292
220	396	1,516.8	202	440	457	3,033.6	236	1150	564	7,929.0	295
230	399	1,585.7	204	460	462	3,171.5	239	1200	569	8,273.7	298
240	403	1,654.7	206	480	466	3,309.4	241	1250	574	8,618.4	301
250	406	1,723.6	208	500	470	3,447.3	243	1300	579	8,963.2	304
260	409	1,792.6	210	550	480	3,792.1	249	1350	584	9,307.9	307

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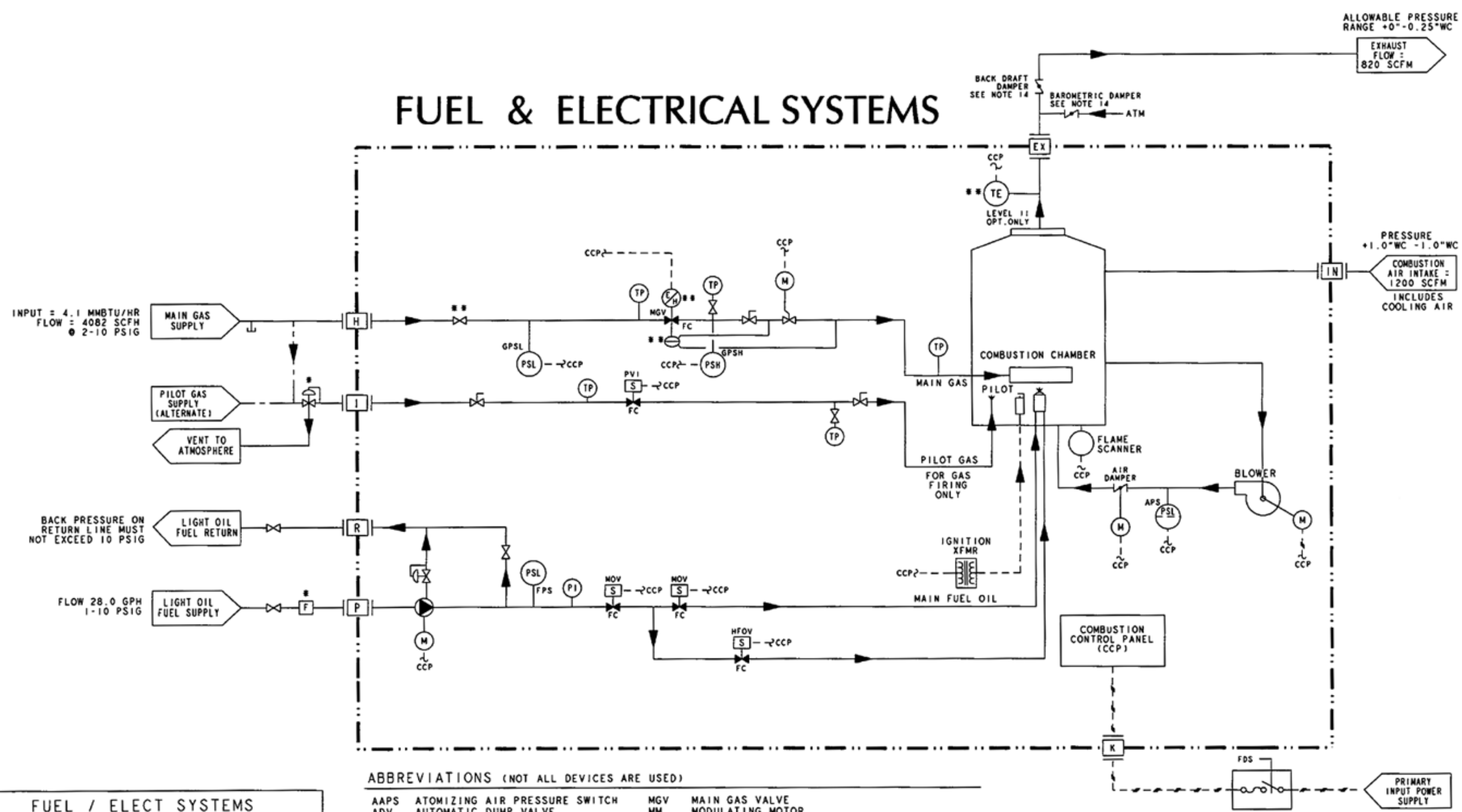
Appendix C

Piping and Instrumentation
Diagrams
(P & I D)

Contents

FUEL & ELECTRICAL SYSTEMS



LEGEND (NOT ALL DEVICES ARE USED)

- VALVE
- GLOBE VALVE
- NEEDLE VALVE
- GAS COCK VALVE
- VALVE WITH HANDWHEEL
- MODULATING VALVE
- DAMPER
- STOP CHECK STRAIGHT VALVE
- CHECK VALVE
- PNEUMATIC CONTROL VALVE
- PRESSURE REGULATOR
- BACK PRESSURE REGULATOR
- DIFFERENTIAL REGULATOR
- SOLENOID VALVE (NORM. OPEN)
- SOLENOID VALVE (NORM. CLOSED)
- MOTOR ACTUATOR BALL VALVE
- ELECTRIC / HYDRAULIC ACTUATED VALVE (NORM. CLOSED)
- ELECTRIC / PNEUMATIC ACTUATED VALVE (NORM. OPEN)
- VACUUM BREAKER
- SAFETY RELIEF VALVE
- STRAINER
- FILTER
- ORIFICE/ RESTRICTOR
- FUNNEL DRAIN
- DROP LEG / CAP
- TURBINE FLOW METER
- FLEX COUPLING (2 FT MIN)
- SPARK PLUG
- PUMP
- STEAM TRAP
- CURRENT / PNEUMATIC POSITIONER
- ELECTRIC MOTOR / ACTUATOR
- INSTRUMENT - NON-ACCESSIBLE
- INSTRUMENT - FIELD MOUNTED
- INSTRUMENT - PANEL MOUNTED
- ELECTRICAL SIGNAL
- CAPILLARY SIGNAL
- MECHANICAL LINK
- PNEUMATIC SIGNAL
- THREE-PHASE ELECTRICAL
- CLAYTON EQUIPMENT BOUNDARY
- ALTERNATE EQUIPMENT

FUEL / ELECT SYSTEMS CUSTOMER CONNECTIONS

EX	11.88" OUTER DIAMETER	EXHAUST
H	1 1/2" FPT (2-10 PSI SUPPLY)	MAIN GAS INLET
I	1/2" FPT	PILOT GAS INLET
IN	N/A	COMBUSTION AIR INLET
K	1 3/8" OPENING	ELECTRICAL INLET (CCP)
P	3/8" FPT	LIGHT OIL INLET
R	3/8" FPT	LIGHT OIL RETURN

ABBREVIATIONS (NOT ALL DEVICES ARE USED)

AAPS	ATOMIZING AIR PRESSURE SWITCH	MGV	MAIN GAS VALVE
ADV	AUTOMATIC DUMP VALVE	MM	MODULATING MOTOR
APS	AIR PRESSURE SWITCH	MOV	MAIN OIL VALVE
ASV	AIR SOLENOID VALVE	MPS	MODULATING PRESS. SWITCH
ATM	ATMOSPHERE	MWV	MAKE-UP WATER VALVE
ATS	AUXILIARY TEMPERATURE SWITCH	OPS	OPERATING PRESSURE SWITCH
CAPS	COOLING AIR PRESS. SWITCH	OPX	OPERATING PRESS. TRANSDUCER
CBV	CONTINUOUS BLEED VALVE	PAV	PILOT AIR VALVE
CC	CONDUCTIVITY CONTROLLER	PC	PRESSURE CONTROL
CE	CONDUCTIVITY ELEMENT	PI	PRESSURE INDICATOR
CWS	COOLING WATER SOLENOID	PPS	PILOT PRESSURE SWITCH - LOW
FC	FAIL CLOSED	PS	PRESSURE SWITCH
FDS	FUSED DISCONNECT SWITCH	PT	PRESSURE TRANSDUCER
FI	FAIL INDETERMINATE	PV	PILOT VALVE
FL	FAIL LOCKED	PVV	PILOT VENT VALVE
FO	FAIL OPEN	SSGV	SAFETY SHUTOFF GAS VALVE
FPS	FUEL PRESSURE SWITCH - LOW	SSOV	SAFETY SHUTOFF OIL VALVE
FPX	FEEDWATER PRESS. TRANSDUCER	TC	TEMPERATURE CONTROL
GFV	GRAVITY FILL VALVE	TDS	TOTAL DISSOLVED SOLIDS
GPSH	GAS PRESSURE SWITCH - HIGH	TDV	TDS DUMP VALVE
GPSL	GAS PRESSURE SWITCH - LOW	TE	TEMPERATURE ELEMENT
HFOV	HIGH FIRE OIL VALVE	TI	TEMPERATURE INDICATOR
LC	LEVEL CONTROL	TP	TEST PORT
LE	LEVEL ELEMENT	TS	TEMPERATURE SWITCH
LI	LEVEL INDICATOR	TCV	TEMPERATURE CONTROL VALVE
LPS	LIMIT PRESSURE SWITCH	VV	VENT VALVE
LS	LEVEL SWITCH		

LTR	REVISION	BY	DATE	CHK
F	UPDATED DRAWING	MY	05-08-09	
E	SEE SHT 2.	CH	02-25-08	
D	REVISED OIL SECTIONS	JL	10-18-07	RY
C	SEE SHEET 2	JL	09-13-07	RY
B	SEE SHEET 2	JL	06-21-07	RY
A	ORIGINAL DRAWING	JL	01-NOV-06	RY

FOR PLATING ALLOWANCE, MICRO FINISH AND GENERAL MANUFACTURING TOLERANCES NOT SPECIFIED ON THIS DRAWING, SEE ENG. ORDER EO-1148

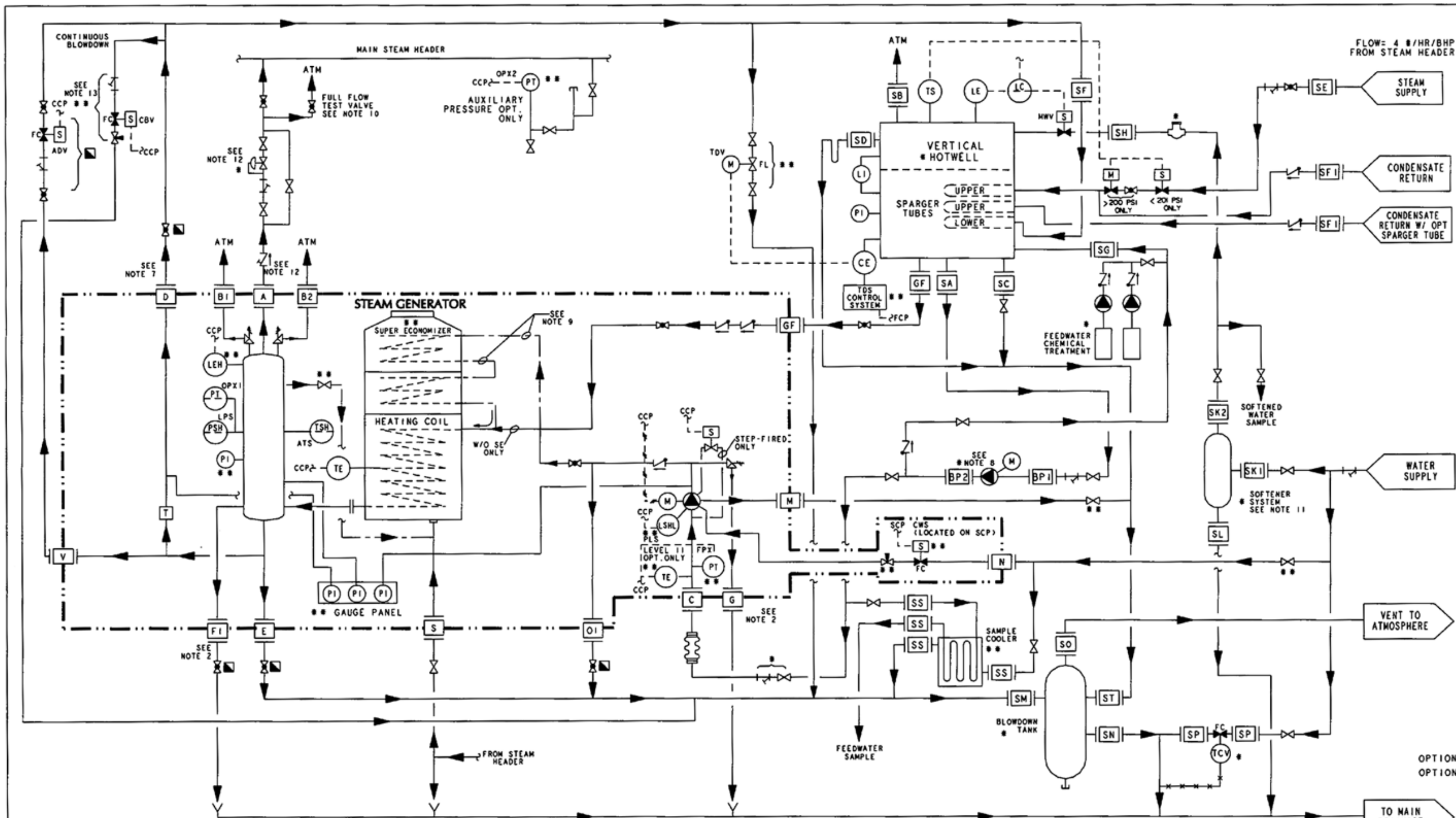
TOLERANCES EXCEPT AS NOTED: ± .50; .X ± 0.3; .XX ± 0.030; ANGULAR ± 1/2°

CLAYTON INDUSTRIES CITY OF INDUSTRY CA., 91744

P&ID (S)SFOG-100M/SF HOTWELL W/ NO SKID

SCALE: NTS — MODEL/TYPE: (S)SFOG-100M/SF — F — R019477 — D

SHEET 1 OF 2



WATER / STEAM SYSTEMS

CUSTOMER CONNECTIONS		
SA	1 1/2" FPT	HOTWELL FEEDWATER OUTLET
SB	3" FPT	HOTWELL VENT
SC	1" FPT	HOTWELL DRAIN
SD	2 1/2" FPT	HOTWELL OVERFLOW
SE	3/4"FPT (MP/HP) 1 1/4" FPT(LP)	HOTWELL STEAM SUPPLY
SF	1 1/2" FPT	TRAP RETURN
SF1	1" FPT	CONDENSATE RETURN
SF1	1 1/2" FPT	OPT CONDENSATE RETURN
SG	3/4" FPT	CHEM. INJECTION/BP RECIRC
SH	1/2" FPT	MAKEUP WATER INLET
SK1 SK2	1" FPT	SOFTENER INLET/OUTLET
SL	1" FPT	SOFTENER DRAIN
SM	1" MPT	BLOWDOWN TANK INLET
SN	1 1/2" FPT	BLOWDOWN TANK DISCHARGE
SO	2 1/2" MPT	BLOWDOWN TANK VENT
SP	3/4" FPT	BLOWDOWN COOLING WATER
SS	3/8" FPT	SAMPLE COOLER CONNECTIONS
ST	2" FPT	BLOWDOWN - HW OVERFLOW
BP1	1 1/4" FPT (MP) 1 1/2" FPT (LP)	BOOSTER PUMP INLET
BP2	1" FPT (MP) 2" FPT (LP)	BOOSTER PUMP OUTLET

	SG CUSTOMER CONNECTIONS		
	A	3" FPT (LOW PRESS.) 2" FPT (STD) 2 1/2" 300# RF FLG (HIEFF)	SEPARATOR OUTLET
	B1	15 PSI: 4" FPT 125 PSI: 1 1/4" FPT 150-200 PSI: 1 1/2" FPT 250-300 PSI: 1 1/4" FPT	SAFETY VALVE OUTLET
	B2	125 PSI: 1 1/4" FPT	SAFETY VALVE OUTLET
	C	2" FPT	FEEDWATER INLET
	D	1" FPT	STEAM TRAP OUTLET
	E	1" FPT	SEPARATOR /BLOWDOWN DRAIN
	F1	1 1/4" FPT 1"FPT (W/OPT VLV KIT)	COIL DRAIN
	G	1/2" FPT	PUMP RELIEF VALVE
	GF	1/2" FPT	GRAVITY FILL
OPTIONAL	M	1/4" FPT	PUMP HEAD COOLING OUTLET
OPTIONAL	N	1/4" FPT	PUMP HEAD COOLING INLET
	O1	3/4" FPT	COIL BLOWDOWN
	S	3/4" MPT	SOOT BLOWER
OPTIONAL	V	1" FPT	AUTO DUMP VALVE

NOTES:

1. ALL INTERCONNECT PIPING SHALL BE SIZED TO ALLOW PROPER FLOW. NO INTERCONNECT PIPING SHALL BE REDUCED BELOW LARGEST CONNECTION SIZE OF EQUIPMENT SUPPLIED BY CLAYTON INDUSTRIES. MANIFOLDING OF COMMON CONNECTIONS MUST INCLUDE HEADER PIPE SIZE DERATING TO PROPERLY HANDLE TOTAL FLOW.
2. CUSTOMER DRAIN CONNECTIONS [F1], & [G] MUST BE PIPED TO OPEN DRAIN TO PROVIDE A VISIBLE MEANS OF DETECTING WATER CONTAMINATION IN THE HEATING COIL AND LEAKAGE OF THE RELIEF VALVE.
3. ALL PIPE SIZES SHOWN ARE CONNECTION SIZES ONLY. IT IS THE INSTALLERS RESPONSIBILITY TO INCREASE PIPE SIZES AS NECESSARY TO ACHIEVE SPECIFIED FLOW VALUES. CLAYTON INSTALLATION INSTRUCTIONS MUST BE FOLLOWED AT ALL TIMES.
4. # DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS SHIPPED LOOSE AND MUST BE INSTALLED BY OTHERS.
5. ## DENOTES OPTIONAL EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. ITEMS SHOWN WITHIN CLAYTON SUPPLIED BOUNDARIES ARE INSTALLED BY CLAYTON WHEN PURCHASED. IF EXTERNAL TO BOUNDARIES, ITEMS ARE SHIPPED LOOSE WHEN PURCHASED AND INSTALLED BY CUSTOMER.
6. ◪ DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS INSTALLED BY CLAYTON WHEN PURCHASED FROM CLAYTON.
7. INCREASE ONE FULL PIPE SIZE AFTER FIRST ELBOW.
8. BOOSTER PUMPS REQUIRED IF RECEIVER TANK ELEVATION CANNOT PROVIDE SUFFICIENT NPSH TO FEEDWATER PUMP.
9. RELEVANT ONLY TO SE OPTION.
10. A FULL FLOW ATMOSPHERIC TEST VALVE IS REQUIRED AND MUST BE READILY ACCESSIBLE. INSTALL A CHAIN OPERATOR ON STOP AND TEST VALVES.
11. WATER SOFTENER REQUIRED IF DEMINERALIZED WATER / RO SYSTEM IS NOT AVAILABLE.
12. A BACK PRESSURE REGULATOR VALVE IS RECOMMENDED ON ALL INSTALLATIONS. A BACK PRESSURE REGULATOR VALVE AND A STOP CHECK VALVE ARE REQUIRED ON APC, AUTO START / STOP, MASTER LEAD LAG, MULTIPLE UNIT INSTALLATIONS AND / OR DESIGN STEAMING PRESSURES OF BELOW 65 PSIG.
13. CUSTOMER MUST INSTALL CLAYTON AVAILABLE CONTINUOUS BLEED VALVE KIT, AUTO TDS CONTROLLER KIT OR PROVIDE OTHER MEANS TO CONTROL THE TDS LEVEL IN THE SYSTEM.
14. BAROMETRIC DAMPER MAY BE REQUIRED TO MAINTAIN REQUIRED STACK DRAFT OF 0.00-0.25 WCI. BACK DRAFT DAMPER REQUIRED IN COLD WEATHER INSTALLATIONS TO PROTECT HEATING COIL FROM FREEZING.
15. REFER TO INSTALLATION MANUAL R-16600 FOR GENERAL INSTALLATION GUIDELINES AND RECOMMENDATIONS. RESPONSIBLITY TO MEET ALL APPLICABLE CODES AND STANDARDS SHALL BE BY OTHERS.
16. OIL & GAS MANIFOLDS ARE TWO SEPARATE ASSEMBLIES. THEY MUST BE MANUALLY CHANGED OUT PER REQUIREMENT.

LTR	REVISION	BY	DATE	CHK
F	UPDATED DRAWING	MY	05-08-09	
E	REMOVE ALL RE-CONN; REVISE PUMP COOLING LINE.	CH	02-25-08	RY
D	SEE SHEET 1	JL	10-8-07	RY
C	REVISED CUSTOMER CONN., ADD NOTE 8	JL	09-13-07	RY
B	REVISED TRAP RETURN PLUMBING	JL	06-21-07	RY
A	ORIGINAL DRAWING	JL	01-NOV-06	RY

DO NOT SCALE PRINT

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TOLERANCES EXCEPT AS NOTED: FRACTION ± .50; .X ± 0.3; .XX ± 0.030; ANGULAR ± 1/2°

FINISH SPECIFICATION

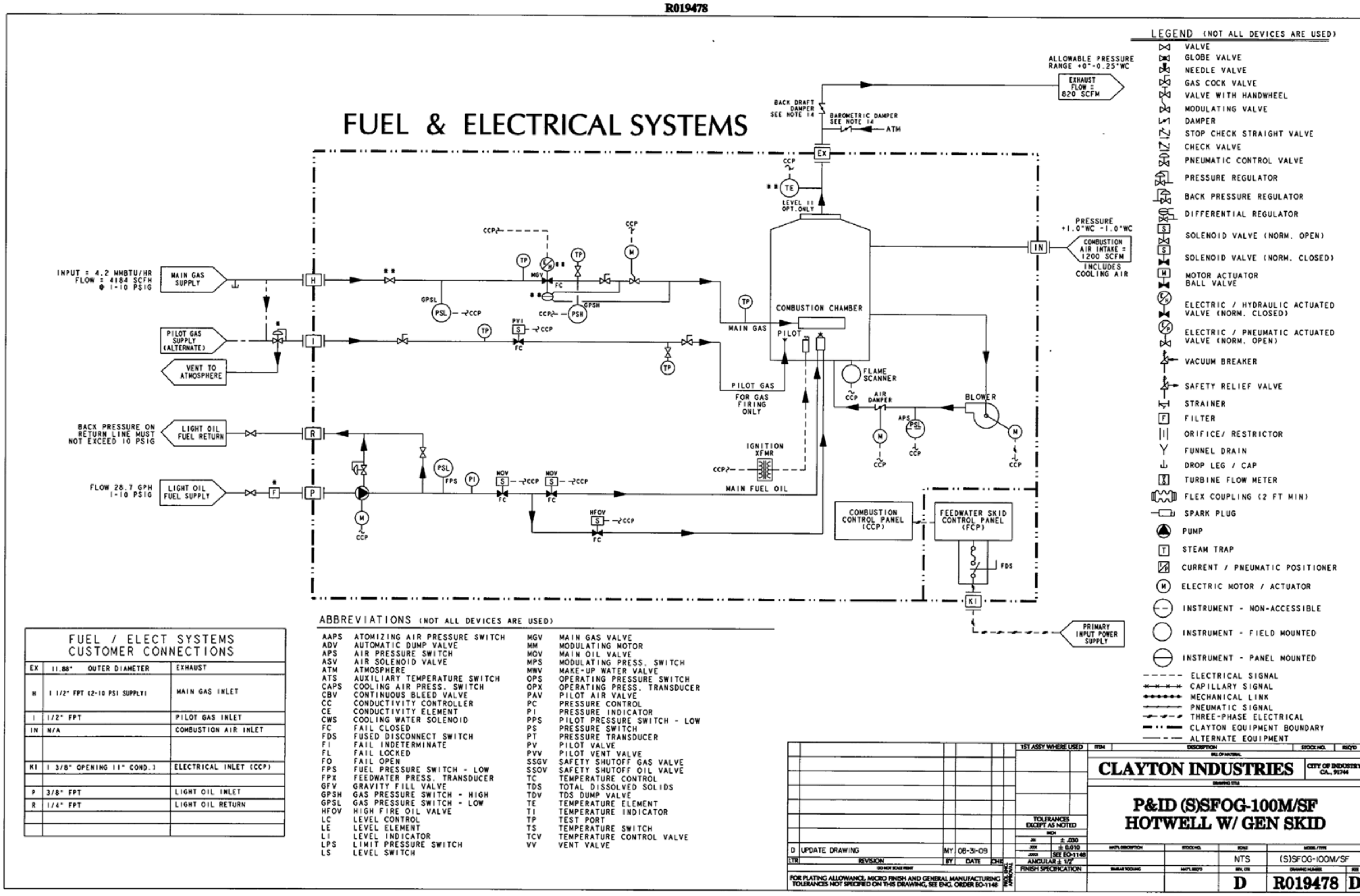
CLAYTON INDUSTRIES — CITY OF INDUSTRY CA., 91744

P&ID (S)SFOG-100M/SF HOTWELL W/ NO SKID

NTS — (S)SFOG-100M/SF

F — R019477 — D

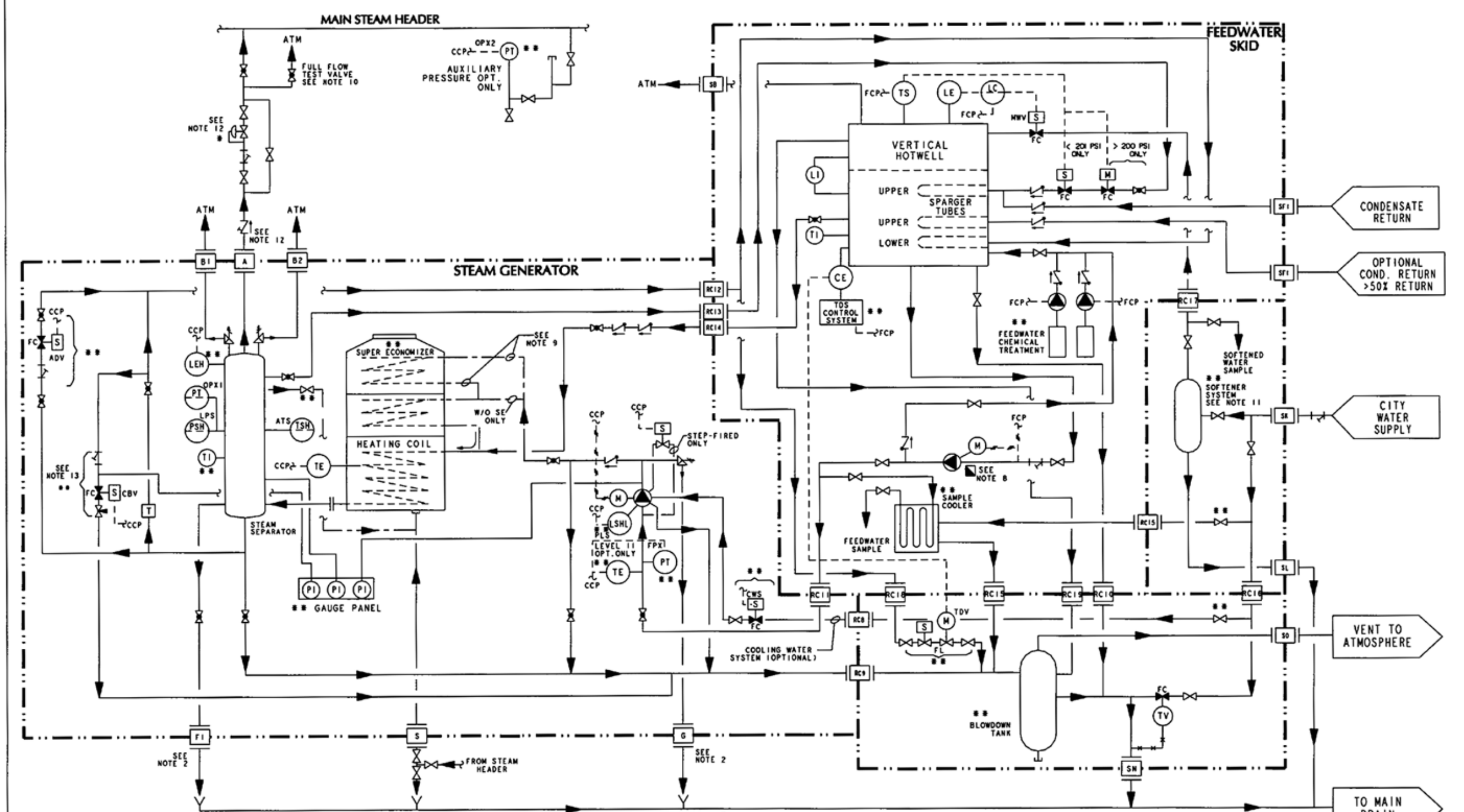
SHEET 2 OF 2



FUEL / ELECT SYSTEMS CUSTOMER CONNECTIONS

EX	11.88" OUTER DIAMETER	EXHAUST
H	1 1/2" FPT (2-10 PSI SUPPLY)	MAIN GAS INLET
I	1/2" FPT	PILOT GAS INLET
IN	N/A	COMBUSTION AIR INLET
KI	1 3/8" OPENING (1" COND.)	ELECTRICAL INLET (CCP)
P	3/8" FPT	LIGHT OIL INLET
R	1/4" FPT	LIGHT OIL RETURN

R019478



WATER / STEAM SYSTEMS

CUSTOMER CONNECTIONS

SB	3" FPT	HOTWELL VENT
SF1	1" FPT	CONDENSATE RETURN
SF1	1 1/2" FPT	OPTIONAL CONDENSATE RETURN
SK	1" FPT	WATER SUPPLY INLET
SL	1" FPT	SOFTENER DRAIN
SN	1 1/2" FPT	BLOWDOWN TANK DISCHARGE
SO	2 1/2" MPT	BLOWDOWN TANK VENT

SG CUSTOMER CONNECTIONS

A	3" FPT (LP, STD) 2" FPT (STD)	STD SEPARATOR OUTLET
	4" 150# RF FLG (LP, HIEFF) 2 1/2" 300# RF FLG (HIEFF)	HIGH EFF SEPARATOR OUTLET
B1	15 PSI= 4" FPT 125 PSI= 1 1/4" FPT 150-200 PSI= 1 1/2" FPT 250-500 PSI= 1 1/4" FPT	SAFETY VALVE OUTLET
B2	125 PSI=1 1/4" FPT	SAFETY VALVE OUTLET
F1	1" FPT	COIL DRAIN
G	1/2" FPT	PUMP RELIEF VALVE
S	3/4" MPT	SOOT BLOWER

CUSTOMER RECONNECTIONS

RC8	COOLING WATER SUPPLY
RC9	BLOWDOWN INLET
RC10	HOTWELL DRAIN
RC11	FEEDWATER PUMP
RC12	TRAP/ CONDENSATE RETURN
RC13	STEAM HEATER/ HOTWELL
RC14	GRAVITY FILL
RC15	SAMPLE COOLER SUPPLY/DRAIN
RC16	BLOWDOWN PUMP HEAD COOLING
RC17	SOFTENED WATER RECONNECT
RC18	TDS CONTROL
RC19	HOTWELL OVERFLOW

NOTES:

1. ALL INTERCONNECT PIPING SHALL BE SIZED TO ALLOW PROPER FLOW. NO INTERCONNECT PIPING SHALL BE REDUCED BELOW LARGEST CONNECTION SIZE OF EQUIOPMENT SUPPLIED BY CLAYTON INDUSTRIES. MANIFOLDING OF COMMON CONNECTIONS MUST INCLUDE HEADER PIPE SIZE DERATING TO PROPERLY HANDLE TOTAL FLOW.
2. CUSTOMER DRAIN CONNECTIONS F1, & G MUST BE PIPED TO OPEN DRAIN TO PROVIDE A VISIBLE MEANS OF DETECTING WATER CONTAMINATION IN THE HEATING COIL AND LEAKAGE OF THE RELIEF VALVE.
3. ALL PIPE SIZES SHOWN ARE CONNECTION SIZES ONLY. IT IS THE INSTALLERS RESPONSIBILITY TO INCREASE PIPE SIZES AS NECESSARY TO ACHIEVE SPECIFIED FLOW VALUES. CLAYTON INSTALLATION INSTRUCTIONS MUST BE FOLLOWED AT ALL TIMES.
4. * DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS SHIPPED LOOSE AND MUST BE INSTALLED BY OTHERS.
5. ** DENOTES OPTIONAL EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. ITEMS SHOWN WITHIN CLAYTON SUPPLIED BOUNDARIES ARE INSTALLED BY CLAYTON WHEN PURCHASED. IF EXTERNAL TO BOUNDARIES, ITEMS ARE SHIPPED LOOSE WHEN PURCHASED AND INSTALLED BY CUSTOMER.
6. ◪ DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS INSTALLED BY CLAYTON WHEN PURCHASED FROM CLAYTON.
7. NOT USED.
8. NOT USED.
9. RELEVANT ONLY TO SE OPTION.
10. A FULL FLOW ATMOSPHERIC TEST VALVE IS REQUIRED AND MUST BE READILY ACCESSIBLE. INSTALL A CHAIN OPERATOR ON STOP AND TEST VALVES.
11. WATER SOFTENER REQUIRED IF DEMINERALIZED WATER / RO SYSTEM IS NOT AVAILABLE.
12. A BACK PRESSURE REGULATOR VALVE IS RECOMMENDED ON ALL INSTALLATIONS. A BACK PRESSURE REGULATOR VALVE AND A STOP CHECK VALVE ARE REQUIRED ON APC, AUTO START / STOP, MASTER LEAD LAG, MULTIPLE UNIT INSTALLATIONS AND / OR DESIGN STEAMING PRESSURES OF BELOW 65 PSIG.
13. CUSTOMER MUST INSTALL CLAYTON AVAILABLE CONTINUOUS BLEED VALVE KIT, AUTO TDS CONTROLLER KIT OR PROVIDE OTHER MEANS TO CONTROL THE TDS LEVEL IN THE SYSTEM.
14. BAROMETRIC DAMPER MAY BE REQUIRED TO MAINTAIN REQUIRED STACK DRAFT OF 0.00-0.25 WCI. BACK DRAFT DAMPER REQUIRED IN COLD WEATHER INSTALLATIONS TO PROTECT HEATING COIL FROM FREEZING.
15. REFER TO INSTALLATION MANUAL R-16600 FOR GENERAL INSTALLATION GUIDELINES AND RECOMMENDATIONS. RESPONSIBLITY TO MEET ALL APPLICABLE CODES AND STANDARDS SHALL BE BY OTHERS.

LTR	REVISION	BY	DATE
D	UPDATE DRAWING	MY	08-31-09

FOR PLATING ALLOWANCE, MICRO FINISH AND GENERAL MANUFACTURING TOLERANCES NOT SPECIFIED ON THIS DRAWING, SEE ENG. ORDER EO-1148

TOLERANCES EXCEPT AS NOTED: .XX ± .030, .XXX ± 0.010, .XXXX SEE EO-1148, ANGULAR ± 1/2°

CLAYTON INDUSTRIES CITY OF INDUSTRY CA., 91744

P&ID (S)SFOG-100M/SF HOTWELL W/ GEN SKID

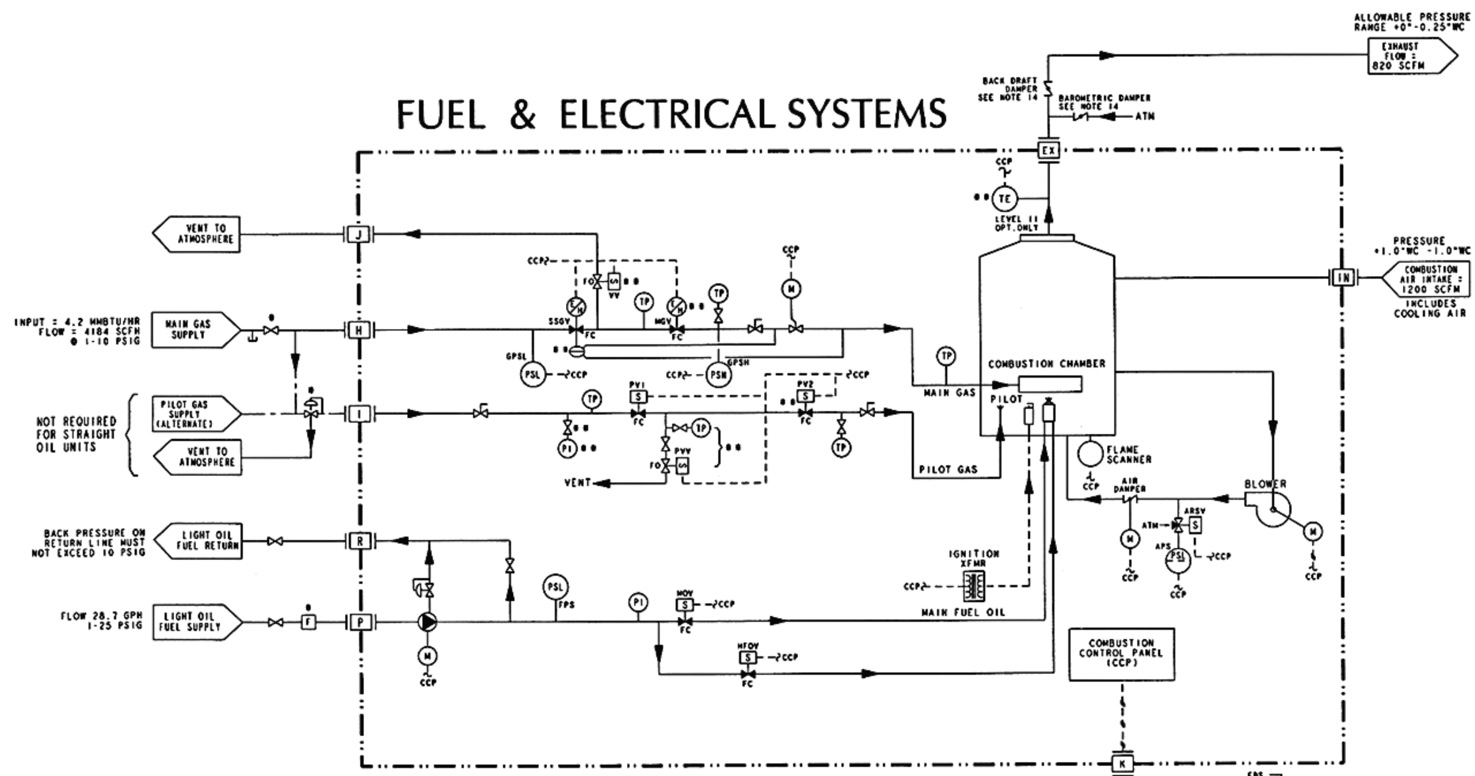
NTS (S)SFOG-100M/SF

D R019478 D

SHEET 2 OF 2

R019520

FUEL & ELECTRICAL SYSTEMS



LEGEND (NOT ALL DEVICES ARE USED)

- VALVE
- GLOBE VALVE
- NEEDLE VALVE
- GAS COCK VALVE
- VALVE WITH HANDWHEEL
- MODULATING VALVE
- DAMPER
- STOP CHECK STRAIGHT VALVE
- CHECK VALVE
- PNEUMATIC CONTROL VALVE
- PRESSURE REGULATOR
- BACK PRESSURE REGULATOR
- DIFFERENTIAL REGULATOR
- SOLENOID VALVE (NORM. OPEN)
- SOLENOID VALVE (NORM. CLOSED)
- ELECTRIC / HYDRAULIC ACTUATED VALVE (NORM. CLOSED)
- ELECTRIC / PNEUMATIC ACTUATED VALVE (NORM. OPEN)
- VACUUM BREAKER
- SAFETY RELIEF VALVE
- STRAINER
- FILTER
- ORIFICE/ RESTRICTOR
- FUNNEL DRAIN
- DROP LEG / CAP
- TURBINE FLOW METER
- FLEX COUPLING (2 FT MIN)
- SPARK PLUG
- PUMP
- STEAM TRAP
- CURRENT / PNEUMATIC POSITIONER
- ELECTRIC MOTOR / ACTUATOR
- INSTRUMENT - NON-ACCESSIBLE
- INSTRUMENT - FIELD MOUNTED
- INSTRUMENT - PANEL MOUNTED
- ELECTRICAL SIGNAL
- CAPILLARY SIGNAL
- MECHANICAL LINK
- PNEUMATIC SIGNAL
- THREE-PHASE ELECTRICAL
- CLAYTON EQUIPMENT BOUNDARY
- ALTERNATE EQUIPMENT

FUEL / ELECT SYSTEMS CUSTOMER CONNECTIONS

EX	11.88" OUTER DIAMETER	EXHAUST
H	1 1/2" FPT (1-10 PSI SUPPLY)	MAIN GAS INLET
I	1/2" FPT	PILOT GAS INLET
IN	N/A	COMBUSTION AIR INLET
J	3/4" FPT(1-10 PSI SUPPLY)	GAS BLEED VALVE
K	1 3/8" OPENING	ELECTRICAL INLET (CCP)
P	3/8" FPT	LIGHT OIL INLET
R	3/8" FPT	LIGHT OIL RETURN

ABBREVIATIONS (NOT ALL DEVICES ARE USED)

AAPS	ATOMIZING AIR PRESSURE SWITCH	MGV	MAIN GAS VALVE
ADV	AUTOMATIC DUMP VALVE	MM	MODULATING MOTOR
APS	AIR PRESSURE SWITCH	MOV	MAIN OIL VALVE
ASV	AIR SOLENOID VALVE	MPS	MODULATING PRESS. SWITCH
ATM	ATMOSPHERE	MWV	MAKE-UP WATER VALVE
ATS	AUXILIARY TEMPERATURE SWITCH	OPS	OPERATING PRESSURE SWITCH
CAPS	COOLING AIR PRESS. SWITCH	OPX	OPERATING PRESS. TRANSDUCER
CBV	CONTINUOUS BLEED VALVE	PAV	PILOT AIR VALVE
CC	CONDUCTIVITY CONTROLLER	PC	PRESSURE CONTROL
CE	CONDUCTIVITY ELEMENT	PI	PRESSURE INDICATOR
CWS	COOLING WATER SOLENOID	PPS	PILOT PRESSURE SWITCH - LOW
FC	FAIL CLOSED	PS	PRESSURE SWITCH
FDS	FUSED DISCONNECT SWITCH	PT	PRESSURE TRANSDUCER
FI	FAIL INDETERMINATE	PV	PILOT VALVE
FL	FAIL LOCKED	PVV	PILOT VENT VALVE
FO	FAIL OPEN	SSGV	SAFETY SHUTOFF GAS VALVE
FPS	FUEL PRESSURE SWITCH - LOW	SSOV	SAFETY SHUTOFF OIL VALVE
FPX	FEEDWATER PRESS. TRANSDUCER	TC	TEMPERATURE CONTROL
GFV	GRAVITY FILL VALVE	TDS	TOTAL DISSOLVED SOLIDS
GPSH	GAS PRESSURE SWITCH - HIGH	TDV	TDS DUMP VALVE
GPSL	GAS PRESSURE SWITCH - LOW	TE	TEMPERATURE ELEMENT
HFOV	HIGH FIRE OIL VALVE	TI	TEMPERATURE INDICATOR
LC	LEVEL CONTROL	TP	TEST PORT
LE	LEVEL ELEMENT	TS	TEMPERATURE SWITCH
LI	LEVEL INDICATOR	TCV	TEMPERATURE CONTROL VALVE
LPS	LIMIT PRESSURE SWITCH	VV	VENT VALVE
LS	LEVEL SWITCH		

LTR	REVISION	BY	DATE
B	REVISED OIL SECTIONS	JL	10-18-07
A	ORIGINAL DRAWING	JL	22-Nov-06

FOR PLATING ALLOWANCE, MICRO FINISH AND GENERAL MANUFACTURING TOLERANCES NOT SPECIFIED ON THIS DRAWING, SEE ENG. ORDER EO-1148

TOLERANCES EXCEPT AS NOTED: ± .030; ± 0.010; SEE EO-1148; ANGULAR ± 1/2°

CLAYTON INDUSTRIES — CITY OF INDUSTRY CA., 91746

P&ID (S)SFOG-100M/SF HOTWELL W/ WATER SKID

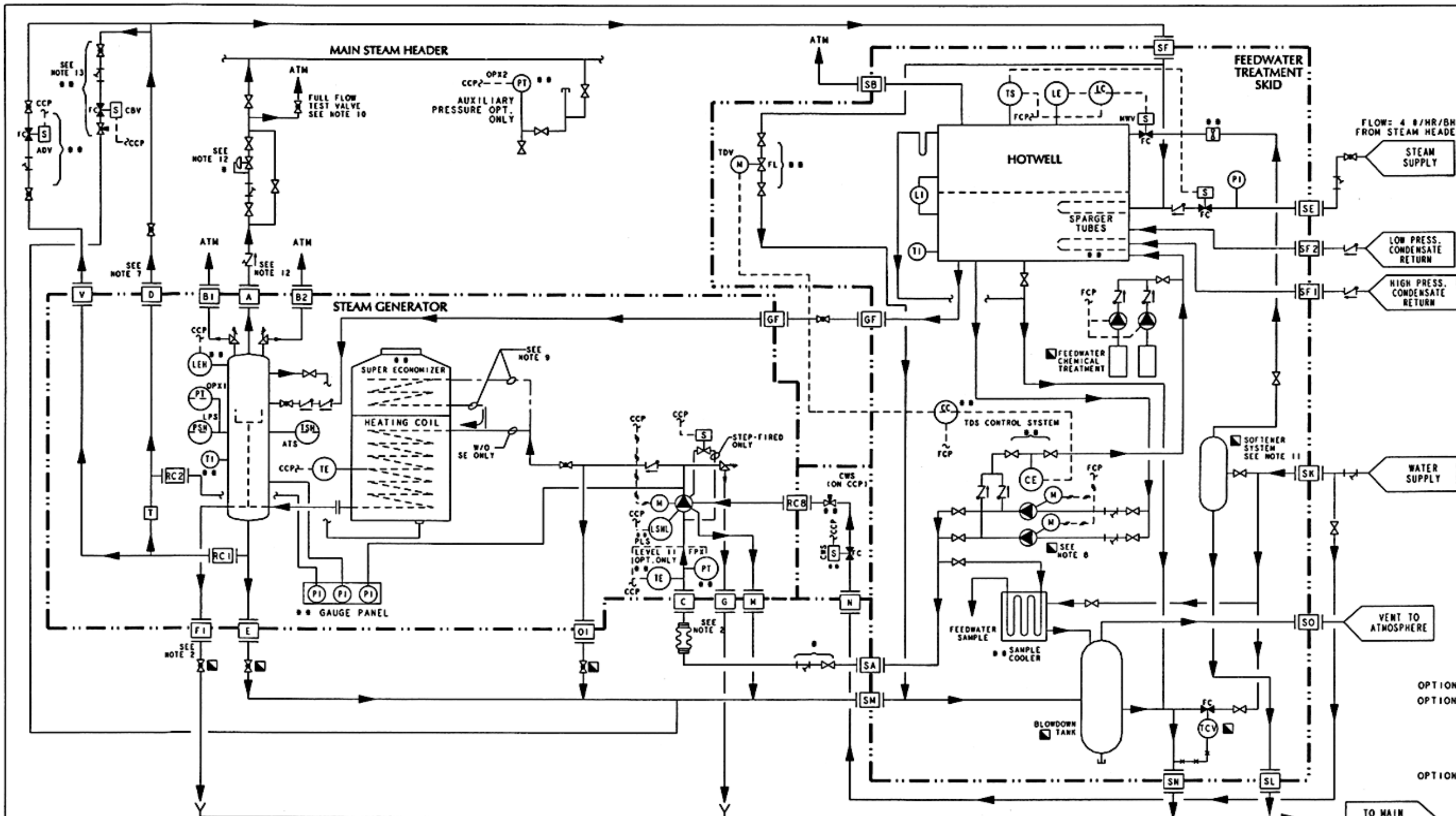
NTS — (S)SFOG-100M/SF

B — R019520 — D

SHEET 1 OF 2

R019520

R019520



WATER / STEAM SYSTEMS

CUSTOMER CONNECTIONS		
SA	1 1/2" FPT	HOTWELL FEEDWATER OUTLET
SB	3" FPT	HOTWELL VENT
SE	3/4"FPT(MP/HP) 1 1/4" FPT(LP)	HOTWELL STEAM SUPPLY
SF	1 1/2" FPT	TRAP RETURN
SF1	1" FPT	HP CONDENSATE RETURN
SF2	1 1/2" FPT	LP CONDENSATE RETURN
SK	1" FPT	SOFTENER INLET
SL	1" FPT	SOFTENER DRAIN
SM	1" MPT	BLOWDOWN TANK INLET
SN	1 1/2" FPT	BLOWDOWN TANK DISCHARGE
SO	2 1/2" MPT	BLOWDOWN TANK VENT

NOTE:
SKID CONNECTION SIZES ARE BASED ON HORSEPOWER OF A SINGLE MACHINE WITHOUT SE OPTION. REFER TO PLAN INSTALL DWG FOR SIZES APPLICABLE TO LARGER HORSEPOWER CAPACITY, SE OPTION AND MULTIPLE UNIT INSTALLATIONS.

	SG CUSTOMER CONNECTIONS		
	A	3" FPT (LOW PRESS.) 2" FPT (STD) 2 1/2" 300# RF FLG (HIEFF)	SEPARATOR OUTLET
	B1	15 PSI=4" FPT 125 PSI=1 1/4" FPT 150-200 PSI= 1 1/2" FPT 250-500 PSI= 1 1/4" FPT	SAFETY VALVE OUTLET
	B2	125 PSI=1 1/4" FPT	SAFETY VALVE OUTLET
	C	2" FPT	FEEDWATER INLET
	D	1" FPT	STEAM TRAP OUTLET
	E	1" FPT	STEAM SEPARATOR BLOWDOWN/DRAIN
	F1	1 1/4" FPT 1"FPT (W/OPT VLV KIT)	COIL DRAIN
	G	1/2" FPT	PUMP RELIEF VALVE
	GF	1/2" FPT	GRAVITY FILL
OPTIONAL	M	1/4" FPT	PUMP HEAD COOLING OUTLET
OPTIONAL	N	1/4" FPT	PUMP HEAD COOLING INLET
	O1	3/4" FPT	COIL BLOWDOWN
OPTIONAL	V	1" FPT	AUTO DUMP VALVE

	CUSTOMER RECONNECTIONS		
	RC1	1" UNION	STEAM TRAP
	RC2	1/4" TUBE	TRAP PI
OPTIONAL	RC8	1/4" TUBE	COOLING WATER

NOTES:

1. ALL INTERCONNECT PIPING SHALL BE SIZED TO ALLOW PROPER FLOW. NO INTERCONNECT PIPING SHALL BE REDUCED BELOW LARGEST CONNECTION SIZE OF EQUIPMENT SUPPLIED BY CLAYTON INDUSTRIES. MANIFOLDING OF COMMON CONNECTIONS MUST INCLUDE HEADER PIPE SIZE DERATING TO PROPERLY HANDLE TOTAL FLOW.
2. CUSTOMER DRAIN CONNECTIONS F1, G MUST BE PIPED TO OPEN DRAIN TO PROVIDE A VISIBLE MEANS OF DETECTING WATER CONTAMINATION IN THE HEATING COIL AND LEAKAGE OF THE RELIEF VALVE.
3. ALL PIPE SIZES SHOWN ARE CONNECTION SIZES ONLY. IT IS THE INSTALLERS RESPONSIBILITY TO INCREASE PIPE SIZES AS NECESSARY TO ACHIEVE SPECIFIED FLOW VALUES. CLAYTON INSTALLATION INSTRUCTIONS MUST BE FOLLOWED AT ALL TIMES.
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6. ◩ DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS INSTALLED BY CLAYTON WHEN PURCHASED FROM CLAYTON.
7. INCREASE ONE FULL PIPE SIZE AFTER FIRST ELBOW.
8. BOOSTER PUMPS REQUIRED IF RECEIVER TANK ELEVATION CANNOT PROVIDE SUFFICIENT NPSH TO FEEDWATER PUMP.
9. RELEVANT ONLY TO SE OPTION.
10. A FULL FLOW ATMOSPHERIC TEST VALVE IS REQUIRED AND MUST BE READILY ACCESSIBLE. INSTALL A CHAIN OPERATOR ON STOP AND TEST VALVES.
11. WATER SOFTENER REQUIRED IF DEMINERALIZED WATER / RO SYSTEM IS NOT AVAILABLE.
12. A BACK PRESSURE REGULATOR VALVE IS RECOMMENDED ON ALL INSTALLATIONS. A BACK PRESSURE REGULATOR VALVE AND A STOP CHECK VALVE ARE REQUIRED ON APC, AUTO START / STOP, MASTER LEAD LAG, MULTIPLE UNIT INSTALLATIONS AND / OR DESIGN STEAMING PRESSURES OF BELOW 65 PSIG.
13. CUSTOMER MUST INSTALL CLAYTON AVAILABLE CONTINUOUS BLEED VALVE KIT, AUTO TDS CONTROLLER KIT OR PROVIDE OTHER MEANS TO CONTROL THE TDS LEVEL IN THE SYSTEM.
14. BAROMETRIC DAMPER MAY BE REQUIRED TO MAINTAIN REQUIRED STACK DRAFT OF 0.00-0.25 WCI. BACK DRAFT DAMPER REQUIRED IN COLD WEATHER INSTALLATIONS TO PROTECT HEATING COIL FROM FREEZING.
15. REFER TO INSTALLATION MANUAL R-16600 FOR GENERAL INSTALLATION GUIDELINES AND RECOMMENDATIONS. RESPONSIBLITY TO MEET ALL APPLICABLE CODES AND STANDARDS SHALL BE BY OTHERS.
16. A HEAD TANK, TO BE ELEVATED AT LEAST 2 FEET ABOVE THE TOP OF THE HEATING COIL, MUST BE PROVIDED WHEN THE BOTTOM OF THE RECEIVER TANK IS NOT HIGHER THAN THE TOP OF THE HEATING COIL.

LTR	REVISION	BY	DATE
B	SEE SHEET 1	JL	10-18-07
A	ORIGINAL DRAWING	JL	22-Nov-06 RY

CLAYTON INDUSTRIES — CITY OF INDUSTRIES CA., 91744

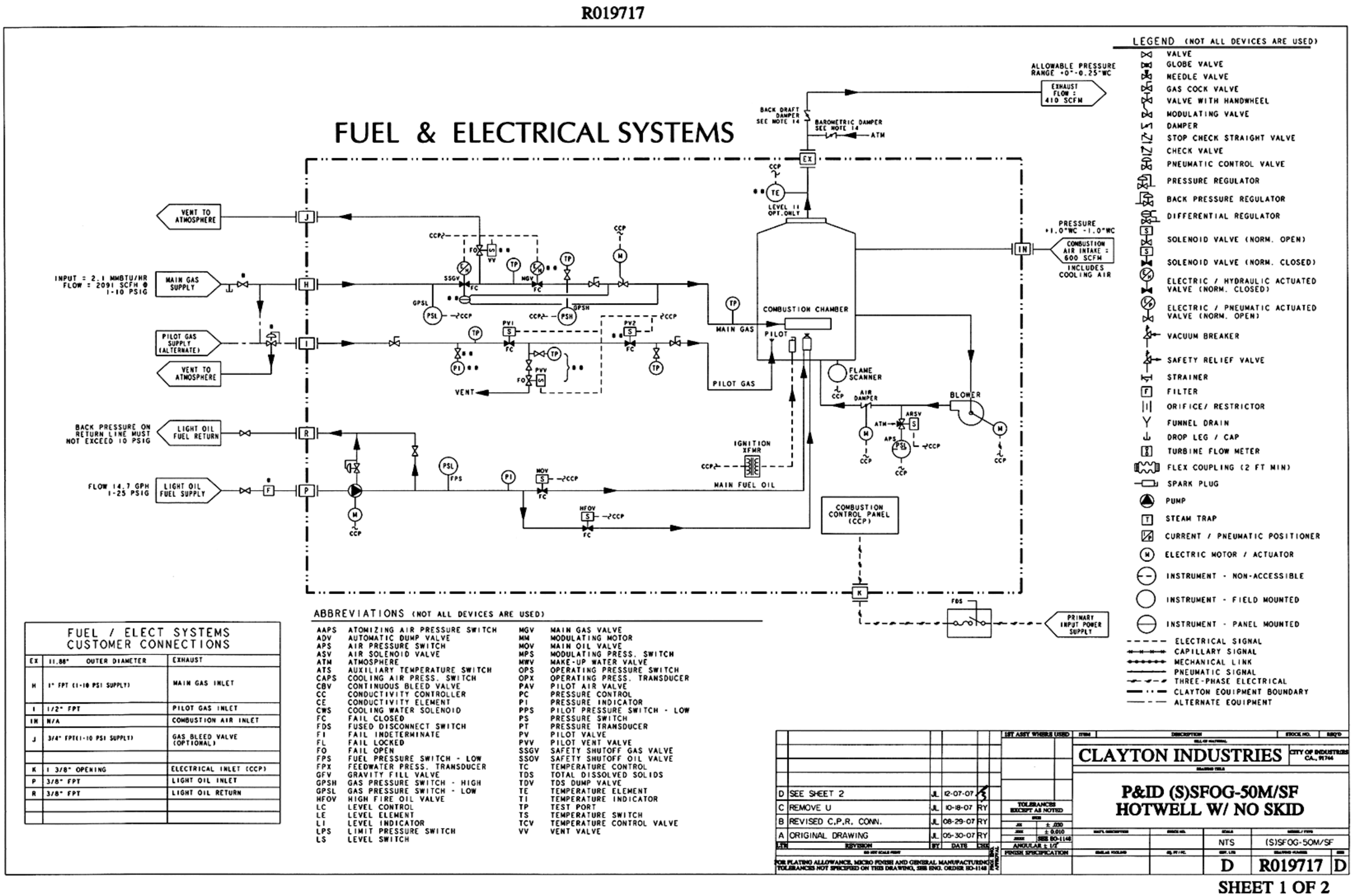
P&ID (S)SFOG-100M/SF HOTWELL W/ WATER SKID

NTS — (S)SFOG-100M/SF

B — R019520 — D

SHEET 2 OF 2

R019520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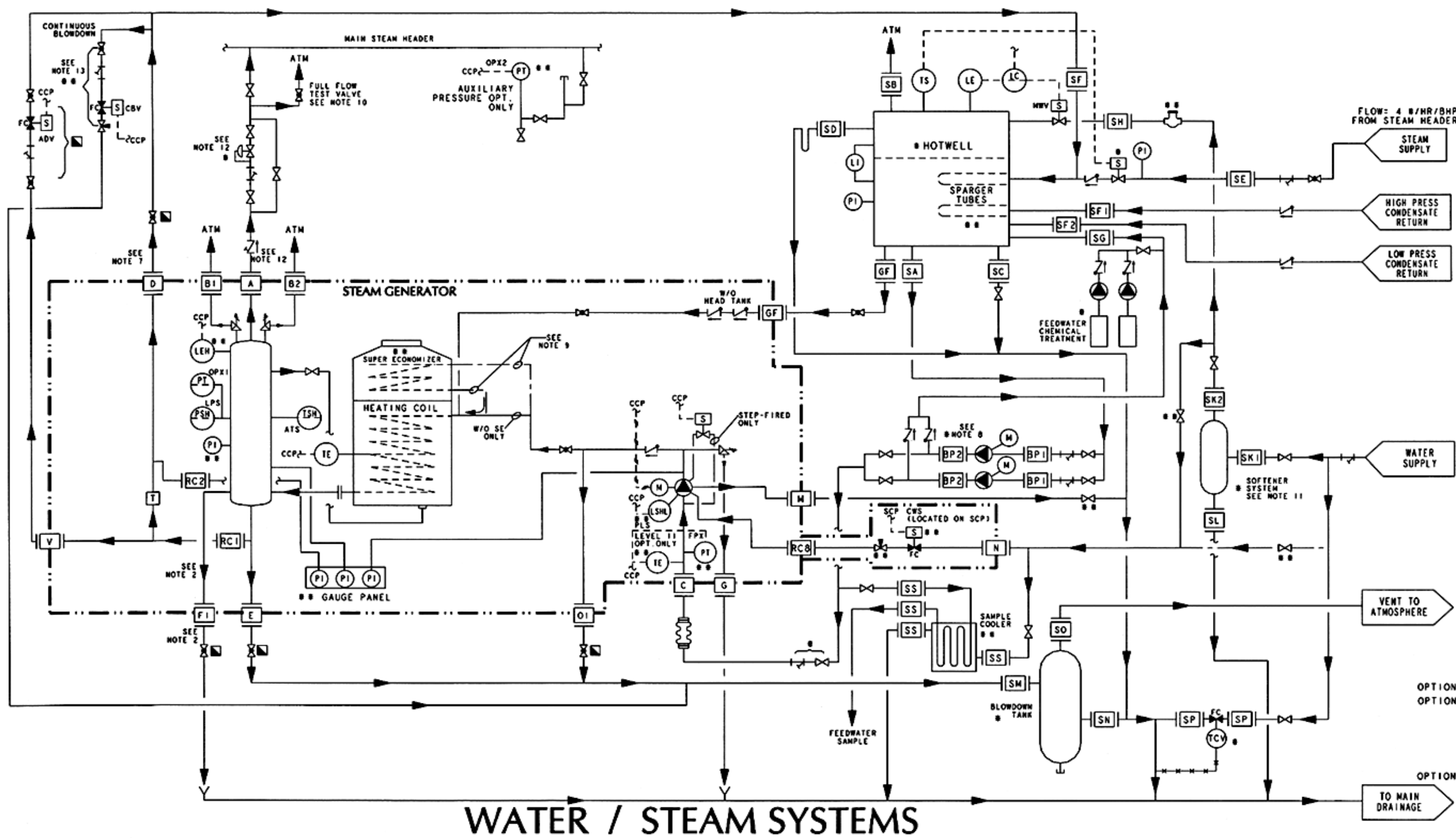
FUEL & ELECTRICAL SYSTEMS
R019717
LEGEND (NOT ALL DEVICES ARE USED)
VALVE
GLOBE VALVE
NEEDLE VALVE
GAS COCK VALVE
VALVE WITH HANDWHEEL
MODULATING VALVE
DAMPER
STOP CHECK STRAIGHT VALVE
CHECK VALVE
PNEUMATIC CONTROL VALVE
PRESSURE REGULATOR
BACK PRESSURE REGULATOR
DIFFERENTIAL REGULATOR
SOLENOID VALVE (NORM. OPEN)
SOLENOID VALVE (NORM. CLOSED)
ELECTRIC / HYDRAULIC ACTUATED VALVE (NORM. CLOSED)
ELECTRIC / PNEUMATIC ACTUATED VALVE (NORM. OPEN)
VACUUM BREAKER
SAFETY RELIEF VALVE
STRAINER
FILTER
ORIFICE/ RESTRICTOR
FUNNEL DRAIN
DROP LEG / CAP
TURBINE FLOW METER
FLEX COUPLING (2 FT MIN)
SPARK PLUG
PUMP
STEAM TRAP
CURRENT / PNEUMATIC POSITIONER
ELECTRIC MOTOR / ACTUATOR
INSTRUMENT - NON-ACCESSIBLE
INSTRUMENT - FIELD MOUNTED
INSTRUMENT - PANEL MOUNTED
ELECTRICAL SIGNAL
CAPILLARY SIGNAL
MECHANICAL LINK
PNEUMATIC SIGNAL
THREE-PHASE ELECTRICAL
CLAYTON EQUIPMENT BOUNDARY
ALTERNATE EQUIPMENT
ALLOWABLE PRESSURE RANGE +0"-0.25"WC
EXHAUST FLOW : 410 SCFM
BACK DRAFT DAMPER SEE NOTE 14
BAROMETRIC DAMPER SEE NOTE 14
ATM
LEVEL II OPT. ONLY
PRESSURE +1.0"WC -1.0"WC
COMBUSTION AIR INTAKE : 600 SCFM INCLUDES COOLING AIR
COMBUSTION CHAMBER
MAIN GAS
PILOT
PILOT GAS
FLAME SCANNER
AIR DAMPER
BLOWER
IGNITION XFMR
MAIN FUEL OIL
COMBUSTION CONTROL PANEL (CCP)
PRIMARY INPUT POWER SUPPLY
FDS
VENT TO ATMOSPHERE
INPUT = 2.1 MMBTU/HR FLOW = 2091 SCFH @ 1-10 PSIG
MAIN GAS SUPPLY
PILOT GAS SUPPLY (ALTERNATE)
VENT TO ATMOSPHERE
BACK PRESSURE ON RETURN LINE MUST NOT EXCEED 10 PSIG
LIGHT OIL FUEL RETURN
FLOW 14.7 GPH 1-25 PSIG
LIGHT OIL FUEL SUPPLY
VENT
FUEL / ELECT SYSTEMS CUSTOMER CONNECTIONS
EX | 11.88" OUTER DIAMETER | EXHAUST
H | 1" FPT (1-10 PSI SUPPLY) | MAIN GAS INLET
I | 1/2" FPT | PILOT GAS INLET
IN | N/A | COMBUSTION AIR INLET
J | 3/4" FPT(1-10 PSI SUPPLY) | GAS BLEED VALVE (OPTIONAL)
K | 1 3/8" OPENING | ELECTRICAL INLET (CCP)
P | 3/8" FPT | LIGHT OIL INLET
R | 3/8" FPT | LIGHT OIL RETURN
ABBREVIATIONS (NOT ALL DEVICES ARE USED)
AAPS ATOMIZING AIR PRESSURE SWITCH
ADV AUTOMATIC DUMP VALVE
APS AIR PRESSURE SWITCH
ASV AIR SOLENOID VALVE
ATM ATMOSPHERE
ATS AUXILIARY TEMPERATURE SWITCH
CAPS COOLING AIR PRESS. SWITCH
CBV CONTINUOUS BLEED VALVE
CC CONDUCTIVITY CONTROLLER
CE CONDUCTIVITY ELEMENT
CWS COOLING WATER SOLENOID
FC FAIL CLOSED
FDS FUSED DISCONNECT SWITCH
FI FAIL INDETERMINATE
FL FAIL LOCKED
FO FAIL OPEN
FPS FUEL PRESSURE SWITCH - LOW
FPX FEEDWATER PRESS. TRANSDUCER
GFV GRAVITY FILL VALVE
GPSH GAS PRESSURE SWITCH - HIGH
GPSL GAS PRESSURE SWITCH - LOW
HFOV HIGH FIRE OIL VALVE
LC LEVEL CONTROL
LE LEVEL ELEMENT
LI LEVEL INDICATOR
LPS LIMIT PRESSURE SWITCH
LS LEVEL SWITCH
MGV MAIN GAS VALVE
MM MODULATING MOTOR
MOV MAIN OIL VALVE
MPS MODULATING PRESS. SWITCH
MWV MAKE-UP WATER VALVE
OPS OPERATING PRESSURE SWITCH
OPX OPERATING PRESS. TRANSDUCER
PAV PILOT AIR VALVE
PC PRESSURE CONTROL
PI PRESSURE INDICATOR
PPS PILOT PRESSURE SWITCH - LOW
PS PRESSURE SWITCH
PT PRESSURE TRANSDUCER
PV PILOT VALVE
PVV PILOT VENT VALVE
SSGV SAFETY SHUTOFF GAS VALVE
SSOV SAFETY SHUTOFF OIL VALVE
TC TEMPERATURE CONTROL
TDS TOTAL DISSOLVED SOLIDS
TDV TDS DUMP VALVE
TE TEMPERATURE ELEMENT
TI TEMPERATURE INDICATOR
TP TEST PORT
TS TEMPERATURE SWITCH
TCV TEMPERATURE CONTROL VALVE
VV VENT VALVE
D SEE SHEET 2 JL 12-07-07
C REMOVE U JL 10-18-07 RY
B REVISED C.P.R. CONN. JL 08-29-07 RY
A ORIGINAL DRAWING JL 05-30-07 RY
CLAYTON INDUSTRIES
CITY OF INDUSTRIES CA. 91744
P&ID (S)SFOG-50M/SF
HOTWELL W/ NO SKID
NTS
(S)SFOG-50M/SF
D R019717 D
SHEET 1 OF 2

R019717



CUSTOMER CONNECTIONS		
SA	1" FPT	HOTWELL FEEDWATER OUTLET
SB	3" FPT	HOTWELL VENT
SC	3/4" FPT	HOTWELL DRAIN
SD	2" FPT	HOTWELL OVERFLOW
SE	1/2"FPT (MP/HP) 1 1/2" FPT(LP)	HOTWELL STEAM SUPPLY
SF	1 1/2" FPT	TRAP RETURN
SF1	1" FPT	HP CONDENSATE RETURN
SF2	1 1/2" FPT	LP CONDENSATE RETURN
SG	1/2" FPT	CHEM. INJECTION/BP RECIRC
SH	1/2" FPT	MAKEUP WATER INLET
SK1 SK2	1" FPT	SOFTENER INLET/OUTLET
SL	1" FPT	SOFTENER DRAIN
SM	1" MPT	BLOWDOWN TANK INLET
SN	1 1/2" FPT	BLOWDOWN TANK DISCHARGE
SO	2 1/2" MPT	BLOWDOWN TANK VENT
SP	3/4" FPT	BLOWDOWN COOLING WATER
SS	3/8" FPT	SAMPLE COOLER CONNECTIONS
BP1	1 1/4" FPT (MP) 1 1/2" FPT (LP)	BOOSTER PUMP INLET
BP2	1" FPT (MP) 2" FPT (LP)	BOOSTER PUMP OUTLET

	SG CUSTOMER CONNECTIONS		
	A	3" FPT (LOW PRESS.) 2" FPT (STD) 2" 300# RF FLG (HIEFF)	SEPARATOR OUTLET
	B1	15 PSI:4" FPT 125-150 PSI:1 1/4" FPT 200-250 PSI:1" FPT 300 PSI:3/4" FPT 350-500 PSI:1" FPT	SAFETY VALVE OUTLET
	B2	N/A	SAFETY VALVE OUTLET
	C	2" FPT	FEEDWATER INLET
	D	3/4" FPT	STEAM TRAP OUTLET
	E	1" FPT	SEPARATOR /BLOWDOWN DRAIN
	F1	1" FPT 1"FPT (W/OPT VLV KIT)	COIL DRAIN
	G	1/2" FPT	PUMP RELIEF VALVE
	GF	1/2" FPT	GRAVITY FILL
OPTIONAL	M	1/4" FPT	PUMP HEAD COOLING OUTLET
OPTIONAL	N	1/4" FPT	PUMP HEAD COOLING INLET
	O1	3/4" FPT	COIL BLOWDOWN
OPTIONAL	V	1" FPT	AUTO DUMP VALVE

	CUSTOMER RECONNECTIONS		
	RC1	1" UNION	STEAM TRAP
	RC2	1/4 " TUBE	TRAP PI
OPTIONAL	RC8	1/4" TUBE	COOLING WATER

WATER / STEAM SYSTEMS

NOTES:

1. ALL INTERCONNECT PIPING SHALL BE SIZED TO ALLOW PROPER FLOW. NO INTERCONNECT PIPING SHALL BE REDUCED BELOW LARGEST CONNECTION SIZE OF EQUIPMENT SUPPLIED BY CLAYTON INDUSTRIES. MANIFOLDING OF COMMON CONNECTIONS MUST INCLUDE HEADER PIPE SIZE DERATING TO PROPERLY HANDLE TOTAL FLOW.
2. CUSTOMER DRAIN CONNECTIONS [F1], & [G] MUST BE PIPED TO OPEN DRAIN TO PROVIDE A VISIBLE MEANS OF DETECTING WATER CONTAMINATION IN THE HEATING COIL AND LEAKAGE OF THE RELIEF VALVE.
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11. WATER SOFTENER REQUIRED IF DEMINERALIZED WATER / RO SYSTEM IS NOT AVAILABLE.
12. A BACK PRESSURE REGULATOR VALVE IS RECOMMENDED ON ALL INSTALLATIONS. A BACK PRESSURE REGULATOR VALVE AND A STOP CHECK VALVE ARE REQUIRED ON APC, AUTO START / STOP, MASTER LEAD LAG, MULTIPLE UNIT INSTALLATIONS AND / OR DESIGN STEAMING PRESSURES OF BELOW 65 PSIG.
13. CUSTOMER MUST INSTALL CLAYTON AVAILABLE CONTINUOUS BLEED VALVE KIT, AUTO TDS CONTROLLER KIT OR PROVIDE OTHER MEANS TO CONTROL THE TDS LEVEL IN THE SYSTEM.
14. BAROMETRIC DAMPER MAY BE REQUIRED TO MAINTAIN REQUIRED STACK DRAFT OF 0.00-0.25 WCI. BACK DRAFT DAMPER REQUIRED IN COLD WEATHER INSTALLATIONS TO PROTECT HEATING COIL FROM FREEZING.
15. REFER TO INSTALLATION MANUAL R-18600 FOR GENERAL INSTALLATION GUIDELINES AND RECOMMENDATIONS. RESPONSIBLITY TO MEET ALL APPLICABLE CODES AND STANDARDS SHALL BE BY OTHERS.

LTR	REVISION		DATE	
D	SB WAS 2"	JL	12-07-07	
C	REVISED CUST. CONN., ADD NOTES 8	JL	09-13-07	RY
B	REVISED C.P.R. CONN.	JL	08-29-07	RY
A	ORIGINAL DRAWING	JL	05-30-07	RY

CLAYTON INDUSTRIES — CITY OF INDUSTRIES CA., 91744

P&ID (S)SFOG-50M/SF
HOTWELL W/ NO SKID

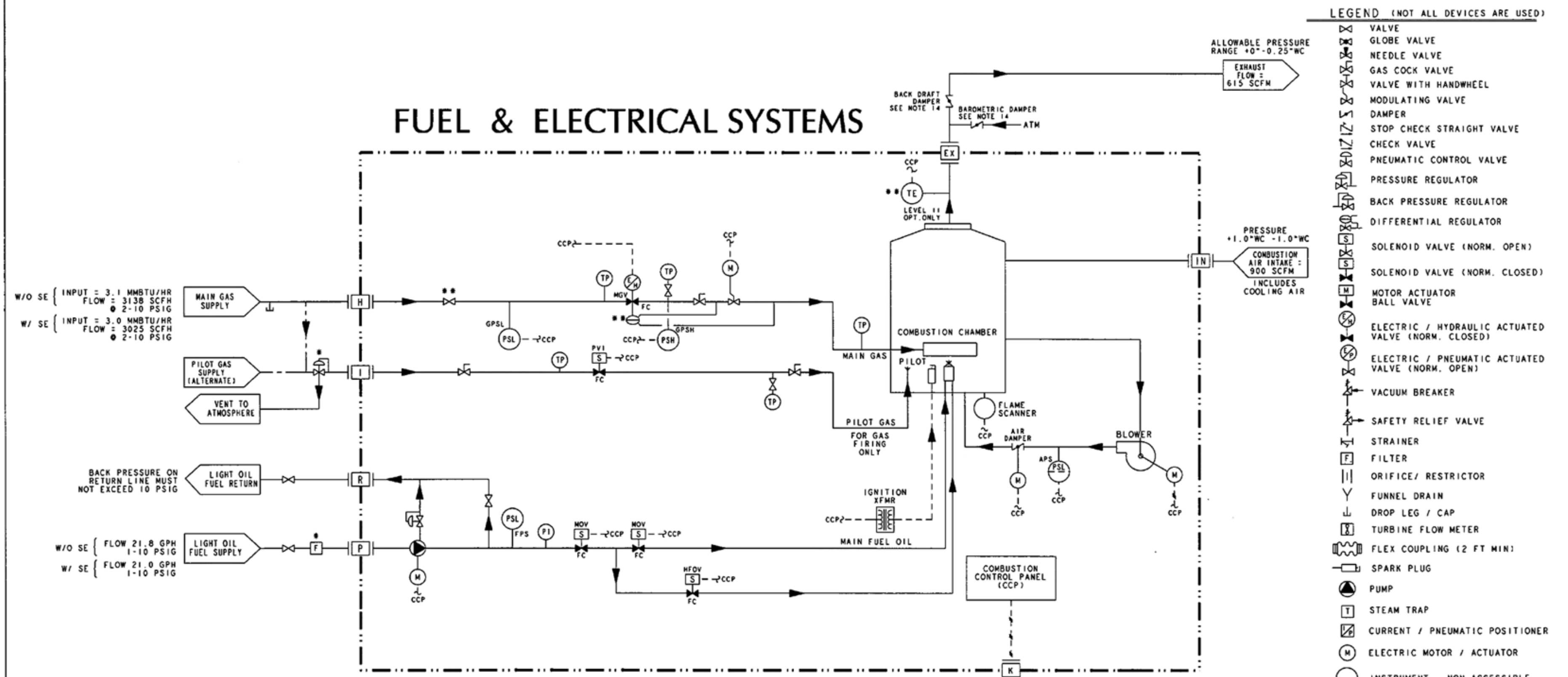
NTS (S)SFOG-50M/SF

D R019717 D

SHEET 2 OF 2

R020010

FUEL & ELECTRICAL SYSTEMS



ABBREVIATIONS (NOT ALL DEVICES ARE USED)

AAPS ATOMIZING AIR PRESSURE SWITCH
ADV AUTOMATIC DUMP VALVE
APS AIR PRESSURE SWITCH
ASV AIR SOLENOID VALVE
ATM ATMOSPHERE
ATS AUXILIARY TEMPERATURE SWITCH
CAPS COOLING AIR PRESS. SWITCH
CBV CONTINUOUS BLEED VALVE
CC CONDUCTIVITY CONTROLLER
CE CONDUCTIVITY ELEMENT
CWS COOLING WATER SOLENOID
FC FAIL CLOSED
FDS FUSED DISCONNECT SWITCH
FI FAIL INDETERMINATE
FL FAIL LOCKED
FO FAIL OPEN
FPS FUEL PRESSURE SWITCH - LOW
FPX FEEDWATER PRESS. TRANSDUCER
GFV GRAVITY FILL VALVE
GPSH GAS PRESSURE SWITCH - HIGH
GPSL GAS PRESSURE SWITCH - LOW
HFOV HIGH FIRE OIL VALVE
LC LEVEL CONTROL
LE LEVEL ELEMENT
LI LEVEL INDICATOR
LPS LIMIT PRESSURE SWITCH
LS LEVEL SWITCH
MGV MAIN GAS VALVE
MM MODULATING MOTOR
MOV MAIN OIL VALVE
MPS MODULATING PRESS. SWITCH
MWV MAKE-UP WATER VALVE
OPS OPERATING PRESSURE SWITCH
OPX OPERATING PRESS. TRANSDUCER
PAV PILOT AIR VALVE
PC PRESSURE CONTROL
PI PRESSURE INDICATOR
PPS PILOT PRESSURE SWITCH - LOW
PS PRESSURE SWITCH
PT PRESSURE TRANSDUCER
PV PILOT VALVE
PVV PILOT VENT VALVE
SSGV SAFETY SHUTOFF GAS VALVE
SSOV SAFETY SHUTOFF OIL VALVE
TC TEMPERATURE CONTROL
TDS TOTAL DISSOLVED SOLIDS
TDV TDS DUMP VALVE
TE TEMPERATURE ELEMENT
TI TEMPERATURE INDICATOR
TP TEST PORT
TS TEMPERATURE SWITCH
TCV TEMPERATURE CONTROL VALVE
VV VENT VALVE

FUEL / ELECT SYSTEMS CUSTOMER CONNECTIONS

EX	11.88" OUTER DIAMETER	EXHAUST
H	1" FPT (2-10 PSI SUPPLY)	MAIN GAS INLET
I	1/2" FPT	PILOT GAS INLET
IN	N/A	COMBUSTION AIR INLET
K	1 3/8" OPENING	ELECTRICAL INLET (CCP)
P	3/8" FPT	LIGHT OIL INLET
R	3/8" FPT	LIGHT OIL RETURN

LTR	REVISION	BY	DATE	CHK
E	UPDATED DRAWING	MY	05-08-09	
D	UPDATED DRAWING	AN	05-15-08	
C	REVISED OIL SECTION	JL	10-8-07	RY
B	MODIFIED A & BI. SEE SHT #2	KT	10-2-07	RY
A	ORIGINAL DRAWING	JL	05-04-09	RY

FOR PLATING ALLOWANCE, MICRO FINISH AND GENERAL MANUFACTURING TOLERANCES NOT SPECIFIED ON THIS DRAWING, SEE ENG. ORDER EO-1148

TOLERANCES EXCEPT AS NOTED: FRACTION ± .50; .X ± 0.3; .XX ± 0.030; ANGULAR ± 1/2°

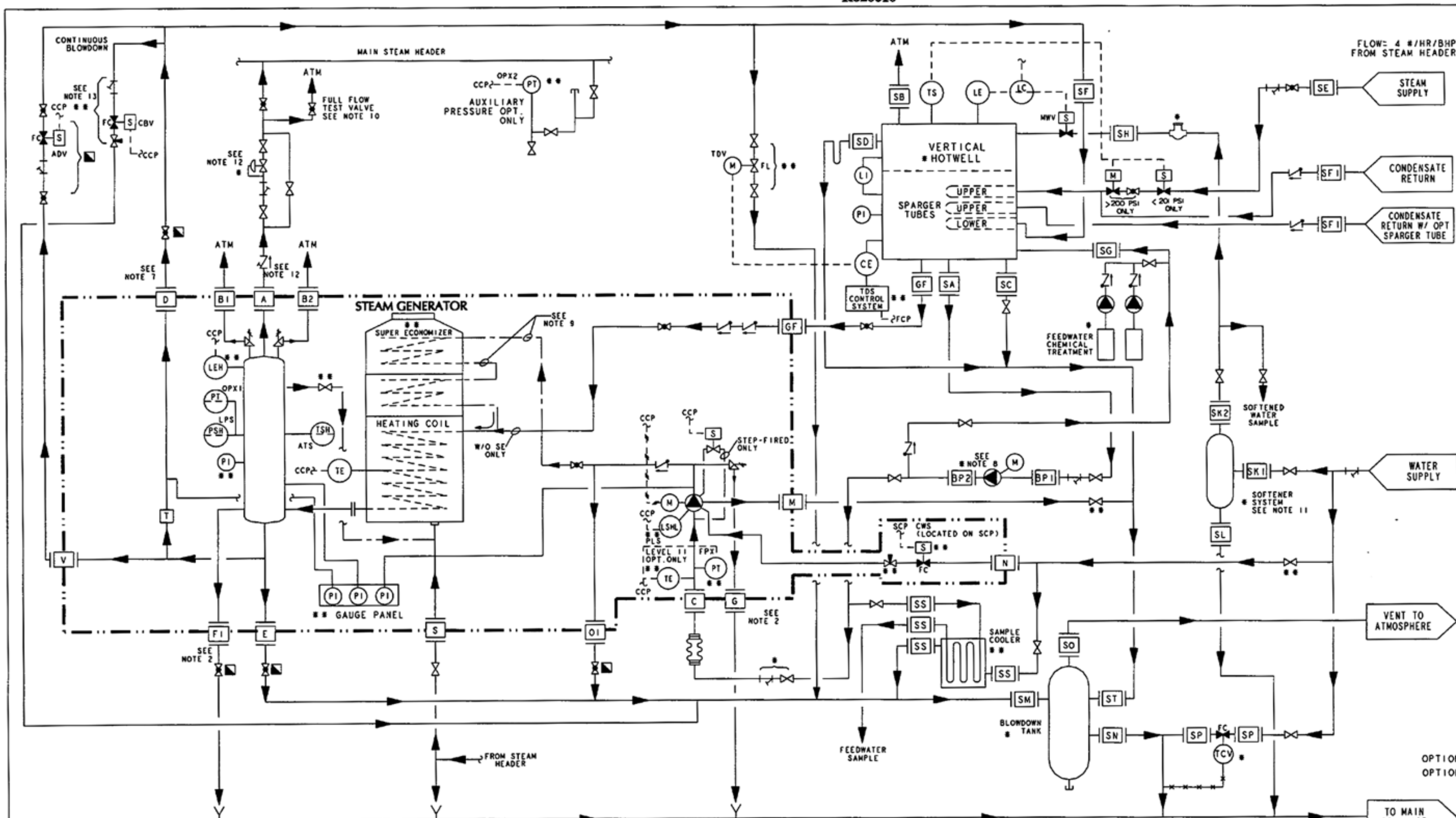
CLAYTON INDUSTRIES CITY OF INDUSTRY CA., 91744

P&ID (S)SFOG-75M/SF HOTWELL W/NO SKID

SCALE: NTS; MODEL/TYPE: (S)SFOG-75M/SF; RO19477; E; R020010; D

SHEET 1 OF 2

R020010



WATER / STEAM SYSTEMS

CUSTOMER CONNECTIONS		
SA	1 1/2" FPT	HOTWELL FEEDWATER OUTLET
SB	3" FPT	HOTWELL VENT
SC	1" FPT	HOTWELL DRAIN
SD	2 1/2" FPT	HOTWELL OVERFLOW
SE	3/4"FPT (MP/HP) 1 1/4" FPT(LP)	HOTWELL STEAM SUPPLY
SF	1 1/2" FPT	TRAP RETURN
SF1	3/4" FPT	CONDENSATE RETURN
SF1	1" FPT	OPT CONDENSATE RETURN
SG	3/4" FPT	CHEM. INJECTION/BP RECIRC
SH	1/2" FPT	MAKEUP WATER INLET
SK1 SK2	1" FPT	SOFTENER INLET/OUTLET
SL	1" FPT	SOFTENER DRAIN
SM	1" MPT	BLOWDOWN TANK INLET
SN	1 1/2" FPT	BLOWDOWN TANK DISCHARGE
SO	2 1/2" MPT	BLOWDOWN TANK VENT
SP	3/4" FPT	BLOWDOWN COOLING WATER
SS	3/8" FPT	SAMPLE COOLER CONNECTIONS
ST	2" FPT	BLOWDOWN - HW OVERFLOW
BP1	1 1/4" FPT (MP) 1 1/2" FPT (LP)	BOOSTER PUMP INLET
BP2	1" FPT (MP) 2" FPT (LP)	BOOSTER PUMP OUTLET

	SG CUSTOMER CONNECTIONS		
	A	3" FPT (LOW PRESS.) 2" FPT (STD) 2" 300# RF FLG (H)EFF) 4" 150# RF FLG (H)EFF)	SEPARATOR OUTLET
	B1	15 PSI = 4" FPT 125 PSI = 1" FPT 150 PSI = 1 1/2" FPT 200 PSI = 1 1/4" FPT 250-300 PSI = 1" FPT 350-400 PSI = 1 1/4" FPT 500 PSI = 1" FPT	SAFETY VALVE OUTLET
	B2	125 PSI=1" FPT	SAFETY VALVE OUTLET
	C	2" FPT	FEEDWATER INLET
	D	3/4" FPT	STEAM TRAP OUTLET
	E	1" FPT	SEPARATOR /BLOWDOWN DRAIN
	F1	1" FPT 1"FPT (W/OPT VLV KIT)	COIL DRAIN
	G	1/2" FPT	PUMP RELIEF VALVE
	GF	3/4" FPT	GRAVITY FILL
OPTIONAL	M	1/4" FPT	PUMP HEAD COOLING OUTLET
OPTIONAL	N	3/8" FPT	PUMP HEAD COOLING INLET
	O1	3/4" FPT	COIL BLOWDOWN
	S	3/4" MPT	SOOT BLOWER
OPTIONAL	V	1" FPT	AUTO DUMP VALVE

NOTES:

1. ALL INTERCONNECT PIPING SHALL BE SIZED TO ALLOW PROPER FLOW. NO INTERCONNECT PIPING SHALL BE REDUCED BELOW LARGEST CONNECTION SIZE OF EQUIPMENT SUPPLIED BY CLAYTON INDUSTRIES. MANIFOLDING OF COMMON CONNECTIONS MUST INCLUDE HEADER PIPE SIZE DERATING TO PROPERLY HANDLE TOTAL FLOW.
2. CUSTOMER DRAIN CONNECTIONS [F1], & [G] MUST BE PIPED TO OPEN DRAIN TO PROVIDE A VISIBLE MEANS OF DETECTING WATER CONTAMINATION IN THE HEATING COIL AND LEAKAGE OF THE RELIEF VALVE.
3. ALL PIPE SIZES SHOWN ARE CONNECTION SIZES ONLY. IT IS THE INSTALLERS RESPONSIBILITY TO INCREASE PIPE SIZES AS NECESSARY TO ACHIEVE SPECIFIED FLOW VALUES. CLAYTON INSTALLATION INSTRUCTIONS MUST BE FOLLOWED AT ALL TIMES.
4. * DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS SHIPPED LOOSE AND MUST BE INSTALLED BY OTHERS.
5. ** DENOTES OPTIONAL EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. ITEMS SHOWN WITHIN CLAYTON SUPPLIED BOUNDARIES ARE INSTALLED BY CLAYTON WHEN PURCHASED. IF EXTERNAL TO BOUNDARIES, ITEMS ARE SHIPPED LOOSE WHEN PURCHASED AND INSTALLED BY CUSTOMER.
6. ◩ DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS INSTALLED BY CLAYTON WHEN PURCHASED FROM CLAYTON.
7. INCREASE ONE FULL PIPE SIZE AFTER FIRST ELBOW.
8. BOOSTER PUMPS REQUIRED IF RECEIVER TANK ELEVATION CANNOT PROVIDE SUFFICIENT NPSH TO FEEDWATER PUMP.
9. RELEVANT ONLY TO SE OPTION.
10. A FULL FLOW ATMOSPHERIC TEST VALVE IS REQUIRED AND MUST BE READILY ACCESSIBLE. INSTALL A CHAIN OPERATOR ON STOP AND TEST VALVES.
11. WATER SOFTENER REQUIRED IF DEMINERALIZED WATER / RO SYSTEM IS NOT AVAILABLE.
12. A BACK PRESSURE REGULATOR VALVE IS RECOMMENDED ON ALL INSTALLATIONS. A BACK PRESSURE REGULATOR VALVE AND A STOP CHECK VALVE ARE REQUIRED ON APC, AUTO START / STOP, MASTER LEAD LAG, MULTIPLE UNIT INSTALLATIONS AND / OR DESIGN STEAMING PRESSURES OF BELOW 65 PSIG.
13. CUSTOMER MUST INSTALL CLAYTON AVAILABLE CONTINUOUS BLEED VALVE KIT, AUTO TDS CONTROLLER KIT OR PROVIDE OTHER MEANS TO CONTROL THE TDS LEVEL IN THE SYSTEM.
14. BAROMETRIC DAMPER MAY BE REQUIRED TO MAINTAIN REQUIRED STACK DRAFT OF 0.00-0.25 WCI. BACK DRAFT DAMPER REQUIRED IN COLD WEATHER INSTALLATIONS TO PROTECT HEATING COIL FROM FREEZING.
15. REFER TO INSTALLATION MANUAL R-1660D FOR GENERAL INSTALLATION GUIDELINES AND RECOMMENDATIONS. RESPONSIBLITY TO MEET ALL APPLICABLE CODES AND STANDARDS SHALL BE BY OTHERS.
16. OIL & GAS MANIFOLDS ARE TWO SEPARATE ASSEMBLIES. THEY MUST BE MANUALLY CHANGED OUT PER REQUIREMENT.

LTR	REVISION	BY	DATE	CHK
E	UPDATED DRAWING	MY	05-08-09	
D	UPDATED DRAWING	AN	05-15-08	
C	SEE SHEET 1	JL	10-18-07	RY
B	ADDED 3" FPT (LOW PRESS.) & 15 PSI = 4" FPT ON SG CUSTOMER CONNECTIONS A & B1	KT	10-12-07	RY
A	ORIGINAL DRAWING	JL	09-13-07	RY

DO NOT SCALE PRINT

FOR PLATING ALLOWANCE, MICRO FINISH AND GENERAL MANUFACTURING TOLERANCES NOT SPECIFIED ON THIS DRAWING, SEE ENG. ORDER EO-1148

PROD. ENG. APPROVAL

1ST ASSY WHERE USED

TOLERANCES EXCEPT AS NOTED
INCH
FRACTION ± .50
.X ± 0.3
.XX ± 0.030
ANGULAR ± 1/2°
FINISH SPECIFICATION

ITEM | DESCRIPTION | STOCK NO. | REQ'D
BILL OF MATERIAL

CLAYTON INDUSTRIES CITY OF INDUSTRY CA., 91744

DRAWING TITLE

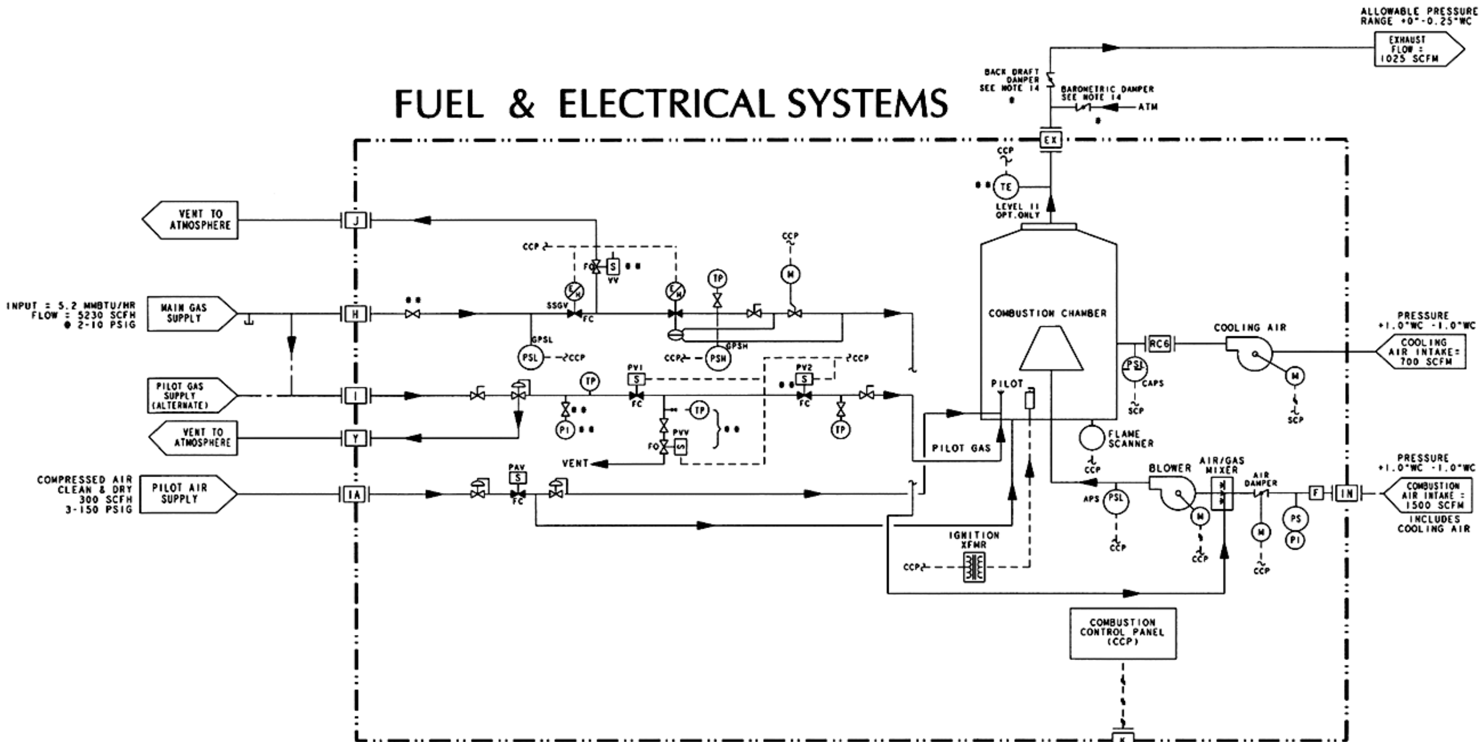
P&ID (S)SFOG-75M/SF HOTWELL W/NO SKID

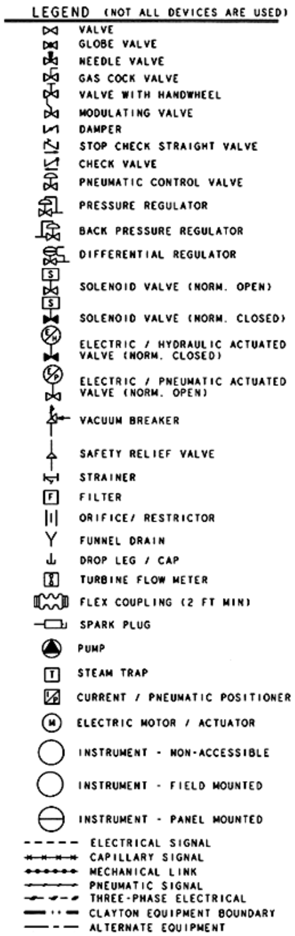
MAT'L DESCRIPTION	STOCK NO.	SCALE	MODEL/TYPE	
		NTS	(S)SFOG-75M/SF	
SIMILAR TOOLING	MAT'L REQ'D	REV. LTR	DRAWING NUMBER	SIZE
R019477		E	R020010	D

SHEET 2 OF 2

R020047

FUEL & ELECTRICAL SYSTEMS





R020047

RE-CONNECTIONS

RC6	4" DUCT	COOLING AIR DUCT

FUEL / ELECT SYSTEMS CUSTOMER CONNECTIONS

EX	11.88" OUTER DIAMETER	EXHAUST
H	1 1/2" FPT (1-10 PSI SUPPLY)	MAIN GAS INLET
I	1/2" FPT	PILOT GAS INLET
IA	1/4" FPT	PILOT AIR INLET
IN	N/A	COMBUSTION AIR INLET
J	3/4" FPT(1-10 PSI SUPPLY)	GAS BLEED VALVE
K	1 3/8" OPENING	ELECTRICAL INLET (CCP)
P	1/2" FPT	LIGHT OIL INLET
R	1/2" FPT	LIGHT OIL RETURN
U	1/2" FPT	ATOMIZING AIR INLET
Y	1/4" FPT	PILOT GAS REGULATOR VENT

ABBREVIATIONS (NOT ALL DEVICES ARE USED)

AAPS	ATOMIZING AIR PRESSURE SWITCH	MGV	MAIN GAS VALVE
ADV	AUTOMATIC DUMP VALVE	MM	MODULATING MOTOR
APS	AIR PRESSURE SWITCH	MOV	MAIN OIL VALVE
ASV	AIR SOLENOID VALVE	MPS	MODULATING PRESS. SWITCH
ATM	ATMOSPHERE	MWV	MAKE-UP WATER VALVE
ATS	AUXILIARY TEMPERATURE SWITCH	OPS	OPERATING PRESSURE SWITCH
CAPS	COOLING AIR PRESS. SWITCH	OPX	OPERATING PRESS. TRANSDUCER
CBV	CONTINUOUS BLEED VALVE	PAV	PILOT AIR VALVE
CC	CONDUCTIVITY CONTROLLER	PC	PRESSURE CONTROL
CE	CONDUCTIVITY ELEMENT	PI	PRESSURE INDICATOR
CWS	COOLING WATER SOLENOID	PPS	PILOT PRESSURE SWITCH - LOW
FC	FAIL CLOSED	PS	PRESSURE SWITCH
FDS	FUSED DISCONNECT SWITCH	PT	PRESSURE TRANSDUCER
FI	FAIL INDETERMINATE	PV	PILOT VALVE
FL	FAIL LOCKED	PVV	PILOT VENT VALVE
FO	FAIL OPEN	SSGV	SAFETY SHUTOFF GAS VALVE
FPS	FUEL PRESSURE SWITCH - LOW	SSOV	SAFETY SHUTOFF OIL VALVE
FPX	FEEDWATER PRESS. TRANSDUCER	TC	TEMPERATURE CONTROL
GFV	GRAVITY FILL VALVE	TDS	TOTAL DISSOLVED SOLIDS
GPSH	GAS PRESSURE SWITCH - HIGH	TDV	TDS DUMP VALVE
GPSL	GAS PRESSURE SWITCH - LOW	TE	TEMPERATURE ELEMENT
HFOV	HIGH FIRE OIL VALVE	TI	TEMPERATURE INDICATOR
LC	LEVEL CONTROL	TP	TEST PORT
LE	LEVEL ELEMENT	TS	TEMPERATURE SWITCH
LI	LEVEL INDICATOR	TCV	TEMPERATURE CONTROL VALVE
LPS	LIMIT PRESSURE SWITCH	VV	VENT VALVE
LS	LEVEL SWITCH		

LTR	REVISION	BY	DATE	CHK
B	ADDED PILOT AIR SUPPLY LINE	AN	03-11-08	
A	ORIGINAL DRAWING	KT	09-28-07	RY

FOR PLATING ALLOWANCE, MICRO FINISH AND GENERAL MANUFACTURING TOLERANCES NOT SPECIFIED ON THIS DRAWING, SEE ENG. ORDER EO-1148

TOLERANCES EXCEPT AS NOTED: .XX ± .030; .XXX ± 0.010; .XXXX SEE EO-1148; ANGULAR ± 1/2°

FINISH SPECIFICATION

CLAYTON INDUSTRIES — CITY OF INDUSTRIES CA. 91744

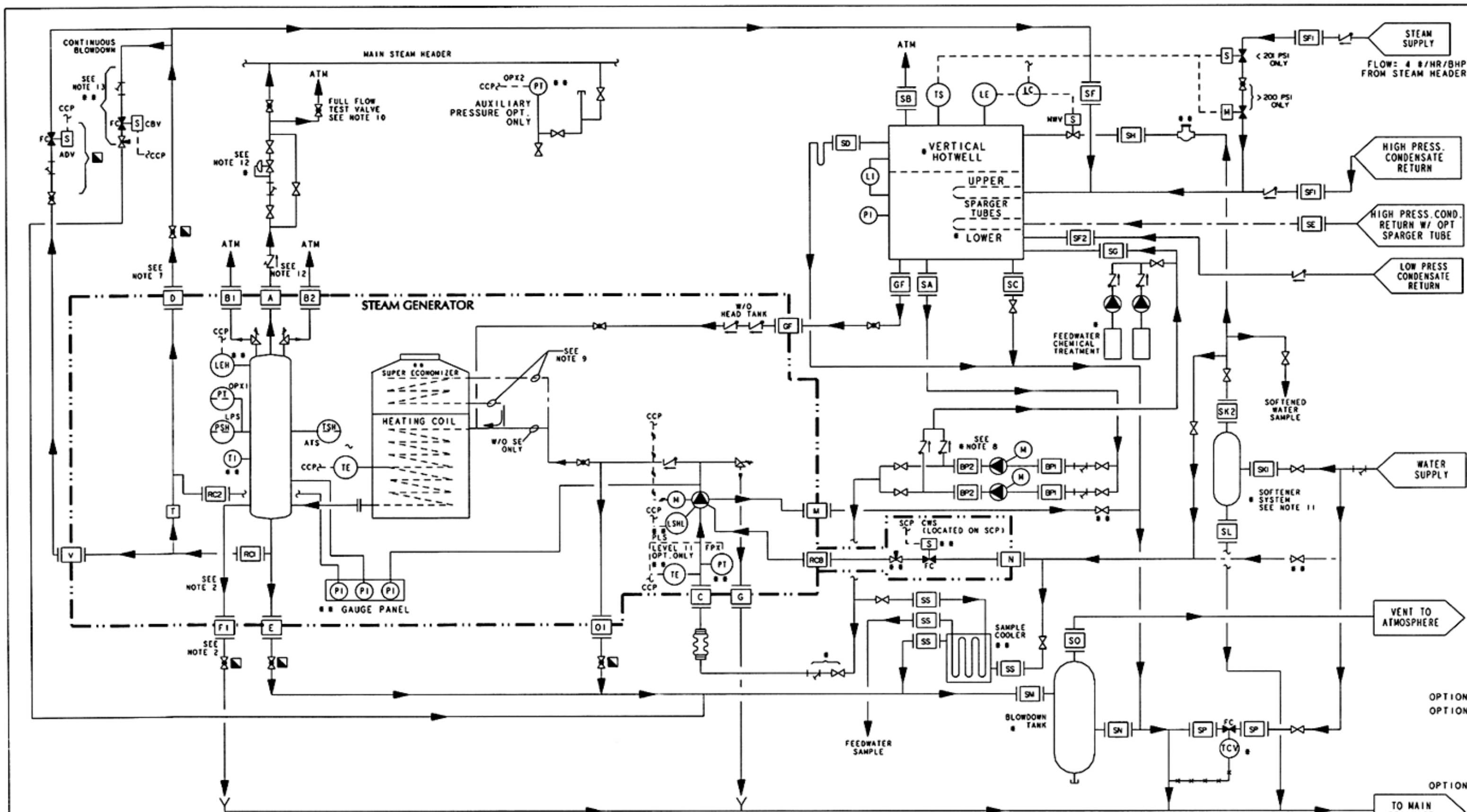
P&ID SFG-125-FMB-SE HOTWELL W/ NO SKID

NTS — SFG-125-FMB-SE

B R020047 D

SHEET 1 OF 2

R020047



WATER / STEAM SYSTEMS

NOTES:

1. ALL INTERCONNECT PIPING SHALL BE SIZED TO ALLOW PROPER FLOW. NO INTERCONNECT PIPING SHALL BE REDUCED BELOW LARGEST CONNECTION SIZE OF EQUIOPMENT SUPPLIED BY CLAYTON INDUSTRIES. MANIFOLDING OF COMMON CONNECTIONS MUST INCLUDE HEADER PIPE SIZE DERATING TO PROPERLY HANDLE TOTAL FLOW.
2. CUSTOMER DRAIN CONNECTIONS FI , & G MUST BE PIPED TO OPEN DRAIN TO PROVIDE A VISIBLE MEANS OF DETECTING WATER CONTAMINATION IN THE HEATING COIL AND LEAKAGE OF THE RELIEF VALVE.
3. ALL PIPE SIZES SHOWN ARE CONNECTION SIZES ONLY. IT IS THE INSTALLERS RESPONSIBILITY TO INCREASE PIPE SIZES AS NECESSARY TO ACHIEVE SPECIFIED FLOW VALUES. CLAYTON INSTALLATION INSTRUCTIONS MUST BE FOLLOWED AT ALL TIMES.
4. ✱ DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS SHIPPED LOOSE AND MUST BE INSTALLED BY OTHERS.
5. ✱✱ DENOTES OPTIONAL EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. ITEMS SHOWN WITHIN CLAYTON SUPPLIED BOUNDARIES ARE INSTALLED BY CLAYTON WHEN PURCHASED. IF EXTERNAL TO BOUNDARIES, ITEMS ARE SHIPPED LOOSE WHEN PURCHASED AND INSTALLED BY CUSTOMER.
6. ■ DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS INSTALLED BY CLAYTON WHEN PURCHASED FROM CLAYTON.
7. INCREASE ONE FULL PIPE SIZE AFTER FIRST ELBOW.
8. BOOSTER PUMPS REQUIRED IF RECEIVER TANK ELEVATION CANNOT PROVIDE SUFFICIENT NPSH TO FEEDWATER PUMP.
9. RELEVANT ONLY TO SE OPTION.
10. A FULL FLOW ATMOSPHERIC TEST VALVE IS REQUIRED AND MUST BE READILY ACCESSIBLE. INSTALL A CHAIN OPERATOR ON STOP AND TEST VALVES.
11. WATER SOFTENER REQUIRED IF DEMINERALIZED WATER / RO SYSTEM IS NOT AVAILABLE.
12. A BACK PRESSURE REGULATOR VALVE IS RECOMMENDED ON ALL INSTALLATIONS. A BACK PRESSURE REGULATOR VALVE AND A STOP CHECK VALVE ARE REQUIRED ON APC, AUTO START / STOP, MASTER LEAD LAG, MULTIPLE UNIT INSTALLATIONS AND / OR DESIGN STEAMING PRESSURES OF BELOW 65 PSIG.
13. CUSTOMER MUST INSTALL CLAYTON AVAILABLE CONTINUOUS BLEED VALVE KIT, AUTO TDS CONTROLLER KIT OR PROVIDE OTHER MEANS TO CONTROL THE TDS LEVEL IN THE SYSTEM.
14. BAROMETRIC DAMPER MAY BE REQUIRED TO MAINTAIN REQUIRED STACK DRAFT OF 0.00-0.25 WCI. BACK DRAFT DAMPER REQUIRED IN COLD WEATHER INSTALLATIONS TO PROTECT HEATING COIL FROM FREEZING.
15. REFER TO INSTALLATION MANUAL R-15600 FOR GENERAL INSTALLATION GUIDELINES AND RECOMMENDATIONS. RESPONSIBLITY TO MEET ALL APPLICABLE CODES AND STANDARDS SHALL BE BY OTHERS.

CUSTOMER CONNECTIONS

SA	3" FPT	HOTWELL FEEDWATER OUTLET
SB	2 1/2" FPT	HOTWELL VENT
SC	1 1/4" FPT	HOTWELL DRAIN
SD	2 1/2" FPT	HOTWELL OVERFLOW
SE	3/4" FPT (HP/MP) 1 1/4" FPT (LP)	HOTWELL STEAM SUPPLY
SF	2 1/2" FPT	TRAP RETURN
SF1	1" FPT	HP CONDENSATE RETURN
SF2	1 1/2" FPT	LP CONDENSATE RETURN
SG	1/2" FPT	CHEM. INJECTION/BP RECIRC
SH	1" FPT	MAKEUP WATER INLET
SK1 SK2	1 1/2" FPT	SOFTENER INLET/OUTLET
SL	1" FPT	SOFTENER DRAIN
SM	1" MPT	BLOWDOWN TANK INLET
SN	1 1/2" FPT	BLOWDOWN TANK DISCHARGE
SO	2 1/2" MPT	BLOWDOWN TANK VENT
SP	3/4" FPT	BLOWDOWN COOLING WATER
SS	3/8" FPT	SAMPLE COOLER CONNECTIONS
BP1	1 1/4" FPT (MP) 1 1/2" FPT (LP)	BOOSTER PUMP INLET
BP2	1" FPT (MP) 2" FPT (LP)	BOOSTER PUMP OUTLET

SG CUSTOMER CONNECTIONS

	A	2" FPT (STD) 2 1/2" 300# RF FLG (HIEFF)	SEPARATOR OUTLET
	B1	125 PSI: 1 1/4" FPT 150-200 PSI: 1 1/2" FPT 250-500 PSI: 1 1/4" FPT	SAFETY VALVE OUTLET
	B2	125-150 PSI: 1 1/4" FPT	SAFETY VALVE OUTLET
	C	1 1/4" FPT	FEEDWATER INLET
	D	1" FPT	STEAM TRAP OUTLET
	E	1" FPT	SEPARATOR /BLOWDOWN DRAIN
	FI	1 1/4" FPT	COIL DRAIN
	G	1/2" FPT	PUMP RELIEF VALVE
	GF	1/2" FPT	GRAVITY FILL
OPTIONAL	M	1/4" FPT	PUMP HEAD COOLING OUTLET
OPTIONAL	N	1/4" FPT	PUMP HEAD COOLING INLET
	O	3/4" FPT	COIL BLOWDOWN
OPTIONAL	V	1" FPT	AUTO DUMP VALVE

CUSTOMER RECONNECTIONS

	RC1	1" UNION	STEAM TRAP
	RC2	1/4" TUBE	TRAP PI
OPTIONAL	RC8	1/4" TUBE	COOLING WATER

LTR	REVISION	BY	DATE	CHK
B	UPDATED DRAWING TO CURRENT STANDARD	AN	03-11-08	
A	ORIGINAL DRAWING	KT	09-28-07	RY

FOR PLATING ALLOWANCE, MICRO FINISH AND GENERAL MANUFACTURING TOLERANCES NOT SPECIFIED ON THIS DRAWING, SEE ENG. ORDER EO-1148

TOLERANCES EXCEPT AS NOTED: .XX ± .030; .XXX ± 0.010; .XXXX SEE EO-1148; ANGULAR ± 1/2°

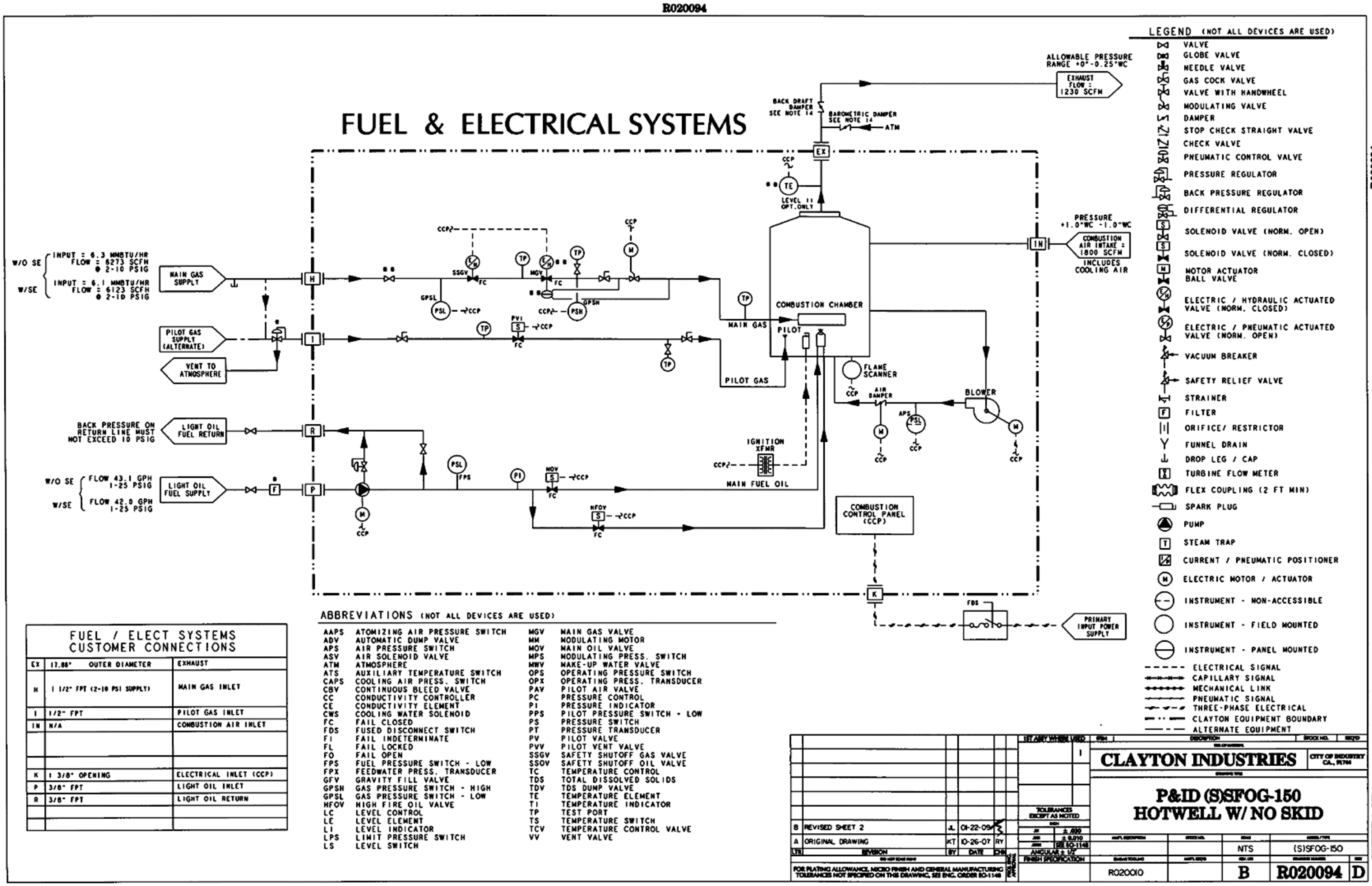
CLAYTON INDUSTRIES — CITY OF INDUSTRIES CA., 91744

P&ID SFG-125-FMB-SE HOTWELL W/ NO SKID

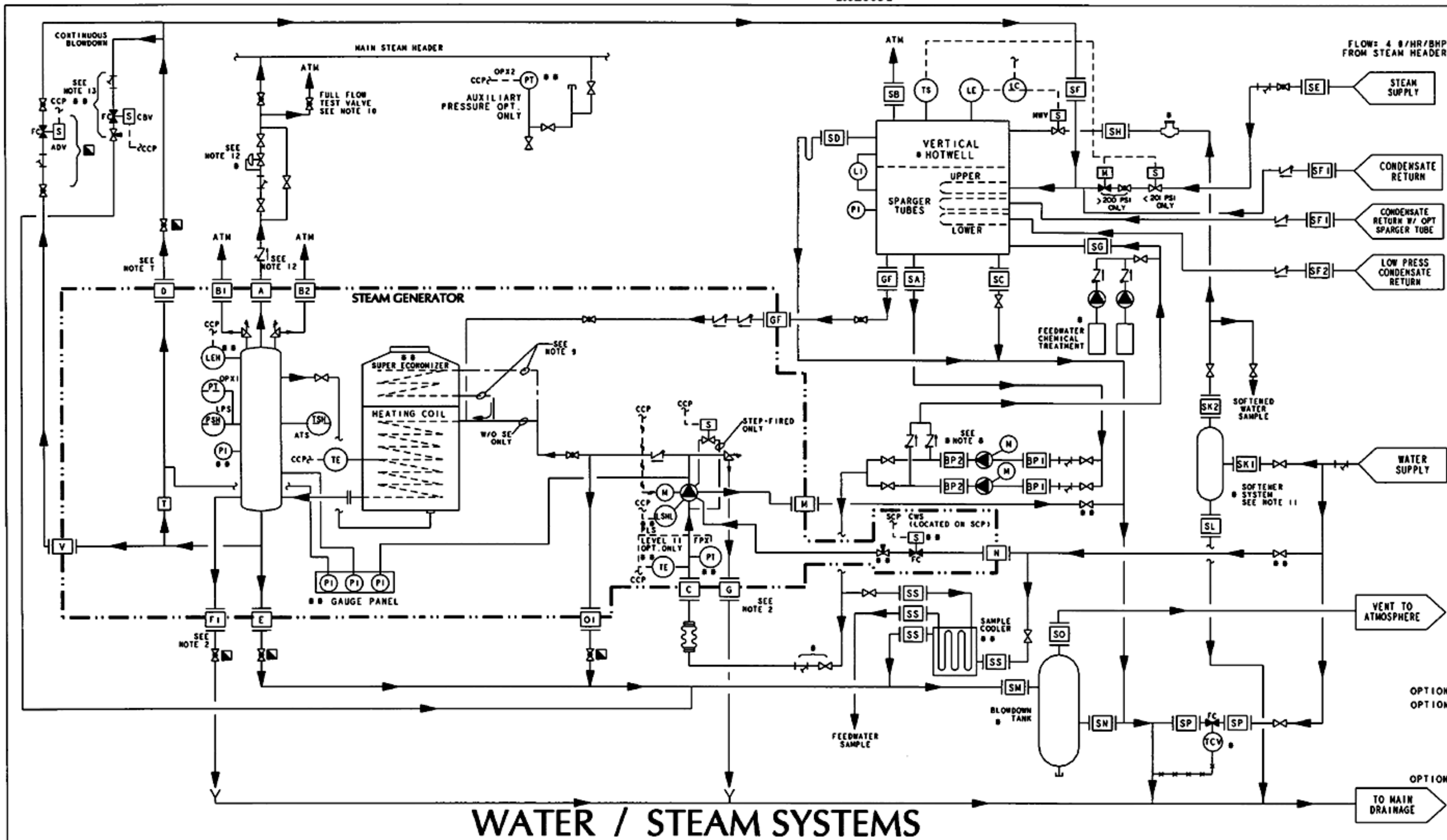
NTS — P&ID SFG-125-FMB-SE

B R020047 D

SHEET 2 OF 2


R020094
FUEL & ELECTRICAL SYSTEMS
W/O SE INPUT = 6.3 MMBTU/HR FLOW = 6273 SCFH @ 2-10 PSIG
W/SE INPUT = 6.1 MMBTU/HR FLOW = 6123 SCFH @ 2-10 PSIG
MAIN GAS SUPPLY
PILOT GAS SUPPLY (ALTERNATE)
VENT TO ATMOSPHERE
BACK PRESSURE ON RETURN LINE MUST NOT EXCEED 10 PSIG
LIGHT OIL FUEL RETURN
W/O SE FLOW 43.1 GPH 1-25 PSIG
W/SE FLOW 42.0 GPH 1-25 PSIG
LIGHT OIL FUEL SUPPLY
ALLOWABLE PRESSURE RANGE +0"-0.25"WC
EXHAUST FLOW = 1230 SCFM
BACK DRAFT DAMPER SEE NOTE 14
BAROMETRIC DAMPER SEE NOTE 14
ATM
LEVEL II OPT. ONLY
PRESSURE +1.0"WC -1.0"WC
COMBUSTION AIR INTAKE = 1800 SCFM INCLUDES COOLING AIR
COMBUSTION CHAMBER
MAIN GAS
PILOT
PILOT GAS
FLAME SCANNER
AIR DAMPER
BLOWER
IGNITION XFMR
MAIN FUEL OIL
COMBUSTION CONTROL PANEL (CCP)
PRIMARY INPUT POWER SUPPLY
FDS
LEGEND (NOT ALL DEVICES ARE USED)
VALVE
GLOBE VALVE
NEEDLE VALVE
GAS COCK VALVE
VALVE WITH HANDWHEEL
MODULATING VALVE
DAMPER
STOP CHECK STRAIGHT VALVE
CHECK VALVE
PNEUMATIC CONTROL VALVE
PRESSURE REGULATOR
BACK PRESSURE REGULATOR
DIFFERENTIAL REGULATOR
SOLENOID VALVE (NORM. OPEN)
SOLENOID VALVE (NORM. CLOSED)
MOTOR ACTUATOR BALL VALVE
ELECTRIC / HYDRAULIC ACTUATED VALVE (NORM. CLOSED)
ELECTRIC / PNEUMATIC ACTUATED VALVE (NORM. OPEN)
VACUUM BREAKER
SAFETY RELIEF VALVE
STRAINER
FILTER
ORIFICE/ RESTRICTOR
FUNNEL DRAIN
DROP LEG / CAP
TURBINE FLOW METER
FLEX COUPLING (2 FT MIN)
SPARK PLUG
PUMP
STEAM TRAP
CURRENT / PNEUMATIC POSITIONER
ELECTRIC MOTOR / ACTUATOR
INSTRUMENT - NON-ACCESSIBLE
INSTRUMENT - FIELD MOUNTED
INSTRUMENT - PANEL MOUNTED
ELECTRICAL SIGNAL
CAPILLARY SIGNAL
MECHANICAL LINK
PNEUMATIC SIGNAL
THREE-PHASE ELECTRICAL
CLAYTON EQUIPMENT BOUNDARY
ALTERNATE EQUIPMENT
FUEL / ELECT SYSTEMS CUSTOMER CONNECTIONS
EX 17.86" OUTER DIAMETER EXHAUST
H 1 1/2" FPT (2-10 PSI SUPPLY) MAIN GAS INLET
I 1/2" FPT PILOT GAS INLET
IN N/A COMBUSTION AIR INLET
K 1 3/8" OPENING ELECTRICAL INLET (CCP)
P 3/8" FPT LIGHT OIL INLET
R 3/8" FPT LIGHT OIL RETURN
ABBREVIATIONS (NOT ALL DEVICES ARE USED)
AAPS ATOMIZING AIR PRESSURE SWITCH
ADV AUTOMATIC DUMP VALVE
APS AIR PRESSURE SWITCH
ASV AIR SOLENOID VALVE
ATM ATMOSPHERE
ATS AUXILIARY TEMPERATURE SWITCH
CAPS COOLING AIR PRESS. SWITCH
CBV CONTINUOUS BLEED VALVE
CC CONDUCTIVITY CONTROLLER
CE CONDUCTIVITY ELEMENT
CWS COOLING WATER SOLENOID
FC FAIL CLOSED
FDS FUSED DISCONNECT SWITCH
FI FAIL INDETERMINATE
FL FAIL LOCKED
FO FAIL OPEN
FPS FUEL PRESSURE SWITCH - LOW
FPX FEEDWATER PRESS. TRANSDUCER
GFV GRAVITY FILL VALVE
GPSH GAS PRESSURE SWITCH - HIGH
GPSL GAS PRESSURE SWITCH - LOW
HFOV HIGH FIRE OIL VALVE
LC LEVEL CONTROL
LE LEVEL ELEMENT
LI LEVEL INDICATOR
LPS LIMIT PRESSURE SWITCH
LS LEVEL SWITCH
MGV MAIN GAS VALVE
MM MODULATING MOTOR
MOV MAIN OIL VALVE
MPS MODULATING PRESS. SWITCH
MWV MAKE-UP WATER VALVE
OPS OPERATING PRESSURE SWITCH
OPX OPERATING PRESS. TRANSDUCER
PAV PILOT AIR VALVE
PC PRESSURE CONTROL
PI PRESSURE INDICATOR
PPS PILOT PRESSURE SWITCH - LOW
PS PRESSURE SWITCH
PT PRESSURE TRANSDUCER
PV PILOT VALVE
PVV PILOT VENT VALVE
SSGV SAFETY SHUTOFF GAS VALVE
SSOV SAFETY SHUTOFF OIL VALVE
TC TEMPERATURE CONTROL
TDS TOTAL DISSOLVED SOLIDS
TDV TDS DUMP VALVE
TE TEMPERATURE ELEMENT
TI TEMPERATURE INDICATOR
TP TEST PORT
TS TEMPERATURE SWITCH
TCV TEMPERATURE CONTROL VALVE
VV VENT VALVE
CLAYTON INDUSTRIES
CITY OF INDUSTRY CA., 91744
P&ID (S)SFOG-150
HOTWELL W/ NO SKID
B REVISED SHEET 2 JL 01-22-09
A ORIGINAL DRAWING KT 10-26-07 RY
TOLERANCES EXCEPT AS NOTED
ANGULAR ± 1/2°
NTS
(S)SFOG-150
R020010
B
R020094
D
SHEET 1 OF 2
FOR PLATING ALLOWANCE, MICRO FINISH AND GENERAL MANUFACTURING TOLERANCES NOT SPECIFIED ON THIS DRAWING, SEE ENG. ORDER EO-1148

R020094



CUSTOMER CONNECTIONS		
SA	1 1/2" FPT	HOTWELL FEEDWATER OUTLET
SB	3" FPT	HOTWELL VENT
SC	1" FPT	HOTWELL DRAIN
SD	2 1/2" FPT	HOTWELL OVERFLOW
SE	3/4"FPT (MP/HP) 1 1/4" FPT(LP)	HOTWELL STEAM SUPPLY
SF	1 1/2" FPT	TRAP RETURN
SF1	1" FPT	HP CONDENSATE RETURN
SF2	1 1/2" FPT	LP CONDENSATE RETURN
SG	3/4" FPT	CHEM. INJECTION/BP RECIRC
SH	1/2" FPT	MAKEUP WATER INLET
SK1 SK2	1" FPT	SOFTENER INLET/OUTLET
SL	1" FPT	SOFTENER DRAIN
SM	1" NPT	BLOWDOWN TANK INLET
SN	1 1/2" FPT	BLOWDOWN TANK DISCHARGE
SO	2 1/2" MPT	BLOWDOWN TANK VENT
SP	3/4" FPT	BLOWDOWN COOLING WATER
SS	3/8" FPT	SAMPLE COOLER CONNECTIONS
BP1	1 1/4" FPT (MP) 1 1/2" FPT (LP)	BOOSTER PUMP INLET
BP2	1" FPT (MP) 2" FPT (LP)	BOOSTER PUMP OUTLET

	SG CUSTOMER CONNECTIONS		
	A	3" 300# RF FLG	SEPARATOR OUTLET
	B1	125-150 PSI:2" FPT 200-350 PSI:1 1/2" FPT	SAFETY VALVE OUTLET
	B2	N/A	SAFETY VALVE OUTLET
	C	2" FPT	FEEDWATER INLET
	D	1 " FPT	STEAM TRAP OUTLET
	E	1" FPT	SEPARATOR /BLOWDOWN DRAIN
	F1	1 1/2" FPT 1 " FPT (W/ VLV OPT KIT)	COIL DRAIN
	G	1/2" FPT	PUMP RELIEF VALVE
	GF	3/4" FPT	GRAVITY FILL
OPTIONAL	N	1/4" FPT	PUMP HEAD COOLING OUTLET
OPTIONAL	N	1/4" FPT	PUMP HEAD COOLING INLET
	O1	3/4" FPT	COIL BLOWDOWN
OPTIONAL	V	1" FPT	AUTO DUMP VALVE

R020094

WATER / STEAM SYSTEMS

NOTES:

1. ALL INTERCONNECT PIPING SHALL BE SIZED TO ALLOW PROPER FLOW. NO INTERCONNECT PIPING SHALL BE REDUCED BELOW LARGEST CONNECTION SIZE OF EQUIOPMENT SUPPLIED BY CLAYTON INDUSTRIES. MANIFOLDING OF COMMON CONNECTIONS MUST INCLUDE HEADER PIPE SIZE DERATING TO PROPERLY HANDLE TOTAL FLOW.
2. CUSTOMER DRAIN CONNECTIONS F1, & G MUST BE PIPED TO OPEN DRAIN TO PROVIDE A VISIBLE MEANS OF DETECTING WATER CONTAMINATION IN THE HEATING COIL AND LEAKAGE OF THE RELIEF VALVE.
3. ALL PIPE SIZES SHOWN ARE CONNECTION SIZES ONLY. IT IS THE INSTALLERS RESPONSIBILITY TO INCREASE PIPE SIZES AS NECESSARY TO ACHIEVE SPECIFIED FLOW VALUES. CLAYTON INSTALLATION INSTRUCTIONS MUST BE FOLLOWED AT ALL TIMES.
4. ● DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS SHIPPED LOOSE AND MUST BE INSTALLED BY OTHERS.
5. ●● DENOTES OPTIONAL EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. ITEMS SHOWN WITHIN CLAYTON SUPPLIED BOUNDARIES ARE INSTALLED BY CLAYTON WHEN PURCHASED. IF EXTERNAL TO BOUNDARIES, ITEMS ARE SHIPPED LOOSE WHEN PURCHASED AND INSTALLED BY CUSTOMER.
6. ◪ DENOTES REQUIRED EQUIPMENT AVAILABLE FOR PURCHASE FROM CLAYTON. EQUIPMENT IS INSTALLED BY CLAYTON WHEN PURCHASED FROM CLAYTON.
7. INCREASE ONE FULL PIPE SIZE AFTER FIRST ELBOW.
8. BOOSTER PUMPS REQUIRED IF RECEIVER TANK ELEVATION CANNOT PROVIDE SUFFICIENT NPSH TO FEEDWATER PUMP.
9. RELEVANT ONLY TO SE OPTION.
10. A FULL FLOW ATMOSPHERIC TEST VALVE IS REQUIRED AND MUST BE READILY ACCESSIBLE. INSTALL A CHAIN OPERATOR ON STOP AND TEST VALVES.
11. WATER SOFTENER REQUIRED IF DEMINERALIZED WATER / RO SYSTEM IS NOT AVAILABLE.
12. A BACK PRESSURE REGULATOR VALVE IS RECOMMENDED ON ALL INSTALLATIONS. A BACK PRESSURE REGULATOR VALVE AND A STOP CHECK VALVE ARE REQUIRED ON APC, AUTO START / STOP, MASTER LEAD LAG, MULTIPLE UNIT INSTALLATIONS AND / OR DESIGN STEAMING PRESSURES OF BELOW 65 PSIG.
13. CUSTOMER MUST INSTALL CLAYTON AVAILABLE CONTINUOUS BLEED VALVE KIT, AUTO TDS CONTROLLER KIT OR PROVIDE OTHER MEANS TO CONTROL THE TDS LEVEL IN THE SYSTEM.
14. BAROMETRIC DAMPER MAY BE REQUIRED TO MAINTAIN REQUIRED STACK DRAFT OF 0.00-0.25 WCI. BACK DRAFT DAMPER REQUIRED IN COLD WEATHER INSTALLATIONS TO PROTECT HEATING COIL FROM FREEZING.
15. REFER TO INSTALLATION MANUAL R-16600 FOR GENERAL INSTALLATION GUIDELINES AND RECOMMENDATIONS. RESPONSIBLITY TO MEET ALL APPLICABLE CODES AND STANDARDS SHALL BE BY OTHERS.
16. OIL & GAS MANIFOLDS ARE TWO SEPARATE ASSEMBLIES.THEY MUST BE MANUALLY CHANGED OUT PER REQUIREMENT.

LTR	REVISION	BY	DATE	CHK
B	REVISED HOTWELL, SPARGER, B1&B2, C. OF CONN. SIZES	JL	01-22-09	
A	ORIGINAL DRAWING	KT	10-25-07	RY

FOR PLATING ALLOWANCE, MICRO FINISH AND GENERAL MANUFACTURING TOLERANCES NOT SPECIFIED ON THIS DRAWING, SEE ENG. ORDER EO-1148

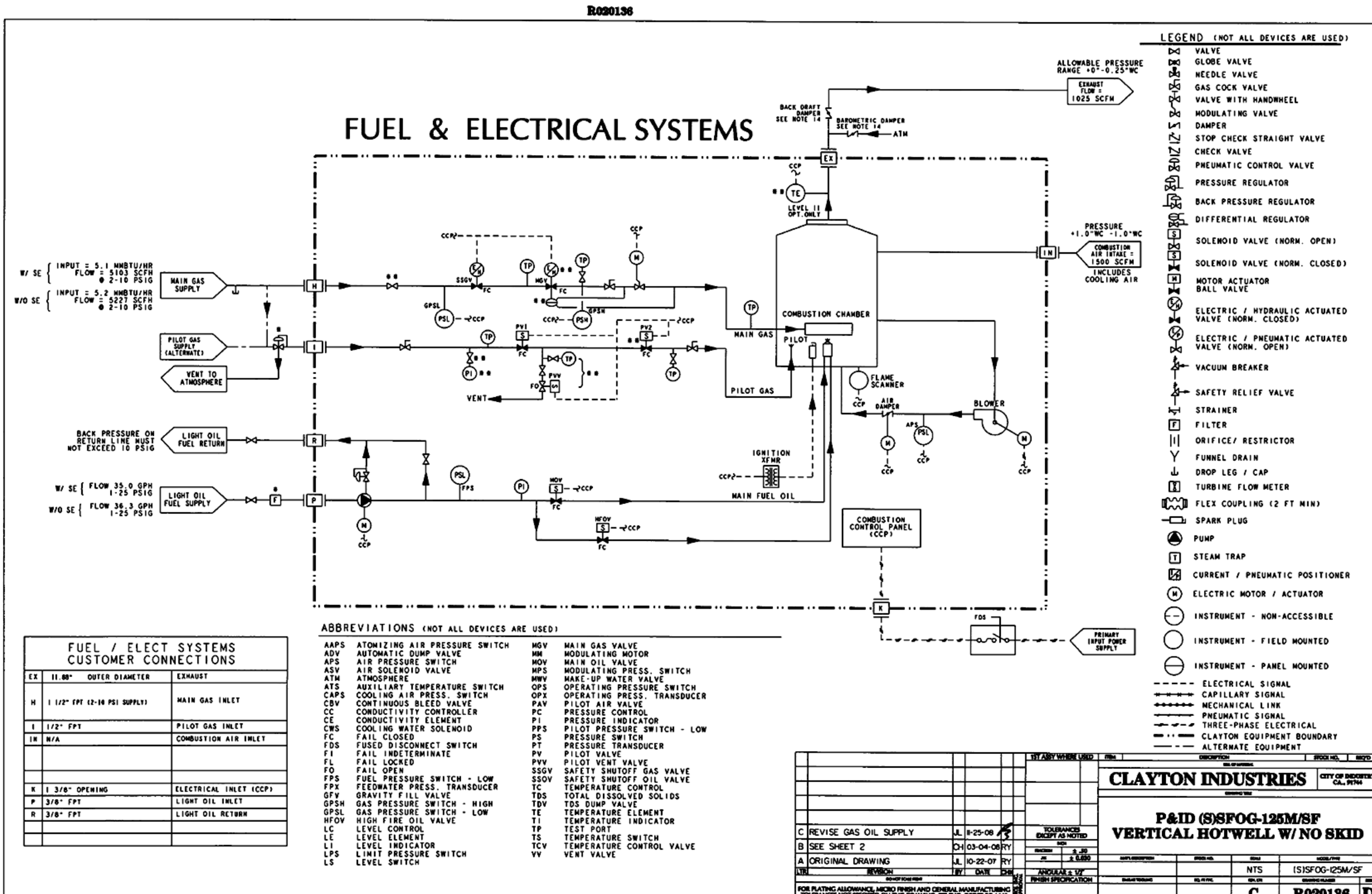
TOLERANCES EXCEPT AS NOTED
ANGULAR ± 1/2°
FINISH SPECIFICATION

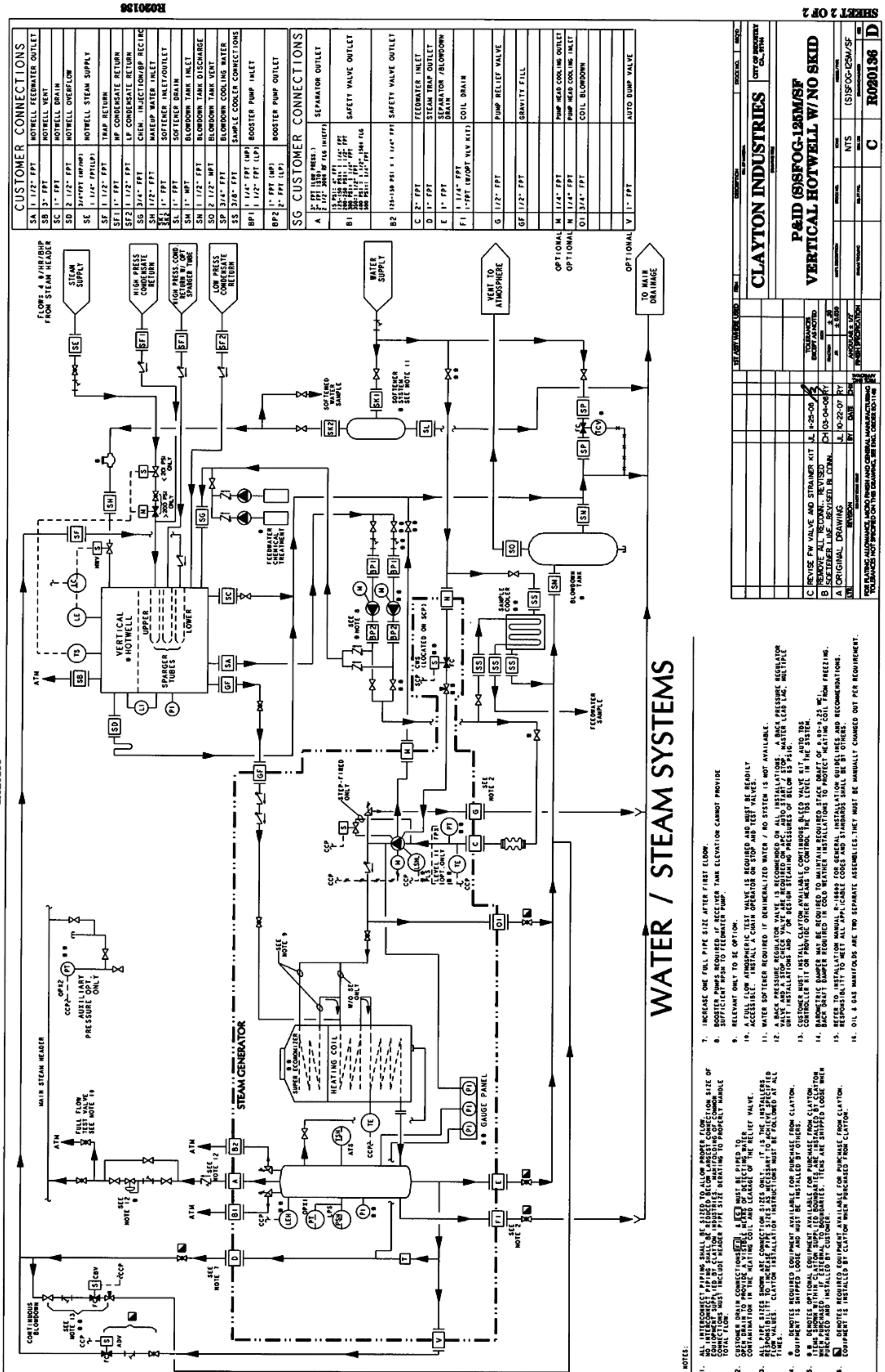
CLAYTON INDUSTRIES
CITY OF INDUSTRY CA. 91746

P&ID (S)SFOG-150
HOTWELL W/ NO SKID

NTS
(S)SFOG-150
R020010
B
R020094
D

SHEET 2 OF 2


R020136
FUEL & ELECTRICAL SYSTEMS
W/ SE { INPUT = 5.1 MMBTU/HR FLOW = 5103 SCFH @ 2-10 PSIG
W/O SE { INPUT = 5.2 MMBTU/HR FLOW = 5227 SCFH @ 2-10 PSIG
MAIN GAS SUPPLY
PILOT GAS SUPPLY (ALTERNATE)
VENT TO ATMOSPHERE
BACK PRESSURE ON RETURN LINE MUST NOT EXCEED 10 PSIG
LIGHT OIL FUEL RETURN
W/ SE { FLOW 35.0 GPH 1-25 PSIG
W/O SE { FLOW 36.3 GPH 1-25 PSIG
LIGHT OIL FUEL SUPPLY
COMBUSTION CHAMBER
MAIN GAS
PILOT
PILOT GAS
MAIN FUEL OIL
IGNITION XFMR
FLAME SCANNER
AIR DAMPER
BLOWER
COMBUSTION CONTROL PANEL (CCP)
PRIMARY INPUT POWER SUPPLY
BACK DRAFT DAMPER SEE NOTE 14
BAROMETRIC DAMPER SEE NOTE 14
ATM
LEVEL II OPT. ONLY
ALLOWABLE PRESSURE RANGE +0"-0.25"WC
EXHAUST FLOW = 1025 SCFM
PRESSURE +1.0"WC -1.0"WC
COMBUSTION AIR INTAKE = 1500 SCFM INCLUDES COOLING AIR
LEGEND (NOT ALL DEVICES ARE USED)
VALVE
GLOBE VALVE
NEEDLE VALVE
GAS COCK VALVE
VALVE WITH HANDWHEEL
MODULATING VALVE
DAMPER
STOP CHECK STRAIGHT VALVE
CHECK VALVE
PNEUMATIC CONTROL VALVE
PRESSURE REGULATOR
BACK PRESSURE REGULATOR
DIFFERENTIAL REGULATOR
SOLENOID VALVE (NORM. OPEN)
SOLENOID VALVE (NORM. CLOSED)
MOTOR ACTUATOR BALL VALVE
ELECTRIC / HYDRAULIC ACTUATED VALVE (NORM. CLOSED)
ELECTRIC / PNEUMATIC ACTUATED VALVE (NORM. OPEN)
VACUUM BREAKER
SAFETY RELIEF VALVE
STRAINER
FILTER
ORIFICE/ RESTRICTOR
FUNNEL DRAIN
DROP LEG / CAP
TURBINE FLOW METER
FLEX COUPLING (2 FT MIN)
SPARK PLUG
PUMP
STEAM TRAP
CURRENT / PNEUMATIC POSITIONER
ELECTRIC MOTOR / ACTUATOR
INSTRUMENT - NON-ACCESSIBLE
INSTRUMENT - FIELD MOUNTED
INSTRUMENT - PANEL MOUNTED
ELECTRICAL SIGNAL
CAPILLARY SIGNAL
MECHANICAL LINK
PNEUMATIC SIGNAL
THREE-PHASE ELECTRICAL
CLAYTON EQUIPMENT BOUNDARY
ALTERNATE EQUIPMENT
FUEL / ELECT SYSTEMS CUSTOMER CONNECTIONS
EX | 11.88" OUTER DIAMETER | EXHAUST
H | 1 1/2" FPT (2-10 PSI SUPPLY) | MAIN GAS INLET
I | 1/2" FPT | PILOT GAS INLET
IN | N/A | COMBUSTION AIR INLET
K | 1 3/8" OPENING | ELECTRICAL INLET (CCP)
P | 3/8" FPT | LIGHT OIL INLET
R | 3/8" FPT | LIGHT OIL RETURN
ABBREVIATIONS (NOT ALL DEVICES ARE USED)
AAPS ATOMIZING AIR PRESSURE SWITCH
ADV AUTOMATIC DUMP VALVE
APS AIR PRESSURE SWITCH
ASV AIR SOLENOID VALVE
ATM ATMOSPHERE
ATS AUXILIARY TEMPERATURE SWITCH
CAPS COOLING AIR PRESS. SWITCH
CBV CONTINUOUS BLEED VALVE
CC CONDUCTIVITY CONTROLLER
CE CONDUCTIVITY ELEMENT
CWS COOLING WATER SOLENOID
FC FAIL CLOSED
FDS FUSED DISCONNECT SWITCH
FI FAIL INDETERMINATE
FL FAIL LOCKED
FO FAIL OPEN
FPS FUEL PRESSURE SWITCH - LOW
FPX FEEDWATER PRESS. TRANSDUCER
GFV GRAVITY FILL VALVE
GPSH GAS PRESSURE SWITCH - HIGH
GPSL GAS PRESSURE SWITCH - LOW
HFOV HIGH FIRE OIL VALVE
LC LEVEL CONTROL
LE LEVEL ELEMENT
LI LEVEL INDICATOR
LPS LIMIT PRESSURE SWITCH
LS LEVEL SWITCH
MGV MAIN GAS VALVE
MM MODULATING MOTOR
MOV MAIN OIL VALVE
MPS MODULATING PRESS. SWITCH
MWV MAKE-UP WATER VALVE
OPS OPERATING PRESSURE SWITCH
OPX OPERATING PRESS. TRANSDUCER
PAV PILOT AIR VALVE
PC PRESSURE CONTROL
PI PRESSURE INDICATOR
PPS PILOT PRESSURE SWITCH - LOW
PS PRESSURE SWITCH
PT PRESSURE TRANSDUCER
PV PILOT VALVE
PVV PILOT VENT VALVE
SSGV SAFETY SHUTOFF GAS VALVE
SSOV SAFETY SHUTOFF OIL VALVE
TC TEMPERATURE CONTROL
TDS TOTAL DISSOLVED SOLIDS
TDV TDS DUMP VALVE
TE TEMPERATURE ELEMENT
TI TEMPERATURE INDICATOR
TP TEST PORT
TS TEMPERATURE SWITCH
TCV TEMPERATURE CONTROL VALVE
VV VENT VALVE
C REVISE GAS OIL SUPPLY JL 11-25-08
B SEE SHEET 2 CH 03-04-08 RY
A ORIGINAL DRAWING JL 10-22-07 RY
CLAYTON INDUSTRIES
CITY OF INDUSTRY CA. 91744
P&ID (S)SFOG-125M/SF
VERTICAL HOTWELL W/ NO SKID
NTS
(S)SFOG-125M/SF
C
R020136
D
SHEET 1 OF 2


SHEET 2 OF 2
R020136
CUSTOMER CONNECTIONS
SA 1 1/2" FPT HOTWELL FEEDWATER OUTLET
SB 3" FPT HOTWELL VENT
SC 1" FPT HOTWELL DRAIN
SD 2 1/2" FPT HOTWELL OVERFLOW
SE 3/4"FPT (HP/MP) 1 1/4" FPT(LP) HOTWELL STEAM SUPPLY
SF 1 1/2" FPT TRAP RETURN
SF1 1" FPT HP CONDENSATE RETURN
SF2 1 1/2" FPT LP CONDENSATE RETURN
SG 3/4" FPT CHEM. INJECTION/BP RECIRC
SH 1 1/2" FPT MAKEUP WATER INLET
SK1 SK2 1" FPT SOFTENER INLET/OUTLET
SL 1" FPT SOFTENER DRAIN
SM 1" MPT BLOWDOWN TANK INLET
SN 1 1/2" FPT BLOWDOWN TANK DISCHARGE
SO 2 1/2" MPT BLOWDOWN TANK VENT
SP 3/4" FPT BLOWDOWN COOLING WATER
SS 3/8" FPT SAMPLE COOLER CONNECTIONS
BP1 1 1/4" FPT (HP) 1 1/2" FPT (LP) BOOSTER PUMP INLET
BP2 2" FPT (HP) 2" FPT (LP) BOOSTER PUMP OUTLET
SG CUSTOMER CONNECTIONS
A SEPARATOR OUTLET
B1 SAFETY VALVE OUTLET
B2 125-150 PSI = 1 1/4" FPT SAFETY VALVE OUTLET
C 2" FPT FEEDWATER INLET
D 1" FPT STEAM TRAP OUTLET
E 1" FPT SEPARATOR /BLOWDOWN DRAIN
F1 1 1/4" FPT 1"FPT (W/OPT VLV KIT) COIL DRAIN
G 1/2" FPT PUMP RELIEF VALVE
GF 1/2" FPT GRAVITY FILL
M 1/4" FPT PUMP HEAD COOLING OUTLET
N 1/4" FPT PUMP HEAD COOLING INLET
O1 3/4" FPT COIL BLOWDOWN
V 1" FPT AUTO DUMP VALVE
STEAM SUPPLY
HIGH PRESS CONDENSATE RETURN
LOW PRESS CONDENSATE RETURN
WATER SUPPLY
VENT TO ATMOSPHERE
TO MAIN DRAINAGE
VERTICAL HOTWELL
SPARGER TUBES
STEAM GENERATOR
HEATING COIL
SUPER ECONOMIZER
GAUGE PANEL
BLOWDOWN TANK
SAMPLE COOLER
FEEDWATER SAMPLE
MAIN STEAM HEADER
CONTINUOUS BLOWDOWN
WATER / STEAM SYSTEMS
NOTES:
CLAYTON INDUSTRIES
P&ID (S)SFOG-125M/SF
VERTICAL HOTWELL W/ NO SKID
R020136 D

Appendix D

Installing SE

(Super Economizer)

Option

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INTRODUCTION

A Clayton SE (Super Economizer) Coil provides added efficiency to your existing Clayton steam generator/fluid heater. The SE coil allows feedwater supply to be preheated prior to entering the main heating section. This preheated fluid helps to reduce the energy consumption of the machine without compromising its output capacity.

An SE coil is offered as a kit. This kit includes the coil assembly, outer shell extensions, band clamps, piping, and necessary hardware.

IMPORTANT

Before ordering an SE Kit, verify there is ample overhead clearance above the machine. An SE section adds twenty-four to forty-eight inches of height to the machine. Additional clearance must also be available for lifting SE coil onto the main coil. See Section 6.7 for height requirements.

WARNING

An SE coil assembly weighs several hundred pounds. Make sure all safety measures are observed throughout the SE Kit installation process. Make sure the lifting apparatus that will be used to hoist the SE coil assembly is designed for lifting such weights.

NOTE

It is always recommended that these procedures be reviewed completely before beginning the SE Kit installation.

INSTALLATION

Execute a dry shutdown of the machine. See Section IV in the Steam Generator/Fluid Heater Instruction Manual for procedure. Allow the machine to cool.

WARNING

Secure the machine to prevent accidental start up during SE Kit installation.

Remove Heater Covers

a. Disconnect and remove the flue exhaust duct from the heater cover.

b. Disconnect and remove the existing feedwater supply and discharge piping from the machine.

c. Remove the outer heater cover clamp bands and outer heater cover (See Figure 1.)

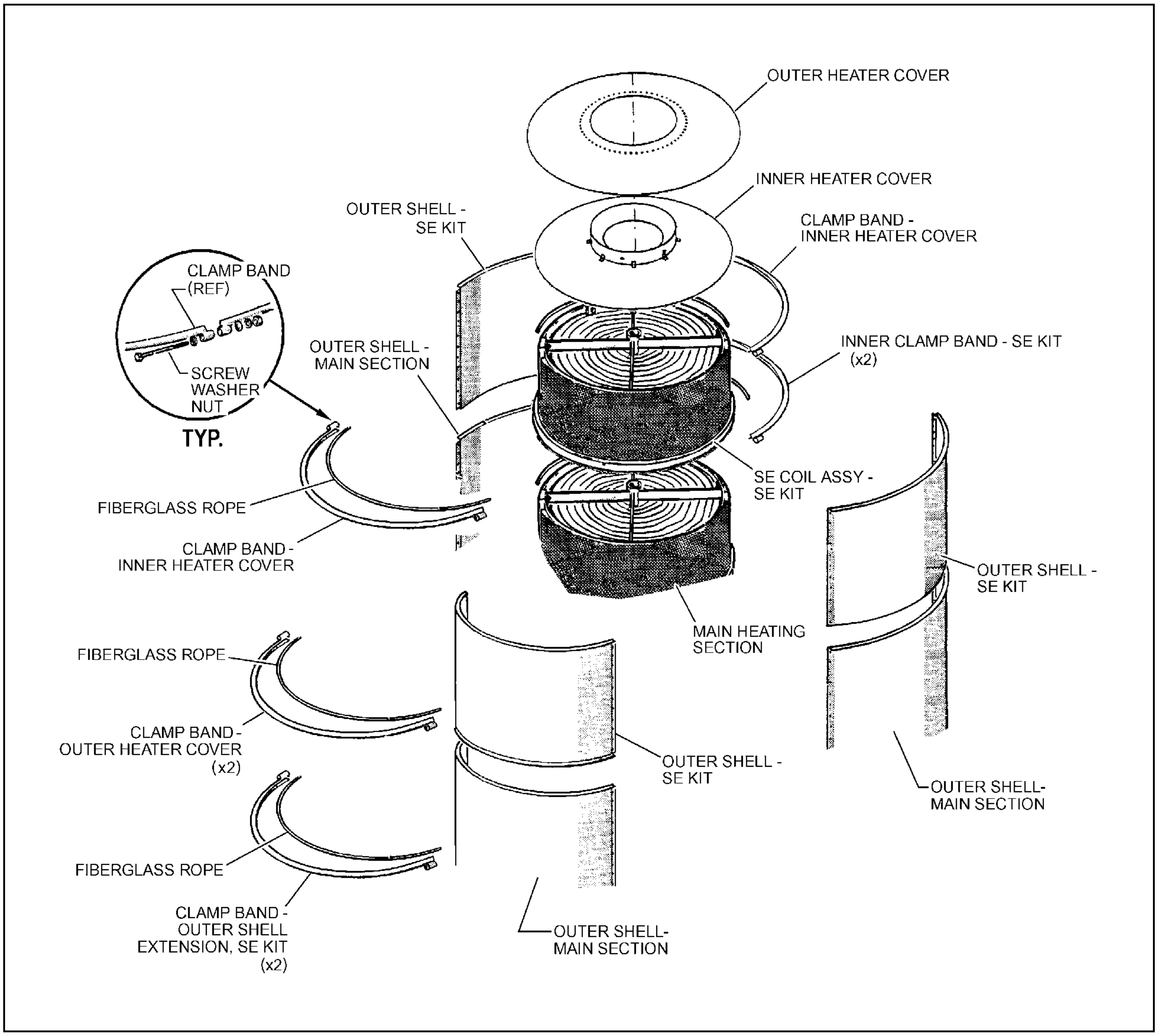

Figure 1 SE Coil Kit installation diagram (typical)

d. If applicable, remove the outer shell extension clamp bands and outer shell extension.

e. Remove the inner heater cover clamp bands and inner heater cover.

Install SE Coil Assembly

(See Figure 1.)

a. Prepare the main heating section flange ring surface with a layer of G. S. Teflon Thread Sealing Compound. This will aid in adjusting the SE coil assembly into alignment with the main heating section.

b. Lift the SE coil assembly up onto the main heating section.

NOTE

If desired, the inner heater cover may be installed on the SE coil assembly prior to lifting it onto the main heating section.

c. Align the SE coil assembly's bottom flange ring with the main coil section flange ring.

d. Rotate the SE coil assembly, as needed, to align the feedwater inlet(s), as shown in Figure 2.

e. Install the inner clamp bands around the main heating section flange ring and the SE coil assembly's bottom flange ring. Secure the clamp bands with their attaching hardware.

f. Place and align the inner heater cover on SE coil assembly.

g. Install the inner heater cover clamp bands around the heater cover and the SE coil assembly's top flange ring. Secure the clamp bands with their attaching hardware.

Install Outer Shells

a. Lift the rear outer shell piece (the shell piece with the cut-outs) up around the rear-side of the SE coil assembly and the feedwater inlet/discharge, allowing it to rest on the main outer shell below. Using a set of self-locking clamps, Vise-Grip® pliers for example, clamp the SE outer shell to the main outer shell.

b. Lift the remaining outer shell piece into place. Screw the two shell ends together. Align the assembled SE outer shells with the main outer shells below.

c. Install the outer clamp bands around the main outer shell flange and the SE outer shell flange. Secure the clamp bands with their attaching hardware.

d. Install the outer heater cover in the same manner as the inner heater cover was installed. Refer to steps f and g in the previous section.

e. Install the patch plates around the feedwater inlet piping and the feedwater discharge piping.

Install Piping

a. Pre-assemble the SE Kit feedwater supply and feedwater discharge piping and flanges.

b. Install the pre-assembled SE piping to the feedwater supply side and the feedwater discharge side of the machine, as shown in Figure 2.

IMPORTANT

Before starting the steam generator/fluid heater, verify all piping connections, outer shell assemblies, and clamp bands are secure.

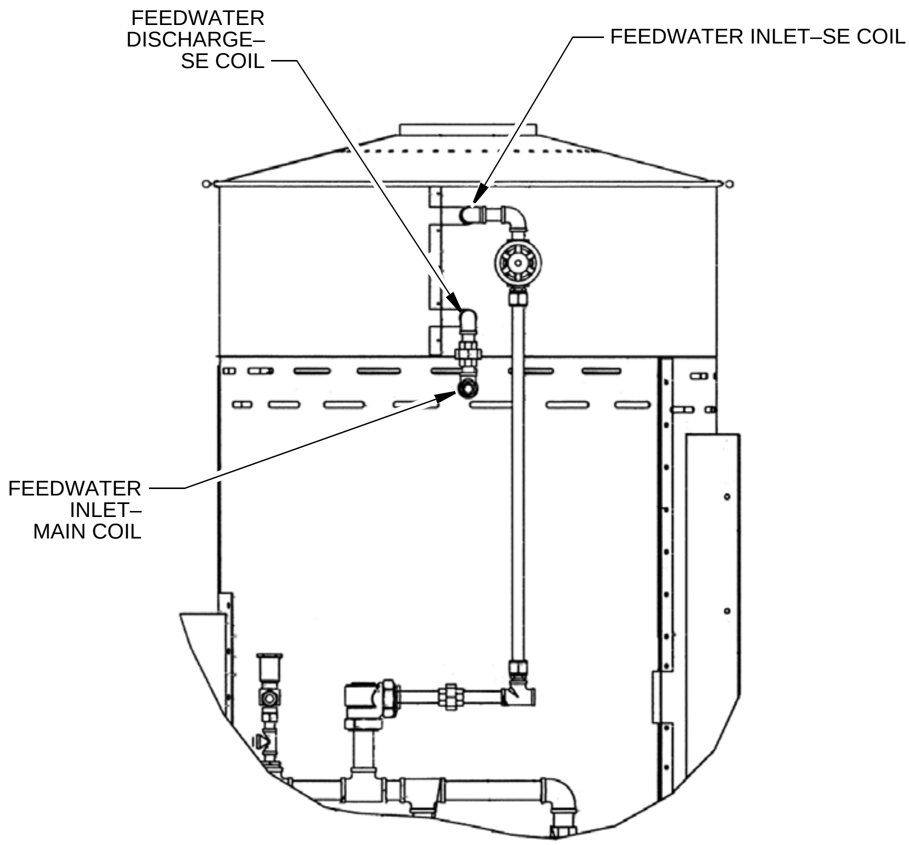

Figure 2 SE Kit completed hookup

Check Completed SE Kit Installation

a. Start and fill the heating unit without burner operation. See the filling procedure in Section IV of the Steam Generator/Fluid Heater Instruction Manual.

b. Check for leakage around connections of the newly installed SE Kit piping.

c. Boil out SE coil using soft water. See the “Conditioning of New Installations” procedure in Section III of the Steam Generator/Fluid Heater Instruction Manual.

The machine should be ready to be placed into regular operation at this point.

NOTE

Some parameters of the control system may require adjustment with the added SE Kit. Consult your Clayton Service Representative for further details.

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