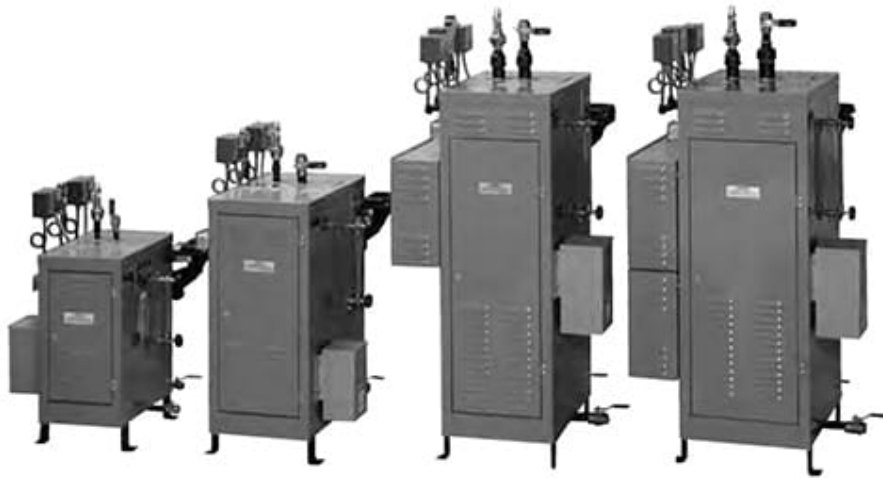


## Installation Instructions

# **CES-6 through CES-180 CSSB-6 through CSSB-180 Electric Steam Generator**

**Standard Trim is 100 PSI — 0-90  
Operating Pressure Range**



PQ444-2  
161-562789-002  
March 2023

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# Scope

These guidelines are provided to assist in the handling, storage, installation, and maintenance for CES or CSSB steam generator. Instructions are provided to prevent work site injury and aid in the handling, installation, and commissioning of this equipment.

It is the responsibility of the site user to fully read and understand this manual prior to performing any work in conjunction with Chromalox equipment.

It is the responsibility of the purchaser of the steam generator to ensure that safe systems of work are adopted for all personnel operating and maintaining the steam generator including testing.

It is a warranty requirement to comply with these instructions and documented evidence shall be maintained in the form of a signed checklist as per the Appendix A or operator's equivalent.

**NOTE:** A completed Maintenance Checklist or equivalent will be required in the event of any safety or warranty claim.

Chromalox has a team of fully trained technicians and engineers who are available to provide a specialist inspection, commissioning, start-up and/or maintenance service. For further details, please contact our customer service department at 1-800-443-2640

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## Precautions & Warnings


### General Equipment Warnings

The user must ensure that their employees are fully trained and supervised in the proper working procedures in order to ensure their safety. The plant must be maintained in a safe condition.

Personnel must be fully aware of the risk associated with electricity and hazardous area usage. Only qualified personnel shall perform work on this unit during installation, operation, and maintenance procedures.

This equipment was specifically designed for its intended purpose and shall not be used for any other application without a complete re-evaluation by the manufacturer. The operator shall ensure these instructions are kept with the equipment to prevent any misuse for which the equipment has not been designed.



The Safety Alert Symbol  is used on the product, consult the documentation to find out the nature of the potential hazard, any actions to be taken, and the consequences of not adhering to the requirement.



**DANGER** – will result in serious injury or death.



**WARNING** – could result in serious injury or death.



**CAUTION** – may result in minor or moderate injury.



Means Protective Earth (ground) terminal.

### Electrical Safety

#### **⚠ WARNING**

**ELECTRIC SHOCK HAZARD Disconnect all power before installing or servicing steam generator. Steam generator must be installed or serviced by a qualified person. Failure to do so could result in personal injury or property damage.**

All personnel working on electrical equipment shall strictly adhere to the applicable local, countrywide, and industry-recognized standards. Examples of such standards may include, but not limited to, the IEC (International Electric Code), NEC (National Electric Code), OSHA (Occupational Safety and Health Administration), NFPA (National Fire Protection Association), Health and Safety Work Act 1974, Factories Act 1961, and others. Failure to adhere to proper safety standards, including proper use of PPE (Personal Protective Equipment) may result in injury or even death. Chromalox will not be liable for failure of customer to adhere to governing standards.

De-energize all equipment before opening junction boxes and control panels and follow the appropriate lockout/tagout procedures. Do not work on live circuits. Qualified persons and associated equipment must be effectively grounded in accordance with the applicable governing standard, such as the IEC (International Electric Code) to eliminate shock hazard. During any service work, please follow the proper electrical isolation, lockout/tagout, and disconnection procedures.

## Pressure & Explosion Warnings

### **⚠ WARNING**

**EXPLOSION HAZARD** When heating in closed vessels, controls and back-up controls must be used to regulate build-up of temperature and/or pressure. Failure to do so could result in personal injury or property damage.

User must understand the pressure and temperature ratings applicable to the particular heater unit.

Before contemplating fill/pressurization, discharge or disconnection, the installation, operation, and maintenance instructions must be read fully. The equipment is not to be disassembled while under pressure or vacuum. The operator must provide devices to prevent physical access whilst pressure or a vacuum exists.

The system owner must provide adequate means of draining and venting of pressure from equipment. The system owner must make provision to ensure proper sealing and pressurization integrity at all connection points.

The system owner must provide for suitable pressure relief measures and procedures to avoid dangerous discharge of pressure relief blow off and to protect against exceeding the vessel maximum design pressure. The operator must ensure that momentary pressure surges be kept to 10% of maximum allowable pressure.

Pressurization of the system shall be gradually applied, if possible, in order to protect pressure connection integrity and minimize risk in the event of improper sealing of connections.

User shall not exceed design conditions per unit nameplate at any time.

## Brittle Fracture

### **⚠ WARNING**

***\*While maintaining CE Certification\****

***The user must not operate the steam generators below a minimum ambient temperature of 34°F. The vessel cannot be subject to thermal or mechanical shock. Failure to do so could result in personal injury or property damage.***

## Temperature & Combustion Warnings



***The system owner must provide devices and warnings to prevent physical contact of personnel with hot surfaces.***

### **⚠ WARNING**

***Since heaters are capable of developing high temperatures, extreme care should be taken to provide adequate spacing between hot surfaces and combustibles. Avoid operation of heater near combustible fluids or combustible gas laden atmospheres. Failure to do so could result in personal injury or property damage.***

The steam generator should be installed with over temperature protection and process flow interlock devices. These devices must be connected to the appropriate alarm / shutdown devices in the control panel. These safety systems must be tested and their correct operation verified prior to applying power to the steam generator.

Minimum designed flow must be maintained through the steam generator before energizing.

The heater shall be allowed to cool off to approximately 35-90°F (20-50°C) prior to the elimination of flow through the system in order to eliminate the risk of over temperature due to latent heat in the elements/system. Where necessary, the system owner must provide means of safe removal of residual heat after shutdown.

The system owner must ensure that steps are taken to avoid a dangerous accumulation of ignitable mixtures of combustible substance that could result in explosion or fire. Where necessary, the system owner must provide for sampling of the vessel from time to time to allow evaluation of the properties of the fluid so as to avoid risks related to deposits and/or corrosion.

Where necessary, the system owner must provide suitable accessories to meet damage-limitation requirements in the event of external fire.

# General Product Overview

## Applications

CES-B Medium Capacity Steam Generators are sized to match the most common requirements for steam in many commercial applications, laboratories, hospitals and industrial plants. CES-B Steam generators are ideal for stand-by operations requiring high pressure steam in remote areas of an industrial plant which might incur excessive pipe losses or expensive piping costs to supply from a central steam supply. They are ideal for off season periods when steam is needed for critical processes or humidification when the main steam generator is shut down.

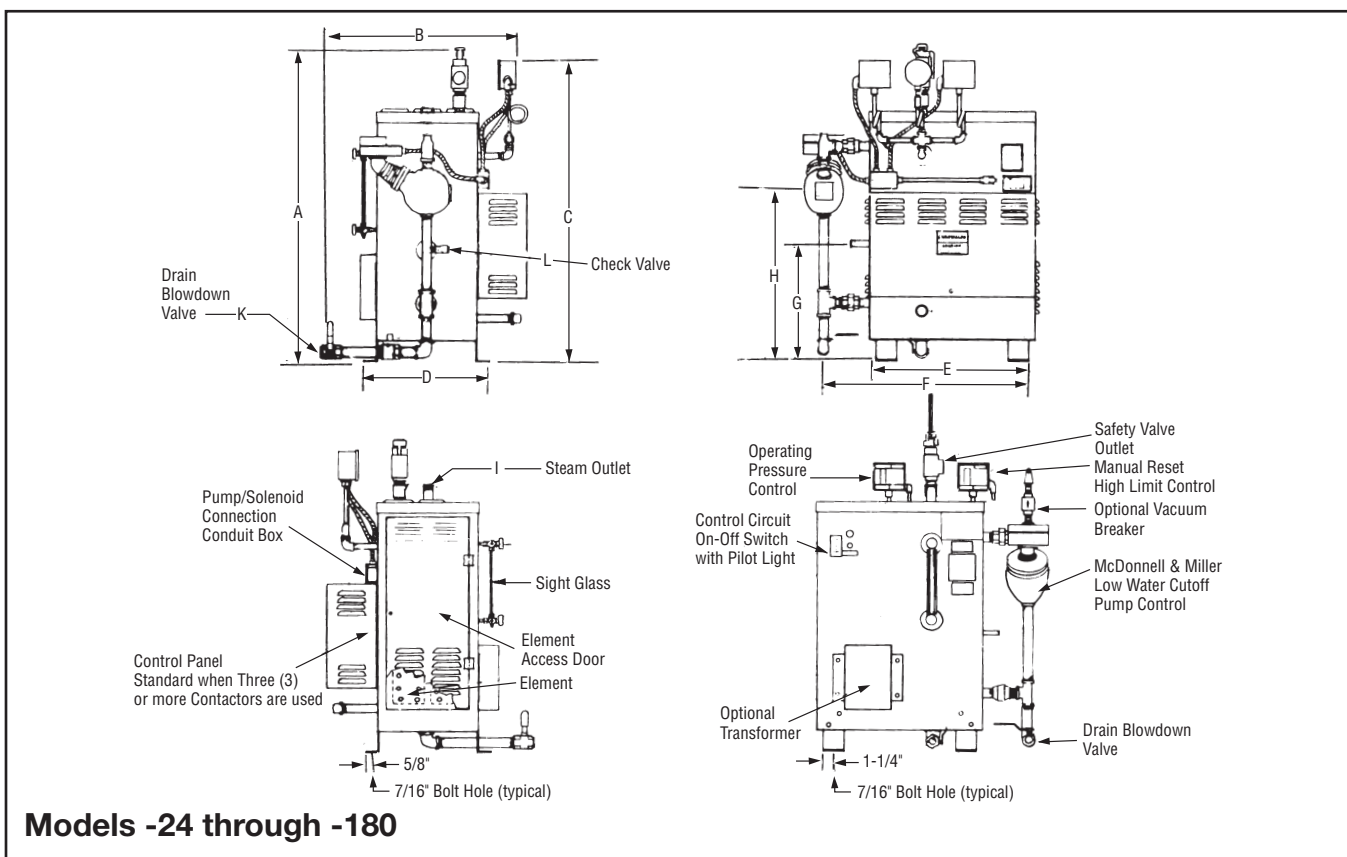
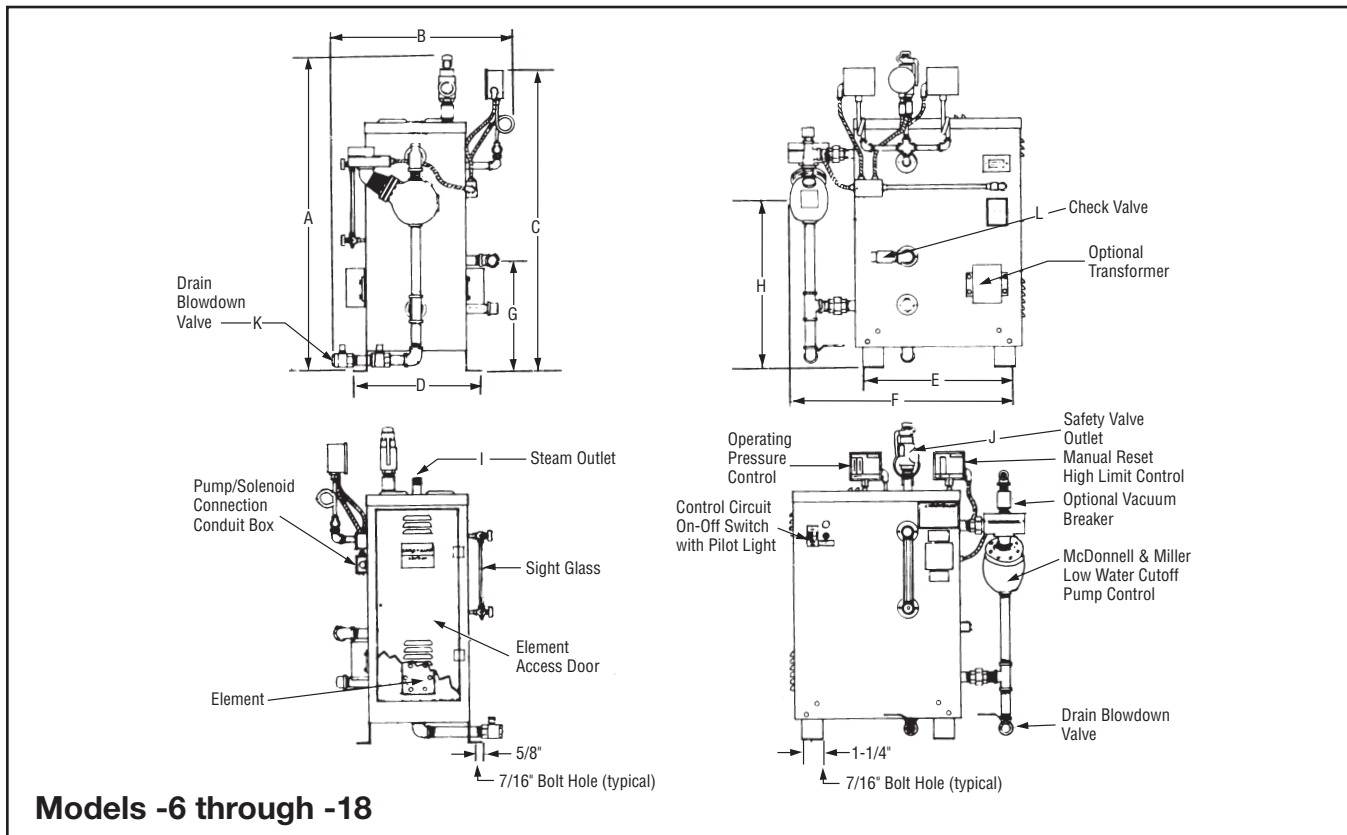
CSSB All Stainless Steel Steam Boilers are specifically designed for use where the purity of the heating fluid must be maintained. Typical applications include sterilizers and autoclaves in research, biological and pharmaceutical laboratories and humidification equipment for the electronics industry (solid state substrates).

CSSB boilers utilize de-ionized, demineralized or distilled water to provide pure steam, free of minerals or undesirable chemical additives. Pure steam eliminates the possibility of carry over of contaminants into the process.

## Features

Steam Generators are trimmed at 100 psig for operation to 90 psig. They are also available (on order) with 15, 30, 50 and 150 psig trim. Steam generators trimmed at 150 psig can be operated up to 135 psig corresponding to 353°F. Steam Generators trimmed at 150 psig use a special ASME Section I, Code "S" pressure vessel. All catalog steam generators are UL Listed, CSA Certified, and CE Certified.

# Dimensions



# Receiving, Handling & Lifting



The packaging supplied is only suitable for short term indoor storage.

Any outdoor storage is considered temporary (less than 48 hours) and the entire system must immediately be protected from the outdoor elements with appropriate coverings. The coverings shall be suitably covered for protection against adverse weather, using a tear-free waterproof membrane such as a tarpaulin. The equipment shall be placed on dry ground or on blocks to lift it clear of any possible water.

Heater equipment shall be unpacked within 48 hours of receipt for proper inspection.

*For long term storage needs, please refer to the Appendix for Long Term Storage Instruction.*

The unit must be handled with care and stored in clean, dry conditions as befits any electrical apparatus. Units must not be exposed to wet or damp atmospheres. Units shall be stored in areas with uniform temperature control to prevent condensate accumulation.

## Cardboard Packaging

All staples to be removed with extractor tool only. Open cardboard flaps and remove heater from packaging. Remove any polyethylene covering using sharp knife, taking care not to damage equipment or paintwork with knife blade.

## Wood Crating

All nails to be removed with nail extractor tool only.

Extract nails, remove batten, and remove lumber from each side individually. Be sure to secure equipment from each side after removing crating. The recommended order for panel removal is – top, side panel, front panel, opposite side panel, and rear panel.

Remove any plastic covering using a sharp knife, taking care not to damage equipment or paintwork.

## Equipment Handling & Lifting

Ensure that the steam generator unit is correctly moved and installed by technically qualified and competent persons experienced in the class of work involved. Know the capabilities of the lifting equipment available to handle the weight of the system. At no time should any person be under, or in contact with, a suspended load.

Ensure that all precautions are taken regarding the weight of the steam generator. Lifting equipment shall have capacity for the given weight. Personnel involved in the installation need to be aware that one end of the

heater will be heavier than the other and that this will affect the lifting.

Exercise care during any movement and placement operations to prevent falling or unintentional rolling or tipping.

Handle the systems with care to avoid damage to the heater electrical enclosure(s) and other protruding device(s).

The unit will be shipped with skid framing; keep the system secured to the shipping skid to prevent distortion of the frame during moving and to minimize tipping.

Equipment can be moved by either crane or fork lift truck (preference should be given to crane handling whenever possible). Slings or ropes must be of good condition, showing no signs of fraying or damage. Using suitable lifting chains, ropes, or slings to prevent damage to the heating elements, observe the following safety points:

- All lifting tackle / equipment must have a safe working load (SWL) capacity in excess of that of the equipment weight and include for snatch factors etc.
- The slings or ropes must have sufficient length to keep the angle between the slings / ropes and the top of the equipment greater than 45°.
- Too short a sling / rope will reduce this angle and so lead to unacceptably high stresses on the eye-bolts/lifting lugs.
- Certain equipment configurations may require a lifting beam to achieve a safe lift.
- Additional support should be provided, as necessary, when lifting, to counteract any out of balance that may be present.
- The swinging of the suspended load must be prevented and / or eased by suitable means.
- Forklift arms should be spaced as far as the configuration of the equipment allows and be long enough to go completely under the equipment.
- Move equipment by forklift truck only as far as is absolutely necessary, particularly at the assembly site and on uneven ground.

The destination needs to be free from obstructions. Ensure equipment is lowered gently to clean and level support to prevent damage.

# Inspection & Storage

Each unit is manufactured with great care from the highest quality materials and thoroughly inspected before leaving the manufacturing facility. Examine the equipment against the packing list to check that the quantity received, and its identity is complete.

The unit must be handled with care and stored in clean, dry conditions as befits any electrical apparatus. Units must not be exposed to wet or damp atmospheres. Units shall be stored in areas with uniform temperature control to prevent condensation accumulation.

Any outdoor storage is considered temporary (less than 48 hours) and the entire system must immediately be protected from the outdoor elements with appropriate coverings. The coverings shall be suitably covered for protection against adverse weather, using a tear-free waterproof membrane such as a tarpaulin. The equipment shall be placed on dry ground or on blocks to lift it clear of any possible water.

Inspect the equipment/system to ensure no damage has occurred within 48 hours of receipt. If damaged, please report any claims to your carrier and contact Chromalox within 7 days for repair options. Do not attempt to operate damaged equipment.

***For long term storage needs, please refer to the Appendix for Long Term Storage Instruction.***

Following inspection, units that are not going to be immediately installed and energized shall be properly

stored to ensure no damage will occur from moisture accumulation. Units must be stored in clean, dry conditions as befits any electrical apparatus. Units must not be exposed to wet or damp atmospheres. Units shall be stored indoors in a heated area with uniform temperature control to prevent moisture accumulation.

Units with anti-condensation heaters shall be powered, according to instructions.

Units without anti-condensation heaters shall have new desiccant packs installed in the terminal housing, according to volume size, with any conduit hubs plugged and the housing shrink-wrapped in a moisture proof material. Refer to the Long-Term Storage instructions for guidelines on desiccant sizing.

For units that will be de-energized for a period of more than four weeks after receiving must be stored in accordance with Chromalox Long Term Storage Instructions – Refer to the Appendix Section B.

It is a warranty requirement to comply with these instructions and documented evidence shall be maintained in the form of a signed checklist as per the Appendix A or operator's equivalent.

**NOTE:** A completed Maintenance Checklist or equivalent will be required in the event of any safety or warranty claim.



# Site Preparation & Heater Design Considerations

## Maintenance & Safety Considerations

Provide adequate space at the terminal end to permit proper access to terminal housing for installation and maintenance.

When positioning the steam generator, at least 21" of clearance shall be provided for the removal of the heater bundles from the installation for servicing purposes. Be sure to consult local building codes for minimum distance for clearance, access, and personnel protection.

Provide adequate spacing from the unit and related piping to nearest combustible material.

Do not operate steam generator near combustible fluids or in combustible vapor or gas laden atmosphere.

## Mounting, Connection, & Support Considerations

In a forced circulating system, the pump outlet should be connected to the feedwater inlet check valve.

If using two or more steam generators for an in-line application, they should be arranged in a parallel configuration.

Unit should never be located at the highest point of a system due to the possible accumulation of air pockets.

A solid foundation pad should be prepared for mounting of the steam. If the steam generator will be located in an enclosed or confined space, a minimum of 28" of clear walking area around the unit must be maintained for personnel safety.

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## Installation

### General

This section outlines the contractor's responsibility for the erection and installation of the equipment supplied.

The steam generator unit shall be installed by the contractor under the surveillance of the client's site engineers, in accordance with these instructions.

The installation shall be carried out in complete accordance with this document, which shall be read as complimentary to all associated contract documents (such as site conditions, contract specifications and drawings) and national legislation / regulations.

The erection contractor shall ensure that their employees are fully trained and supervised in the appropriate site working procedures in order to ensure their safety. The site must be maintained in a safe condition at all times.

The erection contractor shall ensure that their site installation personnel are issued with copies of all relevant drawings, material schedules and specifications to enable them to fulfil their obligations.

The erection contractor shall be responsible for providing all tools and equipment necessary to carry out the installation as required on the schedule drawings.

General safety precautions listed in the plant Safety Manual shall be complied with to prevent injury to personnel or damage to equipment.

**This unit must be installed in accordance with all local codes. The local specifications and codes define the requirements of use for installation and operation of equipment in potentially hazardous atmospheres. The operator installing the heater must**

**either be fully conversant with local specifications or have access to it to ensure the heater is correctly installed.**

Ensure that the area safety supervisor and others in the vicinity are aware that work is being undertaken and post warning notices. A Job Hazard Analysis or Work Permit Review should be completed prior to installation. Ensure that the appropriate safety equipment and clothing is worn. Beware of wet or slippery ladder rungs and working areas if working aloft.

Any persons about to perform installation procedures with any electric heater must first educate themselves as to the nature and extent of any potential hazards that may be encountered. These hazards should be identified by a risk analysis undertaken by the responsible person within the installation team prior to commencement of the installation process.

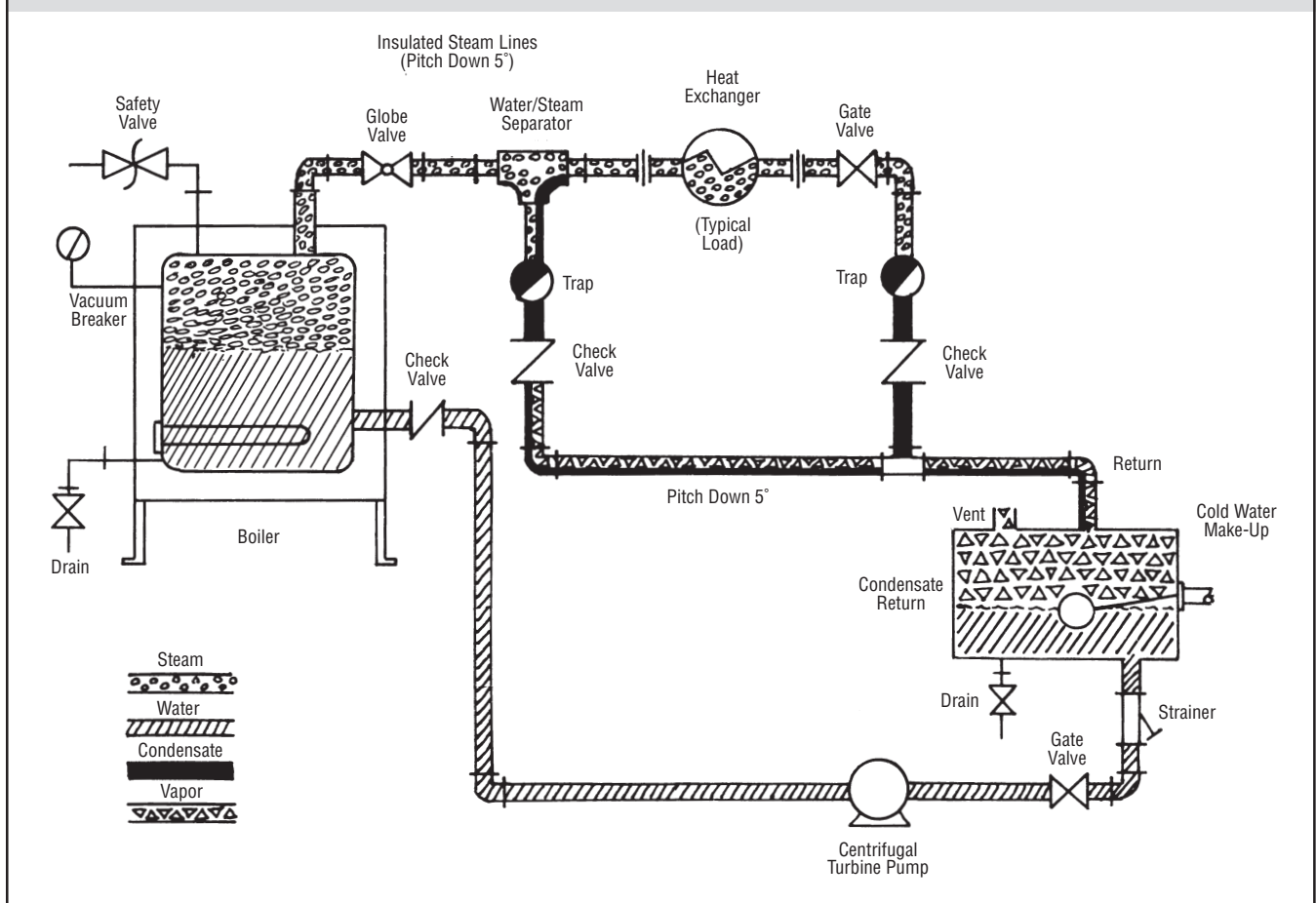
Where work will pass over or near equipment, additional protections such as a metal guard may be needed to prevent damage to the unit or accessory components.

Modifications made to the equipment during installation, other than those explicitly defined by Chromalox, are prohibited and will null and void warranty, and may cause injury to personnel and equipment.

It is a warranty requirement to comply with these instructions and documented evidence shall be maintained in the form of a signed checklist as per the Appendix A or operator's equivalent.

**NOTE:** A completed Maintenance Checklist or equivalent will be required in the event of any safety or warranty claim.

## Typical Plumbing Installation of a Steam Boiler with Condensate Return System



### Mechanical

**NOTE:** When installing steam generator, a minimum of 21" of clearance from steam generator terminal cabinet is required to permit removal and installation of heating elements.

1. The steam generator should be mounted on a solid, level foundation.
2. **WARNING: A minimum of 18" must be maintained between steam generator and any combustible material.**
3. Complete all piping to steam generator. Connect water line to tagged fitting on the motor and pump assembly, if used, or to tagged fitting on water control feeder.
4. For any type of feed other than a pump feed, the existing water supply must be a minimum 10 pounds greater than the steam generator operating pressure to ensure that proper water level is main-

tained in the steam generator. Inadequate feedwater supply can cause low water conditions leading to heater failure. Keep feed water line valves open at all times except during blowdown.

5. All water feed systems must be connected to water inlet check valve.
6. Connect steam line, with globe valve, to steam generator steam outlet. Valve should be placed as close as possible to steam generator steam outlet and sized per label on steam generator.
7. If feedwater pump is located less than 30 feet from the steam generator, a second check valve is required.
8. To optimize efficiency and steam quality, all piping from steam outlet should be insulated.
9. Drain and relief valve piping should be in accordance with state and local codes.

## Electrical

### **⚠ WARNING**

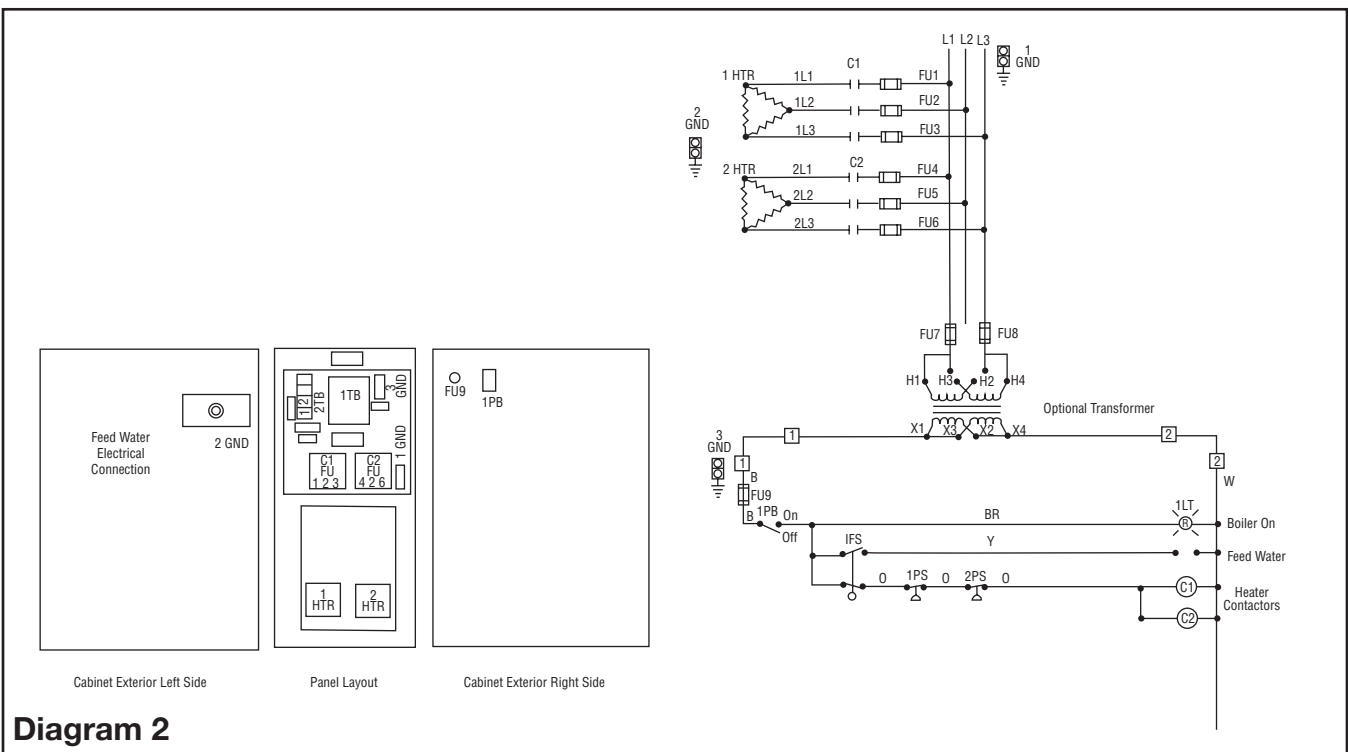
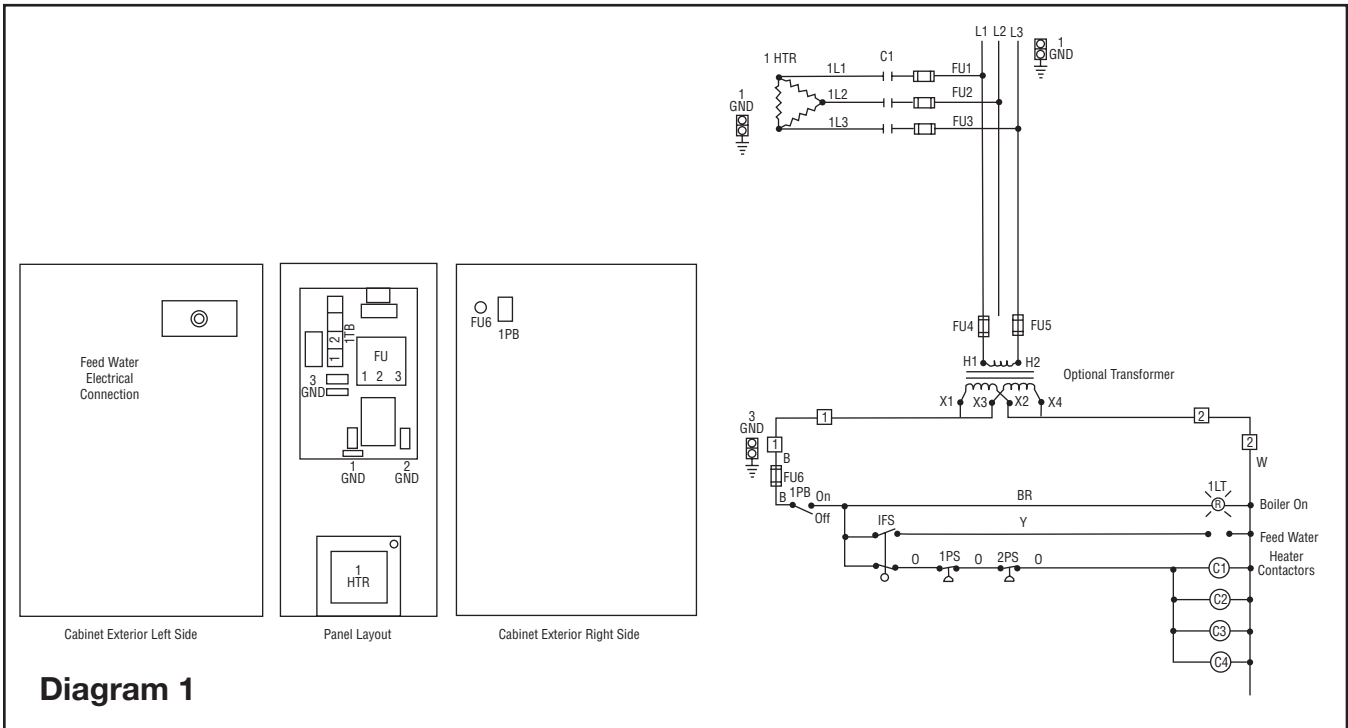
**HAZARD OF ELECTRIC SHOCK. Steam generator must be suitably grounded according to N.E.C. standards.**

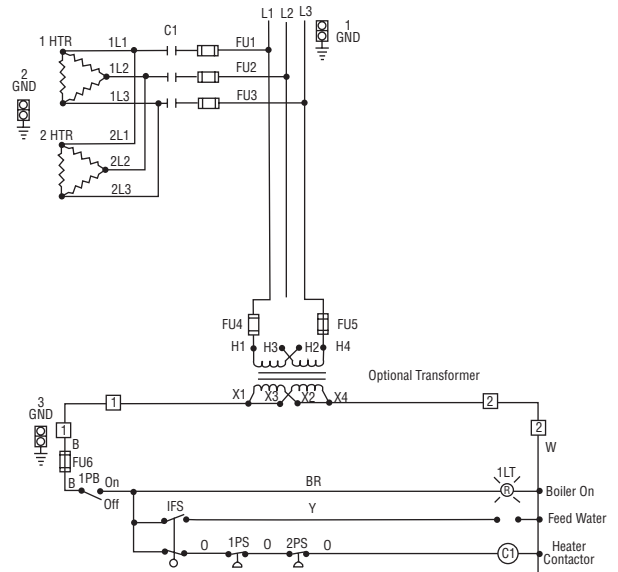
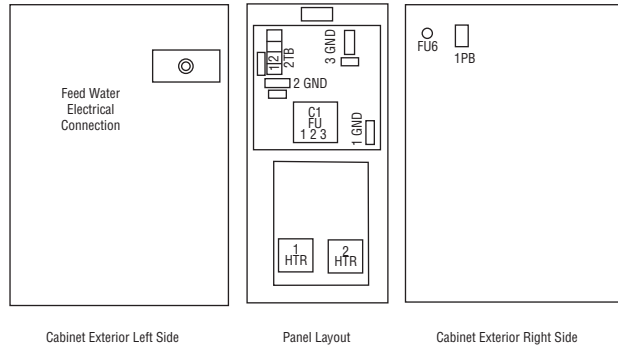
1. All electrical wiring should be done by licensed electrician in accordance with national and local electrical codes.
2. When running power to the steam generator, the electrical cable used must be rated for the amperage listed on the steam generator nameplate. All electrical wiring to steam generator must comply with National Electrical Code or local wiring code and supplied wiring diagram. (See recommendations on safety switches and fusing.)
3. All internal wiring of the steam generator is completed and checked prior to shipment. No additional internal wiring work is required on the part of the customer.
4. If a separate control circuit is used, the control circuit should be connected to the control terminal block, inside access door (not required with transformer).
5. Safety Switches - **WARNING: It is a safety requirement that a circuit breaker or fuse assembly be included between the main power source and the steam generator.**
6. Because steam generators are especially susceptible to lightning damage, industrial type lightning protectors should be installed at user's service entrance per manufacturer's recommendations. Consult a vendor of lightning protection equipment to determine the lightning protection best suited for the steam generator installation requiring protection.
7. Ensure all electrical connections are sufficiently tightened.
8. **WARNING - Substitution of components or modification of internal steam generator wiring will void the warranty and may lead to dangerous operating conditions.**
9. SPECIAL INSTRUCTION FOR CUSTOMERS SUPPLYING THEIR OWN CONDENSATE OR PUMP SYSTEMS:
  - a. Some Chromalox steam generators are supplied with dual voltage systems. The motor voltage should always match the voltage of the control circuit.
  - b. The motor circuit should be wired into the pump control as shown in wiring diagram located inside the steam generator access door.

# Typical Wiring Diagrams

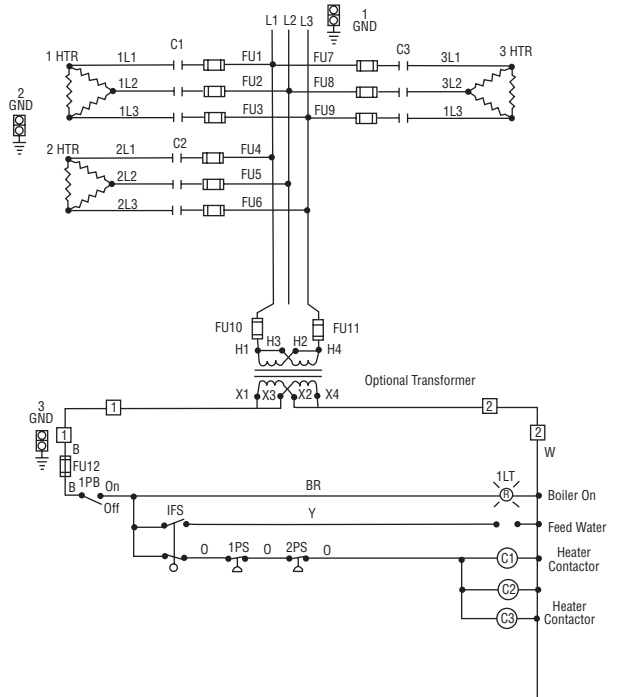
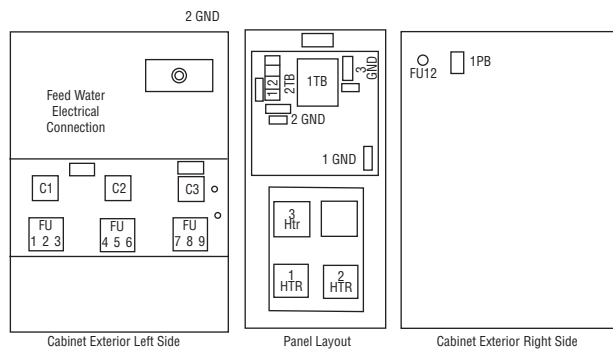
Boiler	3 Phase Voltage			Boiler	3 Phase Voltage			Boiler	3 Phase Voltage		
	208	240	480		208	240	480		208	240	480
-6	1	1	1	-30	2	2	3	-100	8	8	9
-9	1	1	1	-36	2	2	3	-135		10	11
-12	1	1	1	-48	4	4	5	-160		12	13
-18	1	1	1	-60	6	6	7	-180		10	11
-24	2	2	3	-72	6	6	7	Export	14		

Use Applicable wiring diagrams based on model number and power voltage.

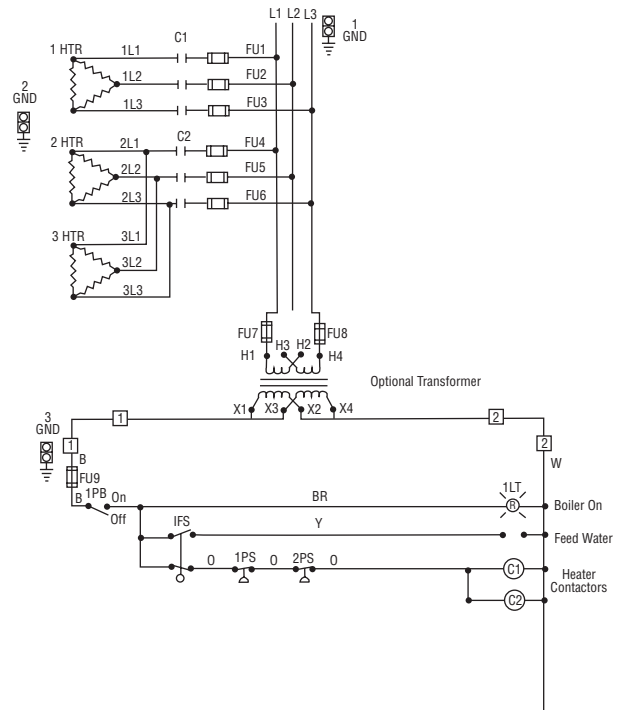
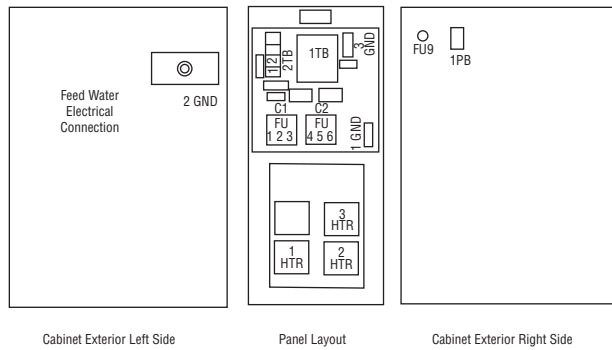




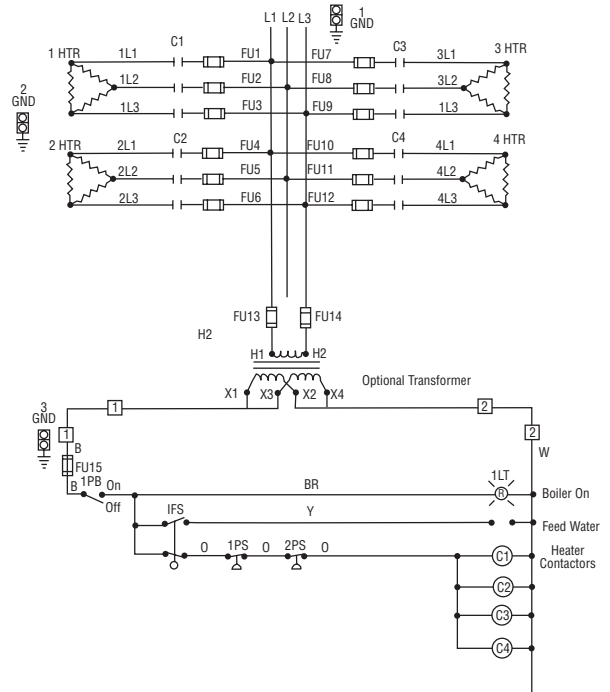
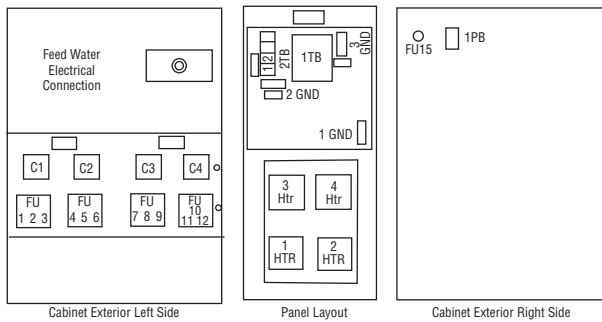
**Diagram 3**



**Diagram 4**



**Diagram 5**



**Diagram 6**

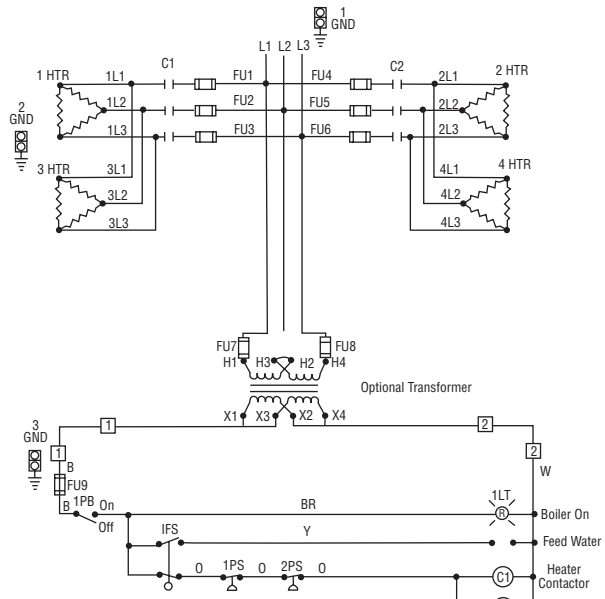
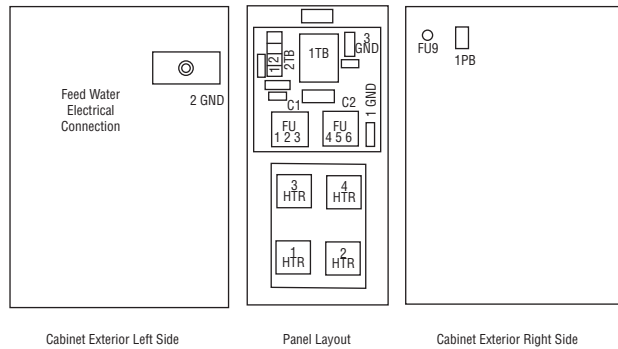


Diagram 7

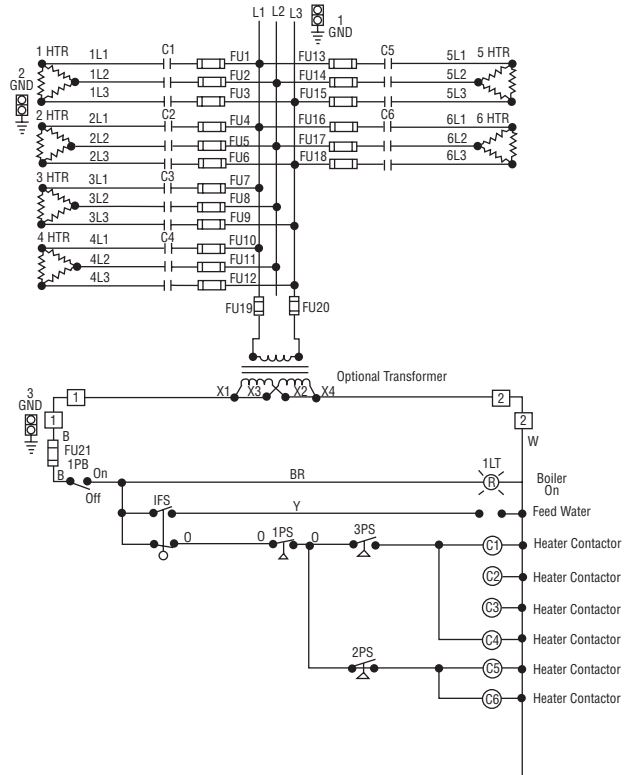
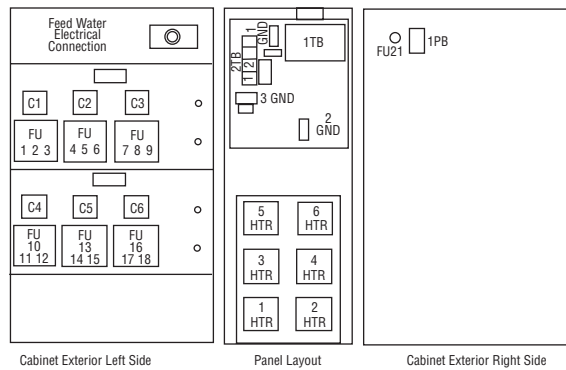


Diagram 8

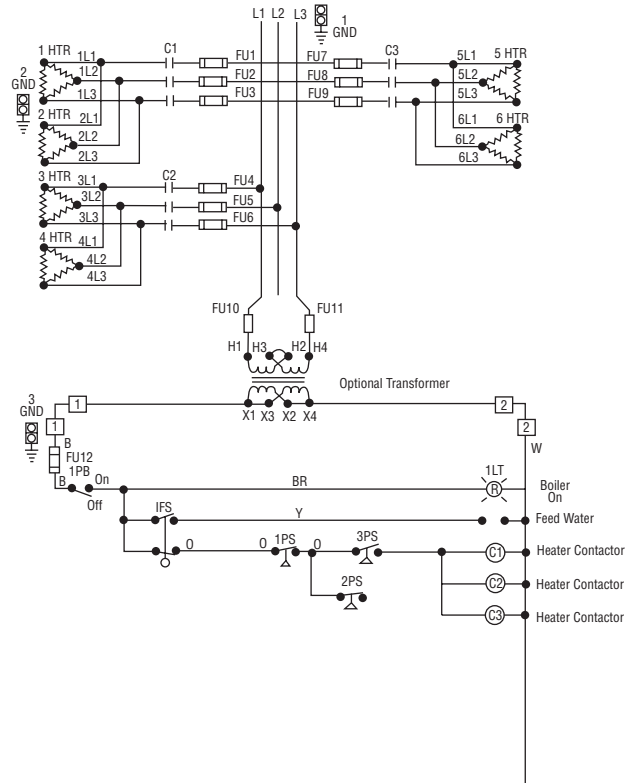
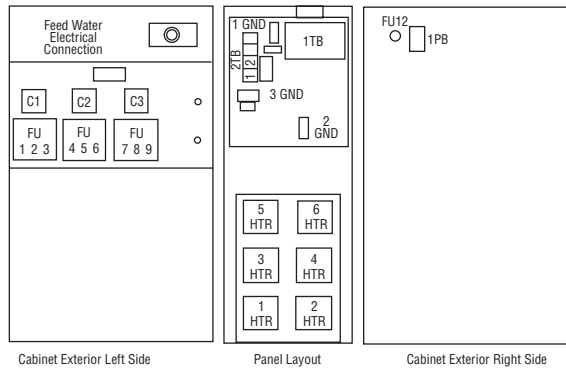


Diagram 9

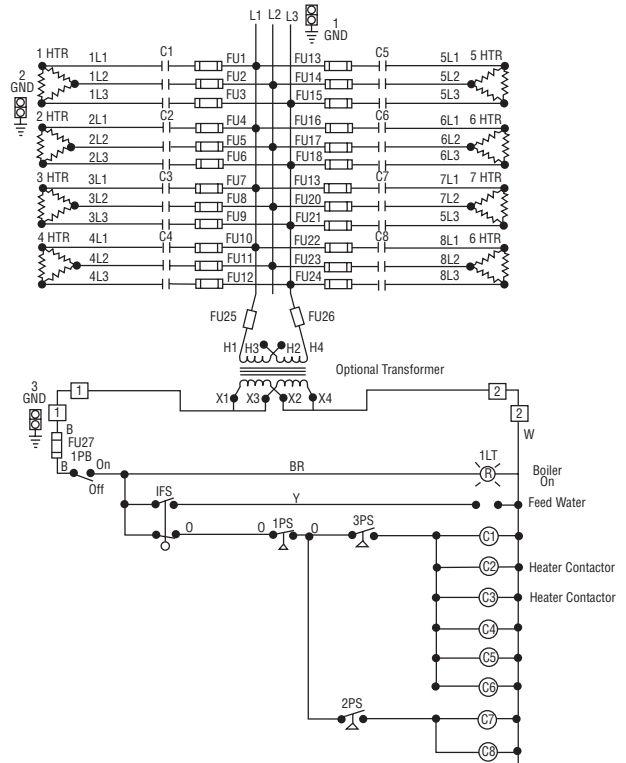
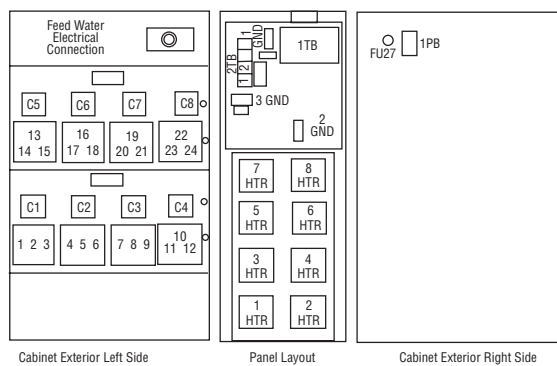


Diagram 10



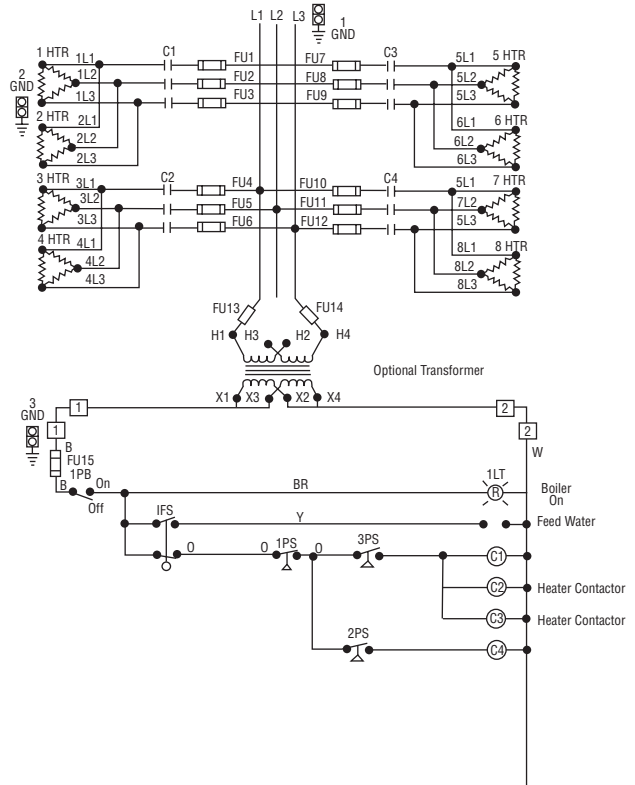
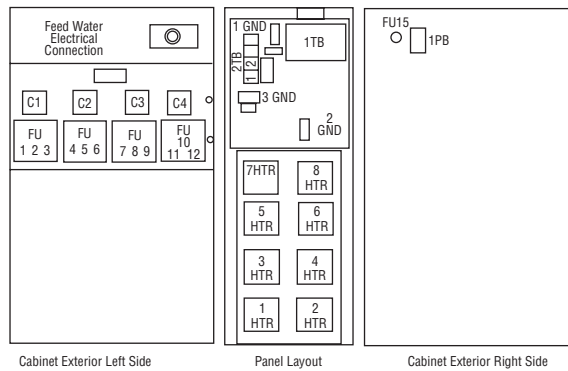


Diagram 11

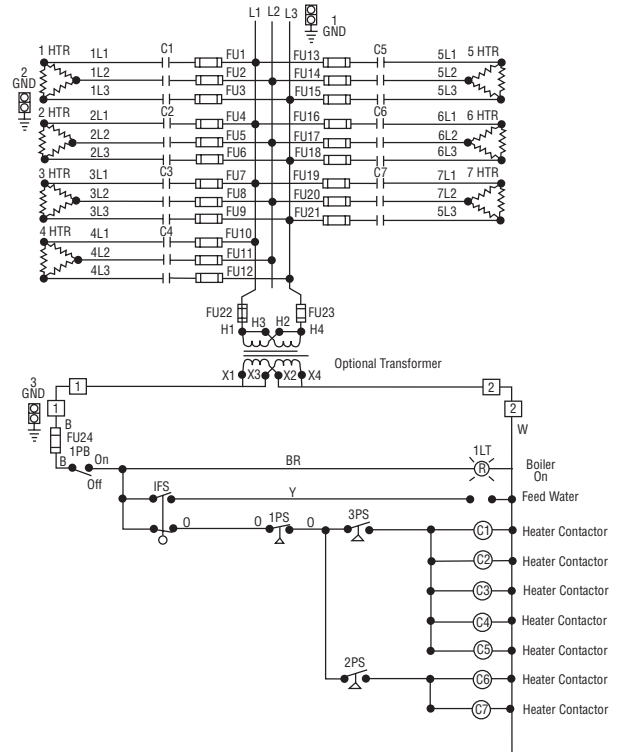
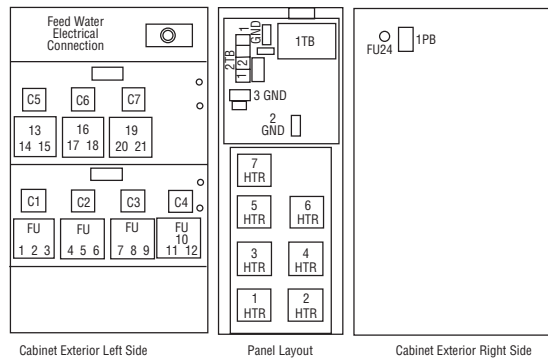


Diagram 12

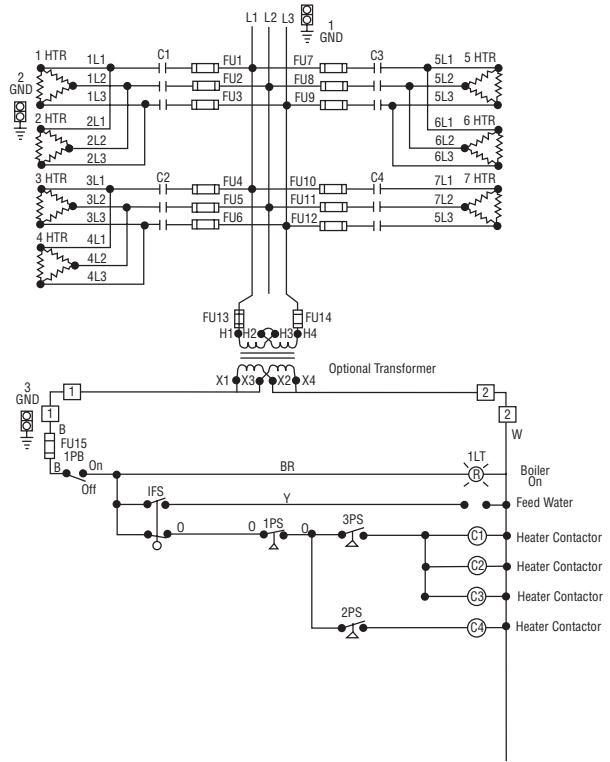
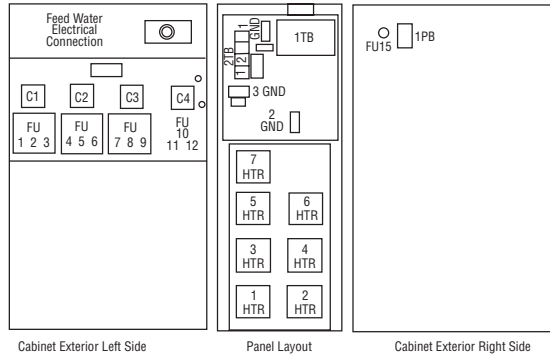


Diagram 13

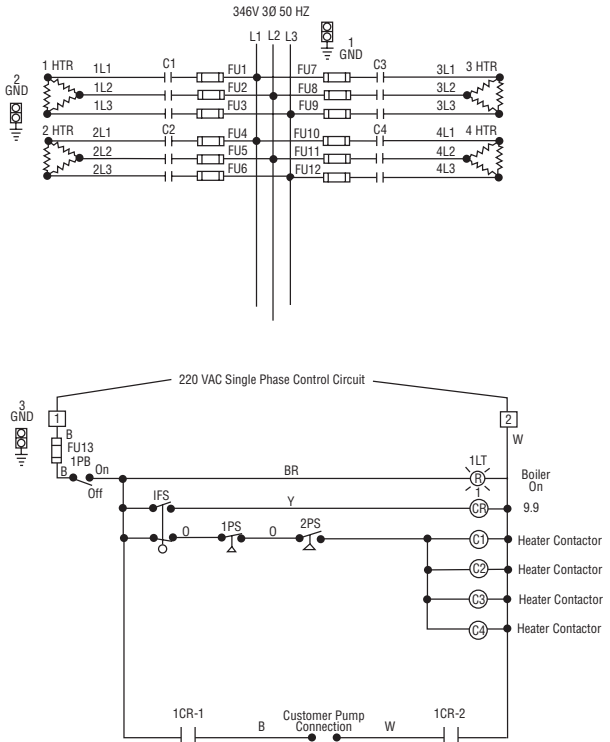
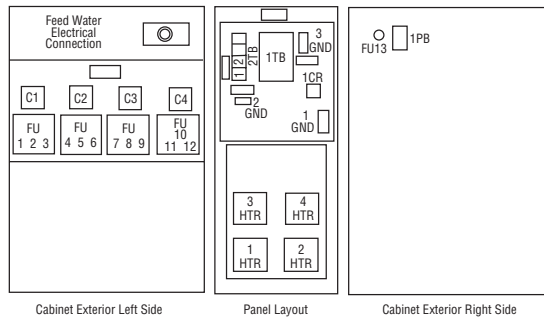


Diagram 14

# Commissioning

Anyone unfamiliar with steam generator operation should contact the Chromalox Service Group for Start-up and Commissioning services.

Before commissioning or after long term storage, it is advisable that the heater assembly be checked to ensure the insulation readings are adequate. Insulation resistance is usually measured using a voltage potential between live circuits (heater terminals) and the chassis (ground).

Insulation resistance shall be measured at the operating voltage, but with direct current and within a tolerance  $\pm 25$  VDC. For example, a 480 volt heater should be measured with 480 volts direct current. Each circuit's insulation resistance shall be greater than 2 giga-ohm.

If there is a low insulation result, it will be necessary to dry the heater elements and bussing assembly. For detailed procedures, please refer to Appendix E, 'Electric Heaters with Low Insulation Resistance', or contact the Chromalox Service Department at 1-800-443-2640

Heater unit shall not be energized until all checks are complete. The terminal enclosure cover shall only be removed when there are no hazardous gases present.

Check overall physical condition of the heater for any signs of damage.

Installation layout should be neat in appearance. Check for any loose components.

Remove all debris from enclosures.

Ensure that any preservation items such as VCI pads or desiccant bags are removed.

Ensure all bussing hardware is tightened per 'Installation' Section. Reconnect the wiring / cabling ensuring terminations are secure.

Ensure both heater and instrument enclosure covers are closed and all fastenings are tight.

Check that labels and tags are secure and correct.

Ensure the operating conditions for which the heater was designed are matching the actual process settings. Ensure the process flow is available

Ensure process media is not corrosive to the heating elements or chamber.

Ensure the process controller and overtemperature controller have the correct operating settings and are functioning properly.

Ensure all other safety and / or shutdown devices are functioning properly.

Check all piping connections are properly torqued. A system hydro-test or leak test is recommended to verify no leakage will occur in the system.

It is a warranty requirement to comply with these instructions and documented evidence shall be maintained in the form of a signed checklist as per the Appendix A or operator's equivalent.

**NOTE:** A completed Maintenance Checklist or equivalent will be required in the event of any safety or warranty claim.

# Pre-Operation Check

After proper wiring and piping of steam generator system is complete, testing of controls can start. **Before testing controls, it is recommended that all contactor fusing be removed.** This is to prevent possible element failure under test conditions.

## A. OPERATING AND TESTING THE LOW WATER CUTOFF AND WATER LEVEL CONTROL

1. Fully open all valves from incoming water supply. Turn steam generator switch to “On” position. Pump or solenoid valve will energize, filling the steam generator with water. Proper water level is determined by supplied float switch level control. Pump or solenoid feed will shut off at proper water level, and contactor(s) will energize, supplying power to heater elements.
2. Checking operation of pump switch. With water level visible in sight glass, partially open drain valve at bottom of steam generator. If automatic blowdown is supplied, push manual blowdown switch until valve open light illuminates, and hold for two to four seconds. Water level will fall, causing float switch level control to energize the pump. Close drain valve or release manual blowdown switch. Pump motor or solenoid valve will deenergize once water level reaches proper fill level determined by float switch level control.
3. Checking low water cutout switch operation. Open drain valve completely. If automatic blowdown is supplied, push and hold manual blowdown switch until water level falls enough to trip cutout switch. Close drain valve or release manual blowdown switch. If low water cutout is automatic reset, pump or solenoid will return water level to normal. If low water cutout is manual reset, then manual reset button on front panel of steam generator must be pushed to complete circuit. Turn off steam generator. Reinstall contactor fuses.

### **⚠ WARNING**

**Be sure all electrical connections are tight before energizing steam generator. Reset all manual reset controls by pushing reset buttons on: (1) high limit pressure control on control cluster on top of steam generator and (2) low water reset on front of steam generator.**

### **⚠ WARNING**

**User shall not exceed design conditions per unit nameplate at any time.**

## B. SETTING AND TESTING PRESSURE CONTROLS

1. Chromalox CES and CSSB Steam generators are supplied with operating pressure and high limit pressure controls. The controls can be distinguished by a manual reset present on the high limit pressure controller case and two adjustment screws present on the operating pressure controller case. (For CES/CSSB-12 – CES/CSSB-72, one operating pressure controller is supplied, for CES/CSSB-100 – CES/CSSB-180, two operating pressure controllers are supplied.)
2. The operating pressure control has two settings: operating pressure (CUT OUT) and differential pressure (CUT IN). The Operating Pressure setting determines the steam generator chamber pressure at which the electric heating elements will de-energize, allowing chamber pressure to slowly bleed off. The Differential Pressure subtracted from the Operating Pressure determines the steam generator chamber pressure at which the electric heating elements will energize and begin building pressure in the steam generator chamber.
3. The high limit pressure control should be set at 10 psig above the Operating Pressure of the steam generator.
4. To verify proper operation of the controls, close steam outlet valve and adjust operating pressure control to a low pressure setting. Set high limit control at 10 psig above operating pressure control.  
  
Turn on the steam generator, and allow pressure to build up. When pressure gauge reading approaches set point of pressure control, the controller will trip and de-energize the steam generator heating elements. Turn off the steam generator.  
  
To reset pressure control, bleed off enough pressure in the steam generator by opening steam outlet, drain, or blowdown valve.
5. HIGH LIMIT PRESSURE CONTROL OPERATION: The high limit is tested in the same manner but with the operating control set above the pressure setting of the high limit. **WARNING: THIS IS FOR TEST PURPOSES ONLY!** When the high limit trips, turn off steam generator and reset high limit to proper setting. The manual reset tab must be pushed to resume operation upon startup.

# Operation

## Recommended Start-Up Procedures

1. Close globe valve on steam outlet side of steam generator. (Customer supplied)
2. Turn on steam generator and allow pressure to build up to operating pressure.
3. Only open globe valve at quarter turns at first, introducing smaller amounts of steam into process. Avoid opening globe valve all at once. This will mitigate the possibility of evacuating the steam generator of water caused by the suddenly increased boiling of the water in the vessel as the pressure is reduced. On steam generators where constant pressure is not maintained, globe valve should be kept partially closed. This will maintain a constant head on the steam generator and help stabilize fluctuations in steam generator water level.

## MANUAL BLOWDOWN INSTRUCTIONS

Regular blowdown is an essential part of steam generator operation that will add years of life to the unit. A daily blowdown schedule must be established and followed to meet warranty requirements.

1. At the end of the working day, while steam generator is still operating, turn switch to the OFF position and close water supply valve. De-energize wall mounted safety switch.
2. If blowing-down into a receptacle allow pressure to decrease to 15-20 psi before opening blowdown valve.
3. It is preferable to connect the blowdown valve directly into a drainage system. If this is done, the steam generator can be discharged at operating pressure.
4. When discharge is complete and steam generator is drained - a) close the blowdown valve; b) open water supply valve; c) put steam generator switch in the ON position; and d) close wall mounted safety switch.
5. When refilling is complete, turn off the steam generator switch unless continuing operation is desired.
6. If you have been supplied with a Manual Reset Low Water control as required in some states, the reset button on the control must be pushed before steam generator will begin developing pressure. (Do not push reset until steam generator has filled with water.)

The use of chemical steam generator cleaning compounds in these steam generators voids all warranties unless approved by manufacturer.

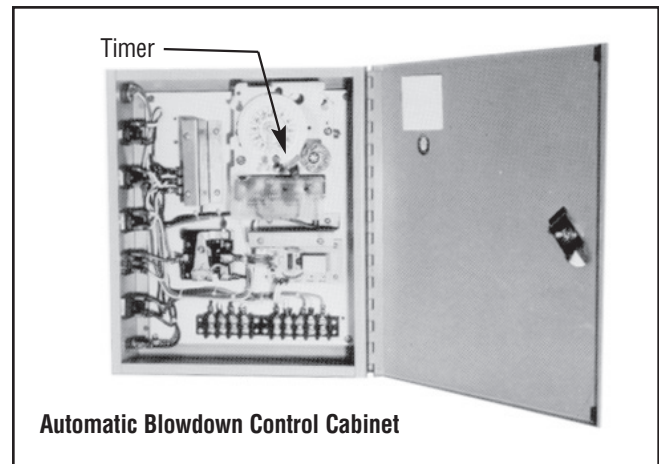
## Automatic Blowdown Instructions (If Furnished)

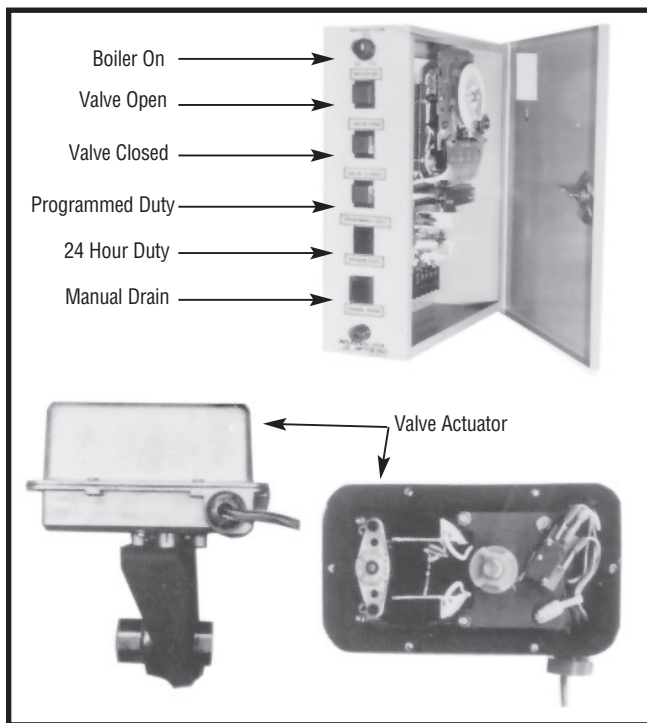
The Automatic Blowdown is a device which automatically starts up your steam generator in the morning; shuts it down at night and blows down (partially drains) the main steam generator chamber and the low water cut-off column for a predetermined time interval each working day.

The heart of the unit is an electrically operated straight-through type ball valve. It is specially designed to handle corrosive fluids and particulate without requiring cleaning or the use of a strainer.

Both the valve and the steam generator are controlled by an electric control unit which indicates with pilot lights when the drain valve is in the opened or closed position and when the steam generator is ON or OFF. In addition to the automatic control function, the unit has a push button which momentarily de-energizes the steam generator and opens the drain valve regardless of the time of day.

The unit may also be used to blow down steam generators which run continuously, day and night.





**INITIAL TESTING** - Set the switch marked “Programmed duty/24 hour duty” located on the panel box to the “ON” position.

On the large timer set the “on” tab at about 8 AM and the “off” tab at about 8 PM Set the blowdown cycle dial at “0”.

Turn the large timer by hand until the “on” tab passes the “time now” indicator so the “time now” arrow indicates about 10 AM.

Energize the main feed to the “line terminals” of the unit. The “Steam generator ON” pilot light as well as the “Valve Closed” light should glow.

Hold down the “Drain” button for about six seconds. The “Steam generator ON” light should go out immediately as well as the “Valve Closed” light. It takes about 4 seconds for the drain valve to open fully at which time the “Drain Valve Open” light should light. As soon as the “Drain” button is released, the valve begins to close. When it reaches the closed position, the “Valve Closed” light and the “Steam generator ON” should light up again.

Now turn the wheel on the large timer until the “off” tab passes the “time now” arrow. The “Steam generator ON” light should go out and the valve should begin to open. Once the “Valve Open” light goes on, the valve should remain open for a few seconds and then automatically close. The “Valve Closed” light should light and the “Steam generator ON” light should remain off.

**OPERATION** - Set the “Programmed Duty/24 Hour Duty” switch to “Programmed Duty” if the steam generator is to be shut down each night. Set it to “24-Hour Duty” if the steam generator is to remain on continuously 24 hours per day (except during blowdown).

Set the tabs on the large timer for the ON and OFF times desired for the steam generator, screw in the small black day-skip tabs if the steam generator is to remain off for the weekend, etc.

If the steam generator is on 24-hour duty, set the OFF tab for the time that is desired for blowdown. The ON tab can be ignored, but must remain on timer.

The small time delay relay controls the time that the drain valve remains open. Time is controlled by adjusting knob marked Blowdown Cycle. Counterclockwise decreases, clockwise increases blowdown time. Time must be adjusted by trial.

# Water Feed Systems

For CSSB units a water feed system supplying deionized, demineralized, or distilled water is required to provide pure steam, free of minerals or undesirable chemical additives. Pure steam eliminates the possibility of carry over of contaminants into the process

## LOW PRESSURE FEED

**NOTE:** Water pressure feeds must be at least 10 psi greater than steam pressure.

Low pressure water feed systems are used to supply make up water to the steam generator where incoming water line pressure is 10 psig or greater than the operating pressure of the steam generator. It consists of strainer, solenoid valve and check valve. Low Pressure (Solenoid Feed) ES-99117SS is rated 120 V with 1/2" inlet and 0-100 psi pressure range.

## Installation

The low pressure feed systems are optional, and are typically factory plumbed and wired to the steam generator. However, CSSB series steam generators which are shipped from stock, the ES-99117SS feed is shipped separately for field installation.

## Field Installation

**NOTE:** The low pressure feed is to be plumbed to the inlet of the factory mounted check valve located on the make up water inlet to the steam generator. The plumbing and wiring are to be conducted by licensed personnel in accordance with national and local codes. For wiring refer to wiring diagrams supplied with the steam generator.

## High Pressure Feed Pump Motor Dimensions

High pressure make up water pumps are used when steam generator pressure exceeds water pressure by more than 10 psi and when condensate water is not

returned to steam generator. **NOTE:** Consult factory or sales office for motor/pump sizing for appropriate water feed system.

## Installation

### **⚠ WARNING**

**To avoid electrical shock hazard, water feed system must be suitably grounded to earth.**

1. Locate feed on level floor or platform.
2. Connect water line to tagged fitting on feed.
3. Connect piping from discharge to water inlet check valve on steam generator with a minimum of 90 deg. bends or other restrictions.
4. All electrical wiring should be done by licensed electrician in accordance with national and local electrical codes. Refer to steam generator instruction manual for wiring diagram.
5. If pump is located less than 30 feet from the steam generator, a second check valve is required.

## CONDENSATE RETURN SYSTEMS

Chromalox condensate return systems are used wherever condensed steam can be collected for reuse in the boiler. Significant energy can be saved by returning condensate to the boiler. The condensed water is free from corroding minerals and carries a substantial amount of heat which does not have to be replenished.

**IMPORTANT:** Vacuum breaker is required whenever using a condensate return system.

# Maintenance

## **⚠ WARNING**

**No operation involving the use of an open flame or other source of ignition shall be attempted until the condition has been made safe (gas free) by the control of the flammable material that may give rise to the risk. Electrical test equipment can constitute a hazard and shall not be used in the presence of a flammable material, unless specifically designed for the purpose and suitably certified.**

Heaters shall be routinely checked and maintained to ensure sustainable operation. The following preventative maintenance shall be carried out at the intervals shown below. Chromalox service technicians are also available to assist in on-site work or personnel training.

## **⚠ WARNING**

**HAZARD OF ELECTRIC SHOCK. Disconnect all power before working on boiler.**

Chromalox Electric Steam Boilers are designed for years of trouble-free performance. To establish a good preventative maintenance program, we suggest the building maintenance team or engineer familiarize themselves with these simple rules:

### **Daily**

The sight glass should be checked daily to ensure the boiler has adequate water.

Boiler blowdowns are critical to prolonging the operational lifespan of any steam generator. Solids are brought into the chamber vessel by feedwater and will become concentrated in the chamber as water is boiled off to generate steam. Accumulated solids contribute to the formation of harmful scale buildup on heating elements, decreasing operational efficiency and heat transfer, and accelerating degradation of heating elements. Blowing down the boiler is imperative to mitigating scale buildup and prolonging the life of the MVSGI unit by maintaining a low level of total dissolved or suspended solids in the boiler water.

Intermittent manual blowdowns and water column blowdowns should both be conducted daily. The procedure will be most effective if performed at a time when steam generation and feedwater input rates are low. The length of a blowdown should be determined by water analysis.

### **Monthly**

A monthly inspection should be made of internal wiring. All electrical connections should be checked for tightness. A check for water or steam leaks should also be made and any loose fittings immediately tightened.

### **Every 3 months**

The elements should be inspected for scale and deposits using the inspection port. If scale has begun to form, boiler should be drained and flushed.

Visual inspection of equipment for any external damage, wear, or leakage.

The paint condition of the equipment must be checked periodically to ensure the corrosion allowance is not exceeded.

All electrical power connection, sensor connections, and mechanical bolting shall be re-torqued to proper specifications.

### **Every 6 months**

Isolate the electrical supply and open the terminal enclosure cover. Do not remove the terminal enclosure cover during wet or humid conditions as this can lead to a reduction in insulation resistance of the heater. Ensure that internals are clean, dry, and free from debris.

Ensure that all grounding / earthing conductors are correctly fitted between all points and main structure.

Visually inspect wire and wire terminations. Replace any which show signs of oxidation which would interfere with establishment of reliable electrical connections.

If the presence of moisture is detected in the terminal housing, measure the insulation resistance of the heating assembly and/or elements to ensure it is within operating tolerance.

Ensure terminal housing gasket is in good condition and refit cover.

Functional check of all related process controllers, power systems, and safety interlocks.

### **Every 12 months**

Check for element operation by comparing phase resistance values from the legs of each circuit.

On a healthy system these values should be equal (+/- 10%).

Coatings – the presence of fluid fouling, scale build-up, deposits, or similar coatings. Any product build-up on the surface of the element must be cleaned. The use of high pressure steam, water jets, or suitable solvent is acceptable. The chloride content of steam or water shall not exceed 20 ppm, otherwise the element sheath can fail through stress corrosion cracking.

Area around elements should be checked for sediment or sludge build-up that would shorten heater life. Correct operating conditions, as needed, to minimize any sheath deterioration due to corrosion.



Corrosion – the presence of acidic solutions can deteriorate the element sheath. Common indicators include scaling, pitting, pin-hole, oxidation, or similar degradation of the metal. While corrosion may not always be avoidable, it is best controlled through proper material selection and process flow chemistry. Consult with Chromalox for alternative material selections, if needed. In more extreme solutions, full heater replacement may be needed as part of a regular maintenance schedule.

*Chromalox will not warrant any electric heater against failure by sheath corrosion if such failure is the result of operating conditions beyond the control of the heater manufacturer. It is the responsibility of the purchaser to make the ultimate choice of sheath materials based on their knowledge of the chemical composition of the corrosive solution, character of materials entering the solution, and controls by which the process can be maintained.*

Mating surfaces and bolting must be evaluated for potential corrosion and if necessary covered with a rust-preventative suited for the materials and as recommended by the manufacturer.

A new gasket should be used when re-installing heater. Gasket and mating surfaces must be clean and dry prior to reinstalling heater bundle. Retighten bolt connections per guidelines in Appendix D.

It is a warranty requirement to comply with these instructions and documented evidence shall be maintained in the form of a signed checklist as per the Appendix A or operator's equivalent.

Chromalox heating elements are designed and manufactured to provide a long trouble-free life and rarely fail if they are operating in the conditions for which they were designed. Should one or more elements require replacement, please note that heater designs that have welded or brazed elements can not be replaced on site. Please contact the Chromalox Service Department at 1-800-443-2640. Heater designs that have a replaceable element design can be replaced on-site by qualified personnel. Please refer to Appendix F for further details.

With heater bundle removed, make a general inspection of the vessel interior for any signs of pitting, scale buildup, or corrosion. Remove any visible contaminants before re-installing heater bundle.

**NOTE:** A completed Maintenance Checklist or equivalent will be required in the event of any safety or warranty claim.

# Instructions For Element Replacement, Read Completely Before Starting Work

Before proceeding with the heating element replacement, review causes of element failure to determine if items other than element replacement need to be serviced.

## **⚠ WARNING**

**HAZARD OF ELECTRIC SHOCK, can cause severe personal injury or death. Disconnect power at source before servicing.**

## **⚠ WARNING**

**HAZARD OF SEVERE PERSONAL INJURY. Allow steam generator to cool and pressure to drop to zero before servicing.**

## **⚠ WARNING**

**Preventative measures should be taken to prevent water damage from any eventual leaking of steam generator or components. Install near floor drain.**

### Read Completely Before Starting Work

1. Disconnect steam generator from electric power supply at main safety switch or fuse panel. Then turn steam generator switch to “off” position.
2. Close valve on incoming water line, and drain steam generator completely of water.
3. Open steam generator door to expose heating elements.
4. Disconnect wire (electric) leads connecting element to main power system of boiler.
5. Ensure that steam generator is properly drained. Note wire locations to facilitate re-assembly, remove failed heating element from the steam generator.
6. Examine condition of other elements in the steam generator. If heavy solids build up is evident or elements show signs of deformation, replace all elements effected.
7. Examine heater element bolts. If these are corroded, replace with ASME grade B-7 bolt of equivalent size.
8. Clean flange face on steam generator carefully to maintain smooth gasket surface.
9. Install gasket over heater element bundle and insert bundle into steam generator. When installing heating element gasket do not use any liquid sealer, etc. Install dry.
10. Bolt tightening sequence included with heater elements must be followed. Bolts should first be tightened to a torque of 100 in. lbs then to a final 200 in. lbs.

**NOTE:** Heater element bolts should be retorqued after generator has been operating several hours at working pressure.

## **⚠ WARNING**

**Retorquing should be done when unit is cold and with power disconnected at source.**

11. Reconnect wiring to heater element and follow steam generator start up procedures. Check that required electrical clearance between terminals is maintained
12. Open water valve so water supply can reach steam generator feed mechanism.
13. Put main safety disconnect switch to “on” position.
14. Turn steam generator switch to “on” position.
15. As steam generator automatically refills, observe the new flange assembly for possible leaks. If water is noticed, the bolts must be tightened. Before doing this, turn the steam generator off at the safety disconnect switch.
16. As steam generator is heated to working pressure, check flange assembly again for leaks.

## **⚠ WARNING**

**Avoid use chemical cleaning compounds. Follow maintenance instructions.**

## **⚠ WARNING**

**Before installing your new elements be sure the low-water cut-off is operating properly and the float chamber and lower equalizer column are completely clear of sludge or other foreign matter. Failure to do this may cause the immediate burnout of the new elements.**

All elements are thoroughly checked before shipment. The manufacturer cannot be responsible for burnouts caused by a faulty low-water cut-off.

The lower equalizer column can best be examined by breaking the unions on either side and then visually and manually examining the piping with your fingers or probes to see if it is clear and clean.

# Optional Equipment for Chromalox Steam Steam Generators

PROPORTIONING PRESSURE CONTROL SUPPLIED ONLY WITH SEQUENCER

## Typical Operation

Pressure variations cause the bellows to expand or contract. Linkage between the bellows and the potentiometer wiper causes the wiper to move across the windings on the potentiometer. This varies the resistance between R and B, and between R and W, causing an unbalance in the circuit connected to the controller.

A proportioning pressure control is used to regulate a motor driven or solid state sequencer. The controller potentiometer, the feedback potentiometer in the motor and a balancing relay in the motor form an electric bridge circuit. As long as the pressure of the controlled medium remains at the set point of the controller, the circuit is balanced; i.e., equal currents flow through both sides of the balancing relay and the relay contacts are open. When the circuit is balanced, the motor does not run.

If the pressure of the controlled medium rises, the wiper in the controller moves toward W. This unbalances the circuit so a larger current flows through one side of the balancing relay. The "close" contacts in the relay make, causing the motor to drive toward its closed position. As the motor runs, the wiper on the feedback potentiometer moves in a direction to balance the circuit. When the circuit is again in balance, the balancing relay contacts open and the motor stops.

Similarly, if the pressure of the controlled medium falls, the wiper on the controller potentiometer moves toward B, and the "open" contacts in the balancing relay make. The motor drives toward its open position until circuit balance is achieved.

The slightest change in the pressure of the controlled medium will cause a change in the number of elements energized to compensate for it, thus keeping the pressure constant. This process is called modulation.

**Main Setting** - Turn the adjustment screw until the indicator is opposite the low point of the desired throttling range. That is, if the pressure is to be held to a minimum of 50 psi, set the indicator at 50 psi. The pressure will then be maintained between 50 psi and a higher pressure equal to the 50 psi plus the throttling range.

**Throttling Range Setting L91B** - After setting the indicator for the minimum pressure, turn the throttling range adjustment screw until the throttling range indicator points to the desired throttling range on the scale. This scale is graduated from "min" to "F". The value of each division varies with the scale range of the instrument.

Pressure Scale Reading	Value Each Division on Scale
0-15 psi	2.2 psi
5-150 psi	3.6 psi

Pressure scale rating will vary depending on pressure control supplied.

## Checkout

After the controller has been installed, wired, and set, it should be tested with the system in operation. First allow the system to stabilize. Then observe the operation of the controller while raising and lowering its set point. Pressure should increase when the set point is raised and decrease when the set point is lowered. Use accurate pressure testing equipment when checking out the controller. Do not rely on inexpensive gauges. The controllers are carefully calibrated at the factory.

If the motor or actuator runs in the proper direction when the set point is adjusted, it can be assumed that the controller is operating properly. If it runs the wrong direction, reverse the B and W wires. Observe the action of the motor to see if it stabilizes. If the motor is moving constantly, widen the proportioning range a little at a time, until the system is stable.

## Steam Generator Sequencer - Solid State Progressive Sequencer

The solid state progressive sequencer provides accurate electronic control of multi-stage loads of the type used in Chromalox steam generators. It features progressive sequencing (first on-first off) which equalizes the operating time of each load. This control gives visual indication of each energized stage by means of integral solid state light emitting diodes. In the event of power interruption all heating elements are immediately de-energized for safety. When power resumes the control will re-stage the loads one at a time.

The solid state sequencer operates on 120 VAC/60 Hz and each output is relay switched with a load rating of 125 VA at 120 VAC.

The input to the sequencer is a 0-135 OHM potentiometer supplied on the operating pressure control. The sequencer has a sensitivity control which is adjustable from min to max. This sensitivity control defines the amount of resistance (pressure) deviation allowed before adding or subtracting a load. Potentiometer resistance should decrease with increasing pressure. Connections are made to red and white terminals of proportional pressure control.

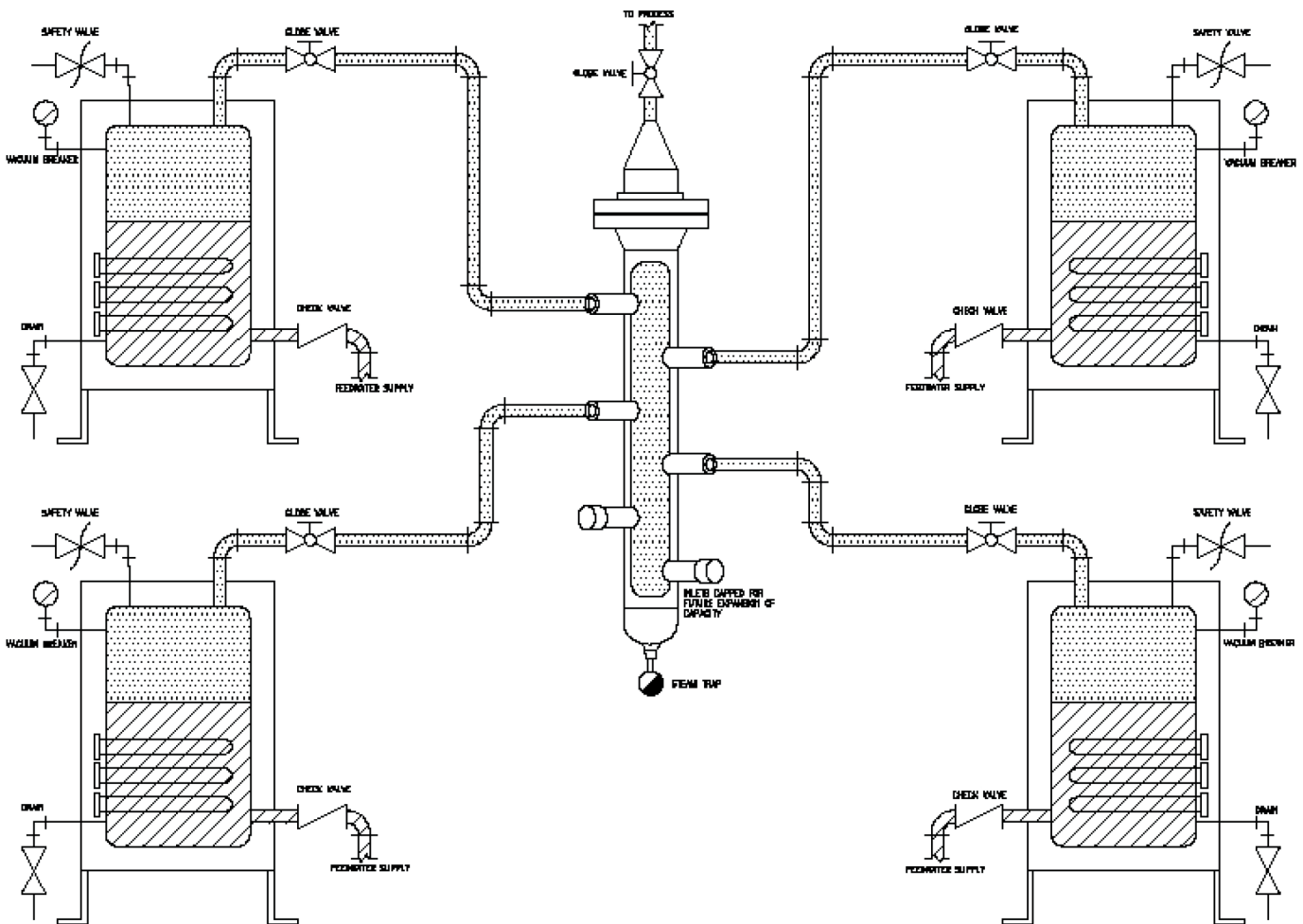
## Modular Steam System Manifold

### **⚠ WARNING**

**Exposed metal surfaces of steam manifold will be hot during operation and can cause burns upon contact. Manifold body should be insulated to increase operational safety and efficiency.**

The modular steam manifold accommodates the connection of up to six CES or CSSB Steam generator units in parallel, allowing the user to supplement steam capacity and meet increased steam demands. It features six steam inlets offset to prevent interference between opposing steam flows. Condensate that forms within the manifold is managed by a steam trap at the base of the unit, while steam is sent to the end process through a 3"-150# flanged connection capable of handling high volumes of steam flow.

The manifold must be inspected and cleaned prior to installation. When installed, it must be mounted vertically with the flanged end at the top of the unit and the steam trap at the bottom. The steam manifold will ship with the steam trap uninstalled. The customer is responsible for the proper installation of the steam trap on the threadolet at the base of the manifold. The flanged steam outlet of the manifold must be equipped with a steam rated globe valve to provide backpressure to the Modular Steam generator System. Steam generators connected to the manifold must be operated with their respective steam outlet globe valves fully open, relying on the manifold steam outlet globe valve to maintain back pressure on the steam generator chambers. Steam generators connected the Modular Steam Manifold must be of the same model and operated with the same settings



# Fault Finding and Correction

The following is a listing of common occurrences and solutions that may occur during heater operation. This is not an all-inclusive list. Each application is unique, and heating equipment is mostly likely integrated with

sensors and controllers outside the scope of this manual. Be sure to consult a certified professional if you are unsure of the situation. Chromalox Service Department is available at 1-800- 443-2640.

Fault	Possible Correction
Process pressure is too low	<ul style="list-style-type: none"> <li>• Isolate power supply</li> <li>• Check supply fuses</li> <li>• Check that the pressure control device set points are correct.</li> <li>• Check sensors for correct location, wiring, operation, and accuracy.</li> <li>• Check that all elements are still operative by taking a load resistance reading. Resistance between phases should be equal.</li> </ul>
Process pressure too high	<ul style="list-style-type: none"> <li>• Check that the pressure control device set points are correct.</li> <li>• Check the sensor location operation</li> </ul>
Heater Shutdown	<ul style="list-style-type: none"> <li>• Check that the supply voltage is correct</li> <li>• Check all trip devices are functioning correctly and sensors have not failed.</li> <li>• Check ambient temperature is within rating</li> <li>• Check overpressure control settings and adjust as needed</li> <li>• Check any liquid level control settings</li> <li>• Check ground fault settings</li> </ul>
System leakage	<ul style="list-style-type: none"> <li>• Check piping and flange connections are tightened to specifications</li> <li>• Check gasket materials and mating surfaces</li> </ul>
Noisy flow or cavitation	<ul style="list-style-type: none"> <li>• Bleed system to remove any air or steam pockets</li> <li>• Check the actual flow conditions match the design parameters.</li> </ul>

# Health & Safety Statements



## Decommissioning, Disposal, and Recycling

There may come a time when equipment needs to be replaced or is no longer required. Prior to decommissioning, make sure equipment is properly shut down and de-energized. Follow guidelines within installation and maintenance sections of this document to disconnect equipment. Check local codes and regulations for proper disposal and recycling of materials. Chromalox is not responsible for improper disposal.



## Non-Potable Use Only

Under the US Federal Safe Drinking Water Act, it is unlawful to install or use this product in any service that comes into contact with water for human consumption. This product is intended exclusively for use in non-potable service.

There are no hazardous or toxic substances supplied with this equipment.



## ROHS Compliance

This unit complies with the Restriction of Hazardous Substance (ROHS), also known as Directive 20011/65/EU.

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# Service & Replacement Parts

Any service work must be performed by trained personnel.

For on-site technical support, please contact the Chromalox Service Department at 1-800-443-2640. Provide your unit part number, model number, and Chromalox purchase order number to properly identify the equipment.

Replacement parts are available by contacting Chromalox Service Department at 1-800-443-2640. Provide the unit part number, model, voltage, and wattage to properly identify unit.

# **Appendix**

**Section A – Installation, Commissioning, and Maintenance Checklist**

**Section B – Long Term Heater Storage**

**Section D – Flange Bolt Tightening Procedure**

**Section G – Water Quality Guidelines**

# Appendix A

## Maintenance Schedule & Record Form

Equipment Received Date \_\_\_\_\_

Equipment Model Description: \_\_\_\_\_ Chromalox PO # \_\_\_\_\_

Equipment Part Number \_\_\_\_\_ Tag No: \_\_\_\_\_

### Receiving, Storage, Commissioning, & Operation Verification – Performed per Instructions

<b>Equipment received &amp; inspected (within 48 hours)</b>	Date		<b>Equipment stored per Short Term Instructions</b>	Date	
	Sign			Sign	
	Print			Print	

<b>Commissioning performed per Instructions</b>	Date		<b>Start-up Operation performed per Instructions</b>	Date	
	Sign			Sign	
	Print			Print	

This blank form may be photocopied, as required, to record the full service history of the equipment.

### Yearly Maintenance Inspection Verification – Performed per Instructions

<b>3 Month Inspections</b>	Date		Date	
	Sign		Sign	
	Print		Print	

<b>6 Month Inspections</b>	Date		Date	
	Sign		Sign	
	Print		Print	

<b>9 Month Inspections</b>	Date		Date	
	Sign		Sign	
	Print		Print	

<b>12 Month Inspections</b>	Date		
	Sign		
	Print		

This blank form may be photocopied, as required, to record the full service history of the equipment.



**Notes:**

1. This checklist, duly completed, must be submitted with any safety or warranty claims.
2. A separate checklist must be completed for each piece of equipment.
3. Where equipment is removed from service a new checklist must be completed upon re-commissioning.
4. Where equipment has been placed in Long Term Storage, a separate checklist must be maintained to confirmed proper maintenance. Refer to Section B.
5. Where equipment has been supplied certified for use in a hazardous area, compliance with the relevant code of practice and installation instructions, regarding operation and maintenance, shall also be required.

Chromalox has a team of fully trained technicians and engineers who are able to offer a specialist inspection, commissioning, start-up and/or maintenance service. For further details, please contact our service department at 1-800-443-2640

# Appendix B

## Long Term Heater Storage



Shipping containers are temporary protective covers. Additional protection must be taken to prepare unit for storage to ensure sustainability.

When equipment is stored, as listed below, equipment will remain safe and protected for up to twelve months in the as-supplied condition. High humidity, tropical, or other extreme environments may require reduced time intervals for each inspection.

During long term storage, any desiccant used must be checked at least once a month, and replaced if needed.



Unit shall be stored in a heated building with adequate air circulation and protected from dirt and water. Unit shall be stored in a clean, dry space where a uniform temperature prevents condensation. Unit shall be stored a minimum of 6" off the ground. If the stored area is not heated, desiccant shall be removed from the terminal housing and an anti-condensation heater shall be installed and connected to a suitable supply and kept in operation.

An anti-condensation heater must be energized in the heater terminal enclosure. Ensure all conduit holes are properly sealed and covers fully intact and secured.

If no anti-condensation heater or associated power source is available, desiccant shall be used in the heater junction box to prevent moisture intrusion into the heating elements. Desiccant shall have color saturation indicators to ascertain effectiveness. The heater junction box shall be opened monthly and desiccant shall be inspected. Replace when warning indicators indicate a change is required. Please refer to the guidelines at the end of this section for recommended desiccant sizing.

### Recommended Sizing for Desiccant bags with Color Saturation Indicators

Drying agents should be inspected regularly and replaced when necessary. The desiccant is to be fitted prior to dispatch.

A general guideline is to use 28 grams of desiccant for each 2 cubic feet (0.06 cubic meters) of volume.

For a more robust storage set-up, please use the following equation:

$$\frac{A \times R \times M \times D}{74} = \frac{W}{2}$$

Desiccant preservation warning labels to be attached at each access point.

VCI (Volatile Corrosion Inhibitors) shall be used in all terminal enclosures during long term storage and regularly checked for effectiveness. VCI can be changed per manufacturer's recommendations.

For units that have unprotected metal surfaces on the internal chamber and/or heating elements, a nitrogen blanket may be installed to help limit oxidation or corrosion that could occur during storage.

All openings shall be properly covered by caps, plugs, water-proof tape, etc.

All fragile parts, sharp edges, and projection shall be properly cushioned.

If flanges are opened for inspection during storage, mating faces shall be cleaned and the gaskets renewed before covers are replaced. Nozzles and flanges shall be blanked with a full face gasket and plate blank flange (coated with primer) secured by 4 bolts minimum, (coated with preservative).

Any spare heater elements shall be stored in the same manner as the primary unit.

### Where:

- W = Weight, in kg, of the basic desiccant
- A = Area, in square meters, of water vapor-proof barrier
- D = Weight, in kg, of hygroscopic blocking, (timber cushioning), and other materials inside barrier
- M = Maximum time of storage, in months, (12 min)
- R = Water vapor transmission rate of the barrier, in grams per square meter per 24 hours, measured at 90% relative humidity differential and 38°C

The waterproof barrier will be polyethene, and the transmission rate is dependent on thickness. Standard thickness is 0.25mm, for which R = 2.

# Long Term Storage Checklist

Equipment Received Date \_\_\_\_\_ Placed in Storage Date \_\_\_\_\_

Equipment Model Description: \_\_\_\_\_ Chromalox PO # \_\_\_\_\_

Equipment Part Number \_\_\_\_\_ Tag No: \_\_\_\_\_

Proper long term storage includes regularly scheduled maintenance checks-to ensure the integrity of both the unit and storage location.

## Every three months:

Sealed, shrink-wrapped, or plastic covered areas shall be visually inspected to confirm integrity of the wrapping material. No moisture or condensation should be present.

Confirm anti-condensation heaters are still operating correctly.

Any desiccant or drying materials must be inspected and replaced if necessary.

Inspect all covers, caps, taping, or similar devices for seal integrity. Retighten or replace if loosened.

Confirm surrounding condition for proper compliance – ambient temperature maintained, no roof leakage, no moisture on floor, no work being performed in area, etc.

## Yearly Maintenance Inspection Verification – Performed per Instructions

<b>3 Month Inspections</b>	Date		Date	
	Sign		Sign	
	Print		Print	
	Date		Date	
	Sign		Sign	
Print		Print		

This blank form may be photocopied, as required, to record the full service history of the equipment.

## Every twelve months:

The unit must be unpacked from storage so that a complete visual inspection can be done of all internal components – bussing, wiring, sensor housings, heating elements, etc. Care should be given to note any signs of corrosion, moisture, physical damage or similar damage that may have resulted from improper storage or damage to the packaging that may have occurred during storage.

If any damage is noted, please contact Chromalox Service Department at 1-800-443-2640 for recommendations of proper repair.

Upon satisfactory inspection of the equipment and storage are, the unit may once again be repackaged per the Long Term Storage Instruction, if needed.

**Storage Verification Checklist – Performed per Instructions**

<b>3 Month Inspections</b>	Date		Date	
	Sign		Sign	
	Print		Print	
	Date		Date	
	Sign		Sign	
	Print		Print	
	Date		Date	
	Sign		Sign	
	Print		Print	

<b>12 Month Inspections</b>	Date		Date	
	Sign		Sign	
	Print		Print	
	Date		Date	
	Sign		Sign	
	Print		Print	

This blank form may be photocopied, as required, to record the full service history of the equipment.

If unit is to be removed from Long Term Storage for operation, a complete mechanical and electrical inspection must be performed. Refer to the Installation Manual for complete details.

Chromalox has a team of fully trained technicians and engineers who are able to offer a specialist inspection, commissioning, start-up and/or maintenance service. For further details, please contact our service department at 1-800-443-2640

# Appendix D

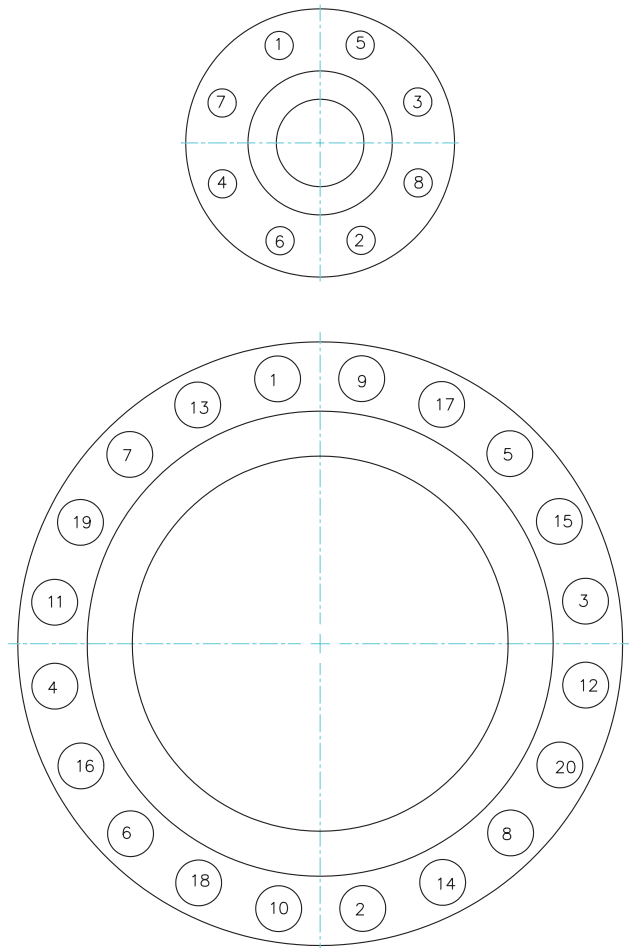
## Flange Tightening Guidelines

**NOTE:** Chromalox recommends specification ASME PCC-1 for detailed guidelines regarding bolted flange joint assembly and disassembly.

The bolt tightening procedure is as follows:

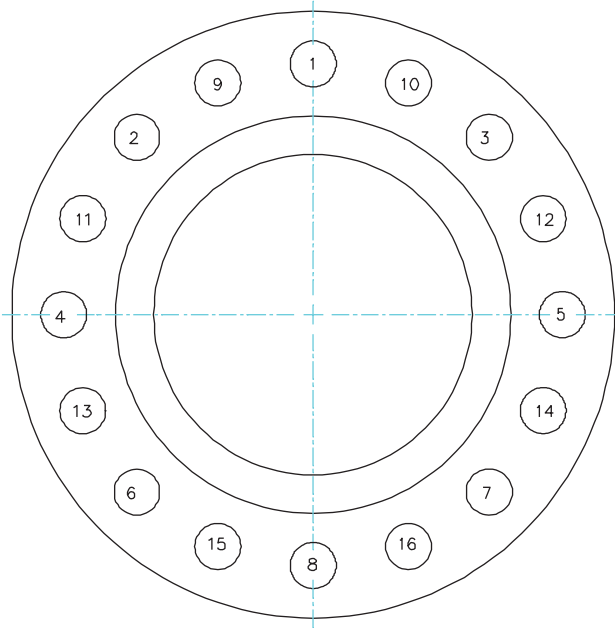
1. Flange faces must be thoroughly cleaned and inspected. Surface marks extending across the joint face or heavy pitting are not acceptable.
2. The alignment of the flanges must be in accordance with the tolerance quoted in the vessel code and manufacturing standard.
3. The gasket or sealing ring must be inspected immediately prior to use.
4. Insert stud bolts and fit the nuts so they are finger tight, checking that there is an equal protrusion of stud bolt through each nut.
5. Stud bolt tightening shall be carried out in stages to predetermined sequence. Acceptable tightening sequences are shown in Figures D.1 and D.2. The sequences shown in Figure D.2 should be used until any flange misalignment is taken up.
6. Throughout the stud bolt tightening sequence, frequent checks shall be made to ensure parallel 'pull-up' of the flanges.
7. Final tightening should be carried out by torque measurement to the value given in Table D.1. To ensure its accuracy, the torque wrench should be calibrated regularly.
8. After final assembly of the flanges, the screw thread protruding beyond the nut faces must be protected against corrosion. The use of flange protectors should also be considered.

Figure D.1: Typical bolt tightening sequence



A tightening sequence similar to that shown in Figure D.2 is recommended for use until any angular misalignment is taken up. When flange faces are parallel the tightening sequence shown in Figure D.1 should be used.

**Figure D.2:** Typical bolt tightening sequence to take up angular misalignment



**Table D.1:** Bolting Torque

Bolt Diameter (inches)	Minimum Torque (Nm)	Max. Permitted Torque (Nm)
1/2	65	90
5/8	130	180
3/4	230	315
7/8	370	515
1	560	770
1-1/8	810	1150
1-1/4	1135	1625
1-1/2	2030	2925
1-5/8	2620	3805
1-3/4	3295	4785
1-7/8	4105	5960
2	5010	7325
2-1/2	10050	14840

**Notes:**

1. The recommended minimum torque figures given above are considered to be sufficient for normal purposes and take into account permitted misalignment between flanges.
2. If necessary, a torque greater than the recommended minimum may be used but the maximum permitted torque should not be exceeded.

# Appendix G

## Boiler Water Recommendations

### Stainless Steel Systems

Stainless steel units, like model CSSB, must be supplied with a water feed system supplying de-ionized, demineralized, or distilled water is required to provide pure steam, free of minerals or undesirable chemical additives. Pure steam eliminates the possibility of carry over of contaminants into the process.

### Non-Stainless Steel Systems

Proper steam generator operation requires appropriate water quality be maintained to prevent scale buildup on the heating elements and steam generator chamber as well as preventing corrosion from acidic contaminants in the supply. Providing the proper water supply will help the unit deliver the highest efficiency possible, while decreasing the amount of downtime needed for inspections and cleaning.

Water treatment can vary based on based on steam pressure, application temperatures, and a variety of other operating conditions. It is recommended to always use soft water with the following general guidelines for water values and/or limits:

Total Hardness	0 to 0.3 parts per million as CaCO <sub>3</sub>
Iron	0.1 parts per million
Copper	0.05 parts per million
Silica	150 parts per million
Alkalinity	700 parts per million
Total Dissolved Solids	2200 to 2800 parts per million
Conductivity	7000 Micro Ohm s/cm
Oxygen	0 to 0.007 parts per million
pH	8.5 to 10.0

The recommendations account for the most common elements but care must be taken to address any other elements that may be present in the local water supply. Water conditions may vary throughout the year and it is recommended to periodically verify and adjust the treatment process. It is recommended to enlist a reliable and recognized water treatment company to review the specific site conditions, regularly perform water analysis, and provide for a specific water treatment program.

Foaming in process flow can create artificially high water level readings within water columns. Precautions must be taken to prevent foaming in boiler water. Artificially high water level readings will allow continued operation with inadequate water levels resulting in damage to or failure of heating elements.

Care must be taken to ensure that total dissolved solids in process flow is adequate for electrical conductivity between water level probes. Inadequate conductivity will result in artificially low water level readings, halting boiler operation.

Sample  
Date:

Record:

Recommended Substances	Supply	Feed	Condensate Return	Boiler Chamber 1	Boiler Chamber 2	Boiler Chamber 3	Any actions taken
Dissolved Oxygen							
Total Iron (ppm Fe)							
Total Copper (ppm Cu)							
Total Hardness (ppm CaCO <sub>3</sub> )							
Silica (ppm SiO <sub>2</sub> )							
Total Alkalinity (ppm CaCO <sub>3</sub> )							
Specific Conductance (μohms/cm)							

Tested By: \_\_\_\_\_

Company: \_\_\_\_\_

Initials: \_\_\_\_\_



**Limited Warranty:**

Please refer to the Chromalox limited warranty applicable to this product at <http://www.chromalox.com/customer-service/policies/termsofsale.aspx>.

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