

Installation and Operating Instructions

DirectConnect™ Medium Voltage Process Heaters



 **CHROMALOX**
Advanced Thermal Technologies

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Scope

1. These guidelines are provided to assist in the handling, storage, installation and maintenance for a medium voltage heater system manufactured by Chromalox. Instructions are provided to prevent

work site injury and aid in the handling, installation and commissioning of this equipment. Please refer to manual 0037-75532 for system startup, operation and safety checks of the control panel.

Precautions & Warnings

⚠ WARNING

ELECTRIC SHOCK HAZARD. *Disconnect all power before installing or servicing heater. Failure to do so could result in personal injury or property damage. Heater must be installed or serviced by a qualified person in accordance with the National Electrical Code, NFPA 70.*

1. All personnel working on medium voltage electrical equipment shall adhere to OSHA, NEC, NFPA 70E and local specifications and standards. Failure to adhere to proper medium voltage safety standards including proper use of PPE may result in injury or even death. Chromalox will not be liable for failure of customer to adhere to governing standards.
2. De-energize all equipment before opening junction boxes and control panels. Do not work on live circuits.
3. 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.
4. 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.
5. The heater is provided with over temperature protection devices. The over temperature protection devices are connected to the appropriate over temperature monitoring device in the control panel. These devices must be tested and their correct operation verified prior to applying power to the heater.
6. 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.
7. The system owner must provide devices and warnings to prevent physical contact of personnel with hot surfaces.
8. The system owner must provide adequate means of draining and venting of pressure equipment.

⚠ WARNING

ELECTRIC SHOCK HAZARD. *Any installation involving electric heaters must be performed by a*

qualified person and must be effectively grounded in accordance with the National Electrical Code to eliminate shock hazard.

⚠ 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.*

9. The system owner must make provision to ensure proper sealing and pressurization integrity at all connection points.
10. Where necessary, the system owner must provide suitable accessories to meet damage-limitation requirements in the event of external fire.
11. 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.
12. Where necessary, the system owner must provide means of safe removal of residual heat after shut-down.
13. 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..
14. Lifting eyes and lugs must be regularly checked for corrosion and appropriate measures taken to remedy corrosion such that the integrity of the lifting eyes and lugs are not compromised.
15. The paint corrosion protection condition of the equipment must be checked periodically to ensure the corrosion allowance is not exceeded.
16. Before contemplating fill/pressurization, discharge or disconnection, the Installation, Operation, and Maintenance instructions must be read fully.
17. Pressurization of the system shall be gradually applied, if possible, in order to allow for pressure connection integrity and minimize risk in the event of improper sealing of connections.
18. The heater shall be allowed to cool off to approximately 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.
19. If the electric bundle is to be removed please follow the proper electrical isolation and disconnection procedures.

Unpacking and Handling

Note: Equipment that is not going to be immediately installed should be kept in the original packaging and stored per instructions.

1. The following steps shall be followed for unpacking:
 - A. All nails to be removed with nail extractor tool only.
 - B. Extract nails from top of case and remove battens.
 - C. Remove all top lumber securing equipment from top.
 - D. Extract nails from one side panel and remove battens.
 - E. Remove all lumber securing equipment from side.
 - F. Extract nails from front panel and remove battens.
 - G. Remove all lumber securing equipment from front.
 - H. Extract nails from second side panel and remove battens.
 - I. Remove all lumber securing equipment from second side.
 - J. Extract nails from back panel and remove battens.
 - K. Remove all lumber securing equipment from back.
 - L. Remove any polythene covering using sharp knife, taking care not to damage equipment or paintwork with knife blade.
 - M. Equipment can now be lifted from base utilizing lifting lugs or eyes placed as per the equipment drawing.
 - N. Ensure equipment is lowered gently to clean and level ground to prevent damage.
 2. Inspect the equipment/system to ensure no damage has occurred.
 3. Handle the systems with care to avoid damage to the heater terminal enclosure.
 4. Know the capabilities of the lifting equipment available to handle the weight of the system.
 5. Keep the system secured to the shipping skid to prevent distortion of the frame during moving and to minimize tipping.
 6. Exercise care during any movement and placement operations to prevent falling or unintentional rolling or tipping.
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Storage

1. Any system that is not installed and energized immediately shall be stored in a clean, dry space where a uniform temperature prevents condensation. It shall be stored in a heated building with adequate air circulation and protected from dirt and water. In non-humidity controlled environments, an anti-condensate heater or desiccant shall be used in the heater junction box to prevent moisture intrusion into the heating elements. **Shipping containers are temporary protective covers. The systems should not be stored outdoors for more than 24 hours.** If the system remains outdoors, the entire system must be protected from the outdoor elements with appropriate coverings.
2. **Short and Long Term Storage of Heaters and Heater Junction Boxes:**
 - A. Unit shall be stored in a clean, dry environment.
 - B. Unit shall be stored off the ground.
 - C. All openings shall be properly covered by caps, plugs, water-proof tape, etc.
 - D. All fragile parts, sharp edges, and projection shall be properly cushioned.
 - E. The desired storage area for the heater shall be an indoor heated facility.
 - F. The heater junction box shall be opened monthly and silica gel bags with color saturation indicators shall be inspected. Replace when warning indicators indicate a change is required.
 - G. If the unit is to be left standing in the open, it shall be suitably covered for protection against adverse weather, using a tear-free waterproof membrane such as a tarpaulin. The equipment shall stand on dry ground, or on blocks to lift it clear of any possible water.
 - H. If the covered area is not heated, desiccant should be removed from the terminal housing and an anti-condensation heater shall be installed and connected to a suitable supply and kept in operation.
 - I. 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).
 - J. All spare heater elements shall be stored securely, in a humidity controlled environment to prevent moisture ingress.

Installation

1. Electrical Sensor Installation

- A. Verify thermocouple and transmitter wires are connected to the correct terminals.
- B. Ensure anti-condensate heater wiring is connected properly to prevent moisture intrusion into the heating elements.

2. Heater Junction Box Installation

- A. All silica gel packs, internal packing, caps, plugs, wrappings, etc. need to be removed before operation.
- B. **Medium voltage cable connections must be installed in accordance with all local electrical codes. The specific local specifications and codes define the code of practice for electrical apparatus for use 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.**
- C. The kirk key lock system is used on both the control panel and heater junction box. The key must be removed from the control panel which will disable power to the system before either the control panel and/or the heater junction box can be opened. The key for the control panel will be used to open the heater junction box.
- D. When opening the heater junction box, the polycarbonate panel must be removed and/or rotated out of the way in order to access the connections.
- E. Ensure cables connecting the control panel to the heater junction box are rated for the line voltage of the system per NEC and NFPA 70E.
- F. Customer cables entering the junction box shall be secured to prevent damage and stress to the heater wire connections.
- G. The only connections that require checks for tightness are the leadwires from the heating elements to the copper bus. Verify lead wires are isolated from and are not making contact with enclosure surfaces or any other electric conduction materials. Connections at the heating element termination are water tight and do not require any further checks. Recommended torque values for #8 & #10 screws at the bus bar connections are 15 in-lbs. and 20 in-lbs., respectively.
- H. Check that the electrical circuits agree with the heater wiring diagram and all electrical connections are tight. Sufficient clearance shall exist between live and electrical parts and live to the ground. For voltages up to 7500kVAC, the distance between phases and phase to ground shall be verified. Spacing requirements: (other than enclosure walls) (air clearance: 2in; creepage: 3.5in) to walls of enclosure (air clearance: 3in; creepage: 4in).
- I. Ensure that the electrical protection is satisfactory. Leadwires, cables and glands shall show no signs of damage and shall be adequate for the stated electrical duty.

- J. Ensure cables connecting the control panel to the heater junction box are installed in conduit and all openings & transitions are protected to prevent moisture intrusion.
- K. Ensure cables and conduits are bonded correctly and secured to prevent damage and stress to the connections.
- L. Verify junction box is free of metal chips and shavings if drilling or punching is necessary.

3. General Electrical Safety

- A. Ensure that the equipment is appropriate to the installed area classification.
- B. Ensure that the equipment is appropriate to the surface temperature class and the heater temperature class stamped on the terminal box label.
- C. Check that the apparatus carries the correct circuit identification. The electrical details of the heater are stamped on the nameplate.
- D. Check that all enclosures, seals and joints are satisfactory. Water and other corrosive fluids must not get into threaded connections. These shall be lightly lubricated with a conductive lubrication compound (i.e. copper-based grease) as needed.
- E. Check that the grounding/earthing is satisfactory. Perform a ground integrity test if necessary to verify sufficient bonding.
- F. Any persons about to perform installation procedures with any electric heater shall first satisfy themselves as to the nature and extent of any potential hazards that may be encountered. These hazards shall be identified by a risk analysis undertaken by the responsible person within the installation team prior to commencement of the installation process.
- G. Only qualified, trained electrical personal shall perform any activity on energized equipment. Lockout/tagout shall always be performed prior to entering electrical panels. Main disconnect switch will lock and remove all power in the panel except very low level DC control circuits being input by the DCS.
- H. With large amounts of fault current available, there is always the possibility of "arc flash". Take all necessary precaution and use appropriate Personnel Protection Equipment (PPE). Never open junction boxes or never work on live circuits unless the equipment has been de-energized.
- I. Operating personnel must at all times observe all safety precautions. Do not replace components or make adjustments inside the equipment with the high voltage supply turned on. Under certain conditions, dangerous potential exists when the power control is off, due to charges retained by capacitors. To avoid electrical shock or injury, always remove power and discharge capacitors before touching a circuit.

- J. Under no circumstances shall any person reach into an enclosure for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid. Verify equipment is de-energized.
 - K. If desired, perform a pre-operational continuity check on the heater circuits. If continuity check indicates an open circuit, check individual heater connections and retighten as necessary. The total resistance of the heater will be a slightly lower value before the system is energized. Consult the factory for the estimated resistance after the system has been energized.
 - L. Perform an insulation resistance test on each heater circuit. The test voltage shall be applied between one of the phases on each circuit and ground. A minimum insulation resistance of 5 MΩ shall exist. Disconnect cables from control panel before performing test. In the event the cold insulation resistance falls below 5 MΩ, the flanged heater shall be baked in an oven between 150-200°F for a minimum of 24 hours. Junction box panel door shall remain open during bake out.
 - M. A factory performed dielectric withstand voltage test has been performed on the elements and flanged heaters. No further dielectric testing is necessary on the system.
- 4. Mechanical Installation**
- A. The heater skid shall be adequately protected against mechanical damage, extreme temperatures and other adverse conditions.
 - B. Ensure that all precautions are taken regarding the weight of the heater. Lifting equipment shall have capacity for the given weight. Personnel involved in the installation shall be aware that one end of the heater will be heavier than the other and that this will affect the lifting.
 - C. When positioning the heater, sufficient clearance shall be provided for the removal of the tube bundle from the vessel, for servicing purposes.
 - D. A new gasket shall be used whenever the heater is removed and re-installed.
 - E. The foundation must be sufficiently strong to prevent the heater from settling, which could cause the piping to transmit excessive strains to the heater nozzles. It is recommended that for concrete footings pipe sleeves shall be fitted on each foundation bolt. These shall be at least one size larger than the bolt diameter, as they allow the bolt center to be adjusted after the foundation has cured.
 - F. Foundation bolts on a single ended heater shall allow free expansion of the shell. The support foot at the cap end is slotted for this purpose.
 - G. All heater openings shall be inspected for foreign material. Protective plugs, covers and silica gel desiccant shall not be removed until just prior to startup. When connecting flanged joints, only nuts, bolts and gaskets in accordance with the applicable piping specification shall be used and tightened to the recommended torque as specified in the piping specification.
 - H. The entire system shall be clean before starting up. Use of filters and/or strainers may be required where elements face exposure to materials other than that for which the heater is designed (particles, foreign matter, etc.). The process or maintenance supervisor shall assess this thoroughly before installation, and ensure that filtering/straining provision is adequate.
 - I. General safety precautions listed in the plant Safety Manual shall be closely complied with to prevent injury to personnel or damage to equipment.
 - J. Ensure that the area safety supervisor and others in the vicinity are aware that work is being undertaken and post warning notices. Ensure that the appropriate PPE and clothing is worn. Beware of wet or slippery ladder rungs and working areas if working aloft.
 - K. Where possible hazards have been eliminated or reduced as far as is reasonably practicable by design but the additional warnings listed below shall be followed to ensure continued safe use.

Startup and Operation

1. Consult the control panel manual for system start-up, operation and general control panel safety checks.
2. Starup of both heater and control panel shall only be performed by Chromalox Personnel. Please contact Chromalox Service at 1-800-443-2640

Heating Element and Bundle Removal

1. Heating Element Replacement

- A. If element to flange connections are made via compression fittings, the heaters can be individually replaced.
- B. If element to be replaced is on the outer circumference of the heater bundle, replacement may be possible without removing the junction box and standoff plate.
- C. Remove service cables to junction box and unbolt bus bars from insulators. Stow remaining element leadwires to prevent damage.
- D. Remove junction box, standoff plate and water tight fittings.
- E. Disconnect bus heating element to be replaced.
- F. The compression fittings at the flange are bored through fittings with a compression nut, front and back ferrules and a welded in or NPT threaded insert. When replacing an element, loosen the compression nut, replace element and install new ferrules. The welded in or NPT insert can remain in the flange during replacement. Ensure the surface of the new heating element where ferrules are installed is free of any burrs. Tighten the compression nut hand tight and then an additional 1-1/4 turns. Additional turns may be necessary to ensure adequate sealing. Reconnect leadwires to the appropriate bus bars.
- G. Reinstall water tight fittings and junction box onto gland plate.
- H. Reinstall bus bars onto insulators and recheck insulation resistance per Installation section.

2. Heating Bundle Removal and Replacement

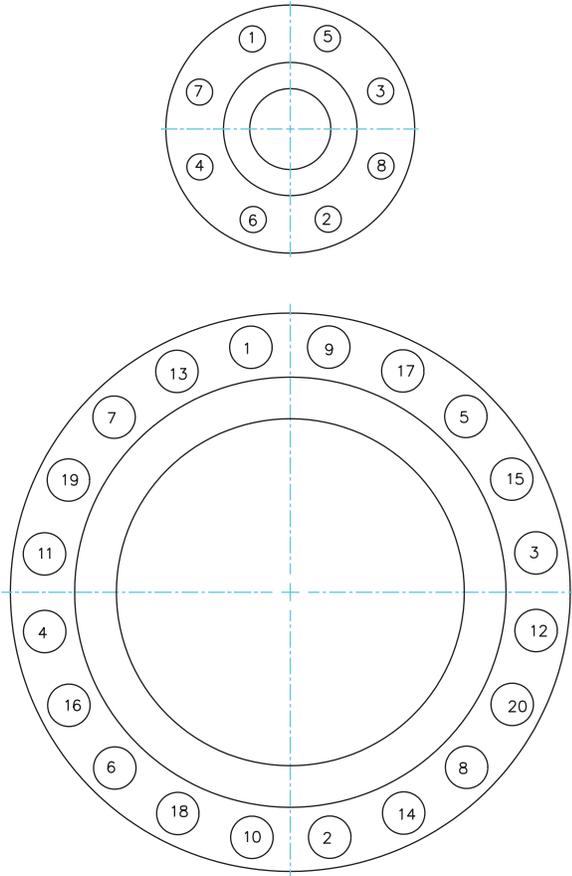
⚠ WARNING

FIRE/EXPLOSION HAZARD. 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.

- A. Flange faces shall be thoroughly cleaned and inspected. Surface marks extending across the joint face or heavy pitting are not acceptable.
- B. The alignment of the flanges shall be in accordance with the tolerance quoted in the vessel code and manufacturing standard.
- C. The gasket or sealing ring shall be inspected immediately prior to use.
- D. The immersion heater can be installed either by use of a crane or by a running block and tackle attached to an overhead stiffener beam (reference Figure 3 as an example). Longer bundles shall be lifted by two cranes (or two sets of blocks and tackles).

- E. Multiple slings shall be placed under multiple spacer/baffle (span not to exceed 84") to evenly distribute the weight of the bundle. DO NOT POSITION SLINGS OR SUPPORTS UNDER THE ELEMENTS AS THIS WILL CAUSE IRREPARABLE DAMAGE.
- F. Hook the chains of lifting device to lifting eyes on bundle flange, and tension. Locate lifting eyes with the aid of the drawings provided.
- G. If applicable, hook the chains of the second lifting device to a baffle along the length of the bundle.
- H. Fit gasket.
- I. Carefully begin inserting bundle, ensuring both lifting devices are moving in synchronization and taking extreme care to avoid finger jams.
- J. As the bundle progresses into the vessel, remove each successive sling at the entry point into the vessel.
- K. Continue slowly inserting bundle.
- L. When bundle is fully inserted, bolt bundle flange to vessel flange.
- M. Remove chains from flange lifting eyes.
- N. Insert stud bolts and fit the nuts so they are finger tight, checking that there is an equal protrusion of stud bolt or two threads showing passed the nut.
- O. Stud bolt tightening shall be carried out in stages to predetermined sequence. Acceptable tightening sequences are shown in Figures 1 and 2. The sequences shown in Figure 2 shall be used until any flange misalignment is taken up.
- P. Throughout the stud bolt tightening sequence, frequent checks shall be made to ensure parallel 'pull-up' of the flanges.
- Q. Final tightening shall be carried out by torque measurement to the value given in Table 1. To ensure its accuracy, the torque wrench shall be calibrated regularly.
- R. After final assembly of the flanges, the screw thread protruding beyond the nut faces shall be protected against corrosion. The use of flange protectors shall also be considered. The immersion heater shall be lifted with care, after ensuring that lifting equipment is of the correct capacity. Customer must install lifting eyes into the threaded openings provided in the main bundle flange. Care shall be taken to ensure that the bundle is lifted in such a way that when it slants it receives no damage from the ground or other obstacles.
- S. The unit is now ready for electrical connection from the junction box to the control panel.
- T. This procedure shall be followed in reverse for removal of bundle.

Figure 1: Typical Bolt Tightening Sequence



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

Figure 2: Typical Bolt Tightening Sequence to Take Up Angular Misalignment

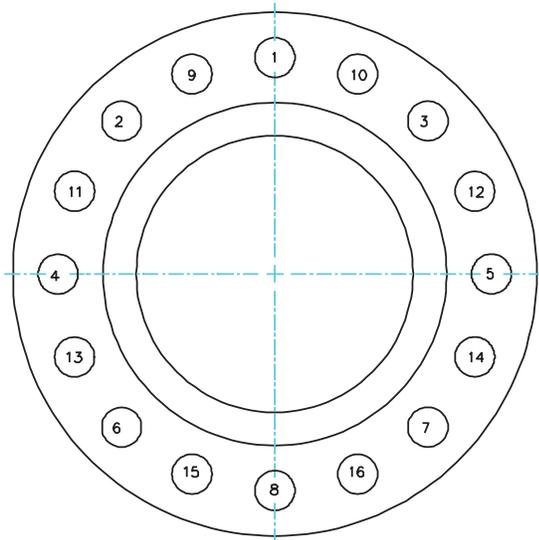


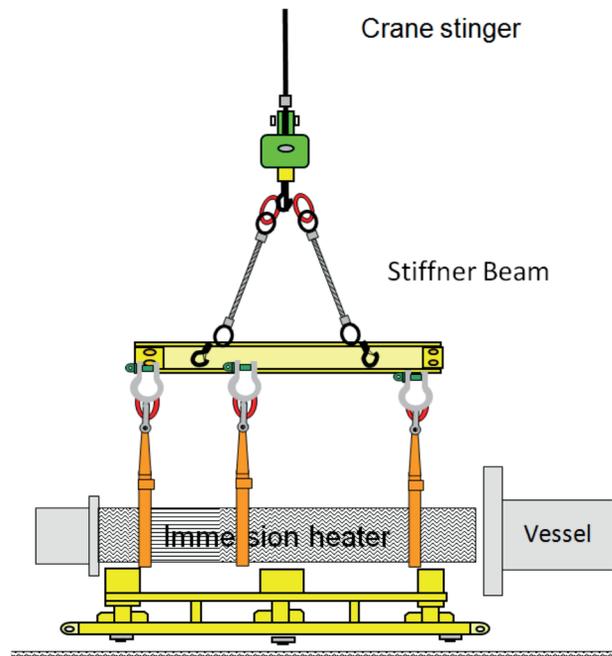
Table 1: Bolting Torque

Bolt Diameter (In)	Recommended Minimum Torque (lbf/ft)	Maximum Permitted Torque (lbf/ft)
1/2	48	66
5/8	96	133
3/4	170	232
7/8	273	380
1	413	568
1-1/8	597	848
1-1/4	837	1199
1-1/2	1497	2157
1-5/8	1932	2806
1-3/4	2430	3529
1-7/8	3027	4395
2	3695	7325
2-1/2	5402	10945

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 shall not be exceeded.

Figure 3: Example Removal Procedure (for reference only)



General Maintenance & Preservation

1. Contact the Chromalox Service Department for additional questions regarding maintenance, repair and startup.
2. Preventative maintenance consists of inspections, tests and cleaning of equipment at scheduled intervals. It helps detect and correct conditions that could cause equipment malfunction. The scheduled maintenance instructions in this manual are recommendations; it is the responsibility of the owner to ensure that all local codes are met.
3. The control panel and junction box use high voltage. It is important that only experienced and authorized technicians who observe standard safety precautions perform all phases of installation, operation, and maintenance. Before conducting any preventive maintenance, fully de-energize and ground the equipment. Tag the controller OUT OF SERVICE only after it has been fully de-energized.
4. Make sure that you are not grounded whenever you adjust equipment or use measuring equipment. Do not use test equipment known to be in poor condition.
5. Equipment shall be kept clean, both inside and outside. Do not allow any water vapor ingress, as this will precipitate corrosion of the electrical components and promote carbon tracking.
6. Ensure that the air surrounding the control panels does not exceed the maximum design temperature of 40°C.
7. At 6 month intervals, check the exterior and interior of all enclosures for visible signs of damage, corrosion, and discoloration and any loose connections in the wiring. Retighten as necessary. Touch-up any paintwork damage to prevent corrosion.
8. Isolate heater and disconnect cabling and busbars from element terminations.
9. Periodically inspect all terminal connections and visible insulation for damage, looseness, fraying and other defects. Retighten any loose terminal lugs and replace or repair damaged or deteriorated insulation. Temperature sensors shall be checked for accuracy and replaced if necessary.
10. Check all cabling for visible damage and check tightness of termination nuts, fittings and glands.
11. During annual shutdown periods (or as scheduled) unbolt heater from its mating flange and check the condition of the heating elements. Discoloration due to overheating shall be investigated further to ascertain the cause. Any product build-up on the surface of the element shall be cleaned off using high pressure steam, water jets or suitable solvent. The chloride content of steam or water shall not exceed 20 ppm, otherwise the element sheath can fail through stress corrosion cracking.
12. Check that the ohms per phase on each stage are within tolerance. If they are not, check each element individually to establish those with unacceptable readings which will need replaced.
Note: Individual elements may temporarily be electrically isolated from a circuit. This can allow the heater to run in a temporary condition while replacements are ordered.
13. Equipment shall be installed at the earliest opportunity. In areas of adverse environmental conditions (for example, very hot or very wet conditions), advice shall be sought from the manufacturer regarding appropriate storage times.
14. Pieces of equipment prone to damage, such as thermocouples, shall be protected from mechanical damage.
15. Mating surfaces and bolting shall be evaluated for potential corrosion and if necessary covered with a rust-preventative suited for the materials and as recommended by the manufacturer.

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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