Boiling Point of Water at various Pressures - Gauge Pressure
(Vacuum and Positive Pressure)

To use this chart correlate the steam temperature gauge vs. the vacuum gauge reading.

Boiling Point of Water Temperature Deg F

Steam Pressure (positive in PSI - negative in INHG)

Low Vacuum Range (Possible Leak)

Strong Vacuum (Healthy Unit)

For service scan the QR code, or call
(780) 875-2530
CWT (Cold Weather Technologies) is an indirect-heater product line of Grit Industries Inc.
Lloydminster, Alberta CANADA
Phone: 780.875.2530 | Toll Free: 877.TRY.GRIT

MODEL NUMBER: ________________________________

SERIAL NUMBER: ______________________________

IMPORTANT NOTES:

1) The installation must conform to the requirements of the authority having jurisdiction or, in the absence of such requirements, to the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.2, Natural Gas and Propane Installation Code.

2) Where required by the authority having jurisdiction, the installation must conform to the Standard for Controls and Safety Devices for Automatically Fire Boilers, ANSI/ASME CSD-1.

3) Placement of the CWT DLH unit should be such that there are no combustibles within three feet (3’) of the skid package or stack placement, and is not to be installed on a combustible floor.

4) The equipment shall be installed in accordance with the current Installation Code for Gas Burning Appliances and Equipment, and applicable State Regulations for the class; which should be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

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

All wiring indicated within this manual shall be done in accordance with the NEC “National Electrical Code” for US applications.

Verify proper operation after servicing.

This manual and the instructions outlined within apply to all CWT “Boiler” Dry Line Heater Models ranging from DLH-140 to DLH-4620
Thank you for purchasing a Cold Weather Technologies (CWT) Natural Gas Line Heater. The following manual has been simplified to give both technical and non-technical owners and operators a detailed and thorough understanding of CWT Natural Gas Line Heater operation. Detailed installation diagrams and pictures can also be found inside this manual. These diagrams will serve you well as a reference for the unit and its materials.

Please note: it is essential that all wiring and piping be installed in accordance with this manual

The low pressure boilers supplied with the CWT Line Heaters are designed, manufactured and registered as ASME Section IV Low Pressure Boilers. The control systems are designed and installed in accordance with ASME CSD-1. Local regulations may vary for installation, design and operator certification requirements. Please review and comply with all local codes and regulations.

The line heater is designed to operate on natural gas. However, please ensure the gas on which the line heater will operate is the same as that specified on the line heater model and rating plate.

Some components in the Instrumentation might have been changed or replaced due to market availability at the time when this manual was prepared. However, a changed component does not affect the overall capability of the CWT Natural Gas Line Heater. With proper care and regular maintenance, the heater should provide years of trouble-free service. Please take a few moments and read through the manual carefully. Keep the manual in a safe place where it can be easily located if needed.

We welcome any suggestions from customers to help improve this product line, please feel free to call CWT.

The CWT line heater and its components are designed, fabricated, tested and inspected in accordance to the laws, codes, statutes and regulations for use in the Province of Alberta, Canada. The end user is responsible for ensuring that CWT line heater complies with all Federal, Municipal, Provincial, State and Local laws, Codes, Statutes and Regulations prior to installation of the unit, and application of permits, licenses, certificates and authorizations thereof.

Warning: This manual must be read in its entirety before installation of this product. Installation must be performed by a qualified technician and adhere to the safety standards. Failure to do so will result in personnel injury or property damage.
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1. Introduction

Cold Weather Technologies (CWT), a division of Grit Industries Inc., has developed the Heat Driven Loop (HDL) technology for a variety of applications for the purpose of heating process fluids and gases in the oil and gas industries. Conventional line heaters utilize heat transfer from a natural draft flame arrested burner system immersed in a glycol bath. The HDL utilizes the energy released when steam changes from a vapour to a condensed state. The HDL operates with high thermal efficiency without any moving mechanical components or external power.

The HDL is comprised of two main components, the low-pressure boiler, and the condenser (heat exchanger). The unit is collectively known as the CWT Natural Gas Line Heater (or just “line heater” for short). In the boiler, the solvent of water and glycol is heated to a point at which the water is separated from the glycol, creating steam. In the heat exchanger, the steam produced from the boiler condenses on the process coils and the heat from the condensing steam is then transferred to the gas in the coils. This separation of components has two advantages. Firstly, the boiler can be utilized for multiple coil/heat exchanger combinations, and multiple boilers may be attached to a heat exchanger for large line heaters. Secondly, because the medium being heated is physically isolated from the combustion process, long term maintenance and safety issues are effectively controlled.

Typically a vacuum is drawn on the line heater prior to shipment, removing all the excess air from the boiler and heat exchanger. The vacuum is important for two main reasons. First, under vacuum the water will begin to boil at a temperature as low as 45°C/113°F, allowing for fast heat transfer to the heat exchanger. Second, the system will respond to heat requirements allowing pressure to range from -26” Hg ( -12.7 psi) to 3 to 5 psi.
The latent heat exchanged from the steam as it condenses into liquid water to the natural gas inside the high-pressure coil is the key to heat exchange in HDL system. A 50/50 propylene glycol/water or ethylene glycol solvent is used in all HDL systems for freeze protection and corrosion inhibition along with minimum oxidation.
2. Site preparation and delivery

2.1 Prior to receiving the line heater

In preparation for the receipt of the line heater the following should be performed:

2.1.1 CWT recommends that the line heater be levelled (a solid pad or base should be completed before arrival of the unit).

*Note:* Please follow all local jurisdictions and codes to design a proper foundation. In addition the equipment shall be installed in accordance with those installation regulations in force in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

The reason for a level and solid base is to ensure the integrity of the HDL (Heat Driven Loop), the line heater depends on gravity for the water to return from the heat exchanger to the boiler. If the foundation slopes the wrong way it puts undue stress on the high pressure flanges and the condensed returning water will be trapped and will “pocket” at the far end of the heater. In this situation the Heat exchange process (HDL) is disrupted as no steam can be generated and the glycol can overheat.

2.1.2 A thermowell MUST be installed in the gas piping downstream of the regulators (depends on application) and this thermowell will receive the probe for the gas temperature control. It is the end user’s responsibility to select, and notify Cold Weather Technologies of, the appropriate thermowells prior to shipping the heating boiler (see section 3.1 for thermowell sizings). The thermowell must be in contact with the flow of gas to operate the system properly.

2.1.3 The CWT boiler fuel supply operates on an inlet fuel pressure of 5 psi or less, depending on the size of the heater. Regulating and fuel supply metering equipment up to the fuel train to provide the required fuel gas pressure is the sole responsibility of the end user. It is also the end user’s responsibility to ensure that an adequate fuel supply is available.
2.2  Upon receiving the line heater

The CWT line heater is typically shipped completely charged with heat transfer fluid and on vacuum (depends on size of heater).

2.2.1 Note any damage to the boiler body and heater exchanger can. If noticed any upon arrival please contact CWT immediately.

2.2.2 Unload the line heater using lift points (lugs on the skid) and place on piles or level cement pad. The offload lift should be carried out as per the lifting diagram supplied by Grit Industries Inc. At ALL times during the lift, the line heater should be level.

2.2.3 The shipping crate will contain:
   (a.) an operating manual,
   (b.) a checklist of parts, and
   (c.) the required parts for installation.
3. Installation procedures

3.1 Place thermowells in downstream gas piping just past the regulator outlet (pressure cut). The line temperature probe is typically placed immediately after the last pressure regulation in the facility. **Place thermowells as close as possible to meter station.** The probe requires a thermowell with an internal bore of minimum .512 inches (13mm). Cold Weather Technologies can supply the appropriate thermowell upon request. Length will depend on pipe size and collar used on pipe. This information will be required in order to send proper length.

**NOTE:** It is suggested that a barrier be created within this conduit prior to the thermowell in the high pressure line.

Use the following table to select the appropriate thermowell, and notify CWT of the part number.

<table>
<thead>
<tr>
<th>Heater size (BTU in 1000's)</th>
<th>Number of thermowells</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
<td>1</td>
</tr>
<tr>
<td>315</td>
<td>1</td>
</tr>
<tr>
<td>385</td>
<td>1</td>
</tr>
<tr>
<td>630 (2-315)</td>
<td>2</td>
</tr>
<tr>
<td>770 (single)</td>
<td>1</td>
</tr>
<tr>
<td>770 (2-385)</td>
<td>2</td>
</tr>
<tr>
<td>1155 (3-385)</td>
<td>3</td>
</tr>
<tr>
<td>1540 (2-770)</td>
<td>2</td>
</tr>
<tr>
<td>2300 (3-770)</td>
<td>3</td>
</tr>
<tr>
<td>3100 (4-770)</td>
<td>4</td>
</tr>
<tr>
<td>4600 (6-770)</td>
<td>6</td>
</tr>
</tbody>
</table>

- It is suggested the tip of the thermowell be in the middle of the pipe, or beyond in smaller pipes.
- Please ensure that proper components and procedures are used for the pressure piping.
- It is suggested that appropriate thermally conductive heat transfer compound be used.

**Note:** One thermowell per boiler.
INSTALLATION PROCEDURES

Figure 3.1.2

NOTE: QUANTITIES OF PARTS WILL VARY BY APPLICATION

Example:

1. Specify part number as per local jurisdiction codes and regulations.

IMPORTANT: Install as per local jurisdiction codes and regulations.

Typical Installation of Line Temperature Control Switch (LTCS)

LTC Wiring in Control Box as per manual.
3.2 Connect the fuel supply line to the fuel train on the boiler. Be sure to check local codes. The CWT boiler operates on an inlet fuel pressure of 5 psi (34.37 kPa) or less.

3.3 If supplied with a line heater having multiple boilers, run cable from the terminal remote box (see figure 3.3) to the remote box.

3.4 To install the line temperature control switch, refer to figure 3.1.2.

3.5 Place B-Vent exhaust stack on boiler (see section 4.1.22 for images of the stack, and Appendixes D, E, and F at the back of the manual):
   - Remove exhaust stack blind or cover. Be sure to save the cover/blind gasket on the stack, as it is to be reused for the stack itself.
   - Place rain cap on exhaust stack section (use screws),
   - Place exhaust stack sections together if necessary (use screws),
   - Place exhaust stack on boiler (lifting equipment maybe needed),
   - Use bolts from cover to secure the boiler, (boiler size 140 will not require bolts).

3.6 Pressure gauges to be placed in valves located on coil (See figure 3.6)

3.7 When completed all parts from crate should be used

3.7.1 Note: CWT highly recommends insulating gas piping from heater coil outlet, up to the pipe where the downstream thermo-probe be installed.

3.7.2 Ready for pre-start up, start-up and run procedure (section 5)
   Note: Please confirm all connections are tight and sealed.
4. Components, safeties, and controls

The Cold Weather Technologies boiler is equipped with a number of safety systems that protect personnel and equipment. These systems function automatically without the need for constant supervision; however, some of the systems may require manual start-up after a shut down. A thorough examination of the device should be performed to determine the cause of any shut down. Activation of a safety shut down may be a signal that maintenance is needed for the device. Contact Cold Weather Technologies Inc. if the cause of the shut down is unknown.

The controls on the CWT operate on the energy provided by the thermopiles located near the continuous pilot. The power provided passes through a circuit that contains the various switches, as illustrated in the following pages.

In general, safety and control is quite simple; if any of the switches open, the circuit will be broken and the main burner will shut down. If the low-low water cut, or high-high pressure open both the main burner and the pilot will be extinguished and a manual restart will be required (system purchased as of July 2014).

Note: Low-pressure boiler regulations may require testing or inspection of boilers and control systems. Please refer to all codes and regulations.

4.1 Boiler section

The firebox contains the burners, burner manifold, burner tray, Ignitor /thermopile assembly and the pilot and main fuel lines.

4.1.1 Swordfish burners (burner manifold or burner tray)

The burners are referred to as “swordfish burner”. Each burner is capable of a maximum firing rate of 35,000 Btu/hr, at 14 inch w.c. and #45 orifices. They sit in slots in the burner tray and can be equipped with a primary air adjuster (upon customer request).
Each swordfish burner generates 35,000 Btu's per hour:
- 140,000 (Btu's) = 4 swordfish burners
- 385,000 (Btu's) = 11 swordfish burners
- 770,000 (Btu's) = 22 swordfish burners

4.1.2 Pilot and thermopile assembly

The pilot and thermopile assembly consists of two 750 mV thermopiles, a pilot burner, and a sparker.

**NOTE:** The pilot orifice should be stamped with the part number BL22N.
4.1.3 The fintube assembly (primary heat exchanger)

The fintubes are located above the burners and span the width of the firebox. The flue gas passes through the fins and exit through the flue and stack. As the heated flue gas pass through the fintubes they heat the water-glycol mixture and cause the water to boil, generating steam.

The photo above shows the primary heat exchanger with the side (saddle) tank open. The heat transfer fluid sits in the saddle tanks and fins as the combustion products pass upward, through the fins.

NOTE: The internal design is different for different models.
The control box is attached to the boiler and houses the various controls and safeties for the CWT heating unit. The controls and safeties have been designed to meet the requirements of ASME CSD-1. They include the Robertshaw gas valve, the switches for operating steam pressure, high-high steam pressure (with ESD), low-fluid level, low-low fluid level (with ESD).

Also included are the ignition box and a gauge to indicate main fuel line pressure downstream of the gas control valve. The gas line temperature control, while usually remote from the line heater, is also connected to the control box and system control logic.

*Please refer to figures 4.1.4.a through 4.1.4.c*
4.1.5 P and ID drawings
4.1.6 Flame or flashback arrestors

It is a simple device, which quenches the flame from escaping to the outside of the burner housing. Ensure you are following local codes and regulations in the use and cleaning of a flame arrestor.
4.1.7 Robertshaw gas valve

The Robertshaw gas valve is the primary fuel control on the line heater. The current generated by the thermopiles in the continuous pilot powers the valve. The valve has three settings: off, pilot, and on. When the valve is in the on position it will respond to the controls in thermostats in the circuit and the unit will operate.

The pressure regulating process of the Robertshaw gas valves are bypassed. The pressure regulating for the units is performed by the supplied Fisher HSR regulators upstream of the Robertshaw gas valve.

**WARNING:** The Robertshaw gas valve is not intended for operation at higher than 14.0” W.C. (.5 psi) supply gas pressure. Exposure to higher supply pressure may cause damage and could result in fire.

*NOTE:* Please refer to Technical Manual section for detailed product information.
4.1.8 Low fluid level switch

If the fluid level in the heater falls below this level switch setting, the unit will open circuits to the main burner gas supplies. The operator should review heater to determine possible cause of fluid loss and repair and replace fluid. This will not require manual relighting of the heater.
4.1.9 Low-low fluid level switch with ESD

If the fluid level in the heater falls below this level switch setting, the unit will open circuits to the pilot and main burner gas supplies shutting down both the pilot and main gas. The operator must review heater to determine cause of fluid loss and repair and replace fluid. This will require manual relighting of the heater.
4.1.10 Ignitor box and hand-held sparker

The ignition box assembly consists of a receiver in the control panel and a separate hand-held sparker. Inside the sparker is an AA battery.

**NOTE:** Before lighting the evaporator, it is mandatory to test the atmosphere first for combustible gases around the unit.

*NOTE:* When lighting the CWT unit using the hand held igniter this is the only time that the system is capable of producing a spark to light gases and is not CL1 Zone 2 “Non-Incendive” certified. The atmosphere around the control cabinet should be tested or checked prior to lighting the unit for personal safety.
4.1.11 Pressure safety valve (relief valve)

The release of fluid from the heater may lead to decreased efficiency by removing water that generates steam. If fluid is seen in the collection barrel review the line heater for any issues and repair as needed. It may be necessary to remove and replace fluid in the heater.
4.1.12 Operating steam pressure switch

If the steam pressure in the heater exceeds 5 psi, the unit will open circuits to the main burner gas supplies, leaving the pilot burning. As the steam cools, decreasing the pressure to below 5 psi the main burner will be allowed to relight automatically.
4.1.13 High-high steam pressure switch with ESD

If the steam pressure in the heater exceeds 10 psi, the unit will open circuits to the pilot and main burner gas supplies causing both the main flame and pilot to extinguish. The operator must review heater to determine the cause of the excess pressure. A manual resetting of the ESD switch will be required prior to relighting heater.
4.1.14 Temperature control (line temperature control)

The line temperature control monitors the temperature of the gas in the downstream gas piping.

It is generally set between 0°C (32°F) and 5°C (41°F) in natural gas distribution applications. If the gas temperature in the downstream gas piping falls below this set point the switch will close, allowing gas to flow to the main burner, generating steam for heat transfer.

Once the heated gas passing the line temp controller has exceeded its set point. The contacts will open which stops the gas flowing to the main burners.

If low or zero gas flow situations exist we strongly recommend installing an additional probe called the High Temp Shut Down (HTSD) near the outlet of the high-pressure coil.

The temperature set point on the HTSD probe must then be increased to account for the pressure drop through the gate station.

(As a general rule, a 100 Psi / 689.4 kPa drop in pressure will result in drop of 7°F (-13.9°C) of temperature).

**NOTE:** Please refer to technical manual section for detailed product information.
4.1.14a 140 / 385 boiler line temperature controller (T675A switch)

As the temperature of the controlled medium falls below the set point less differential, the T675A switch makes terminals R to B an energize a normally closed solenoid valve to provide heat. Figure 4.1.14a.1 shows the operation of the T675A. Figure 4.1.14a.2 shows the location of the adjustment dial on models with an adjustable differential.
4.1.14b 770 boiler line temperature controller (T678A switch)

When the temperature at the sensing element rises above the set point of the controller, the switch on the right breaks R to W. Should the temperature continue to rise through the preselected interstage differential of the controller, the switch on the left will make R to W.

Conversely, on a temperature fall, the switch on the left makes R to B, providing first step switching. If the temperature continues to fall, the switch on the right makes R to B to provide sequencing of equipment.

The T678A temperature controller has an adjustable interstage differential. The set point adjustment knob determines the temperature at which the right switch operates. The left switch can be adjusted to operate from 3 to 10 degrees F (1.7 to 5.6 degrees C) (or 3.6 to 12 degrees F (2.0 to 6.7 degrees C) on some models) above the point of operation of the right switch. An illustration depicting the operation of the T678A is shown in figure 4.1.14b.1. The interstage differential is adjusted by turning the star wheel with a narrow screwdriver inserted into the rectangular hole in the chassis (figure 4.1.14b.2).
4.1.15 Fisher HSR regulator

Pressure to the Robershaw gas control valve. The maximum inlet pressure to the HSR is 20 psi due to the .5” orifice installed within the unit. **Vent as per local codes.**

![Fisher HSR regulator](image)

(Figure 4.1.15)

The following table is using a HSR with .5 inch orifice.

Inlet pressures and standard cubic feet per hour for each line heater assembly:

<table>
<thead>
<tr>
<th>LINE HEATER SIZE</th>
<th>INLET PRESSURE</th>
<th>REQUIRED SCFH</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
<td>1 psig</td>
<td>200</td>
</tr>
<tr>
<td>315</td>
<td>3 psig</td>
<td>340</td>
</tr>
<tr>
<td>385</td>
<td>5 psig</td>
<td>480</td>
</tr>
<tr>
<td>630</td>
<td>5 psig</td>
<td>680</td>
</tr>
<tr>
<td>770 (Single)</td>
<td>5 psig</td>
<td>1050</td>
</tr>
<tr>
<td>770 (2-385)</td>
<td>5 psig</td>
<td>960</td>
</tr>
<tr>
<td>1155 (3-385)</td>
<td>5 psig</td>
<td>1440</td>
</tr>
<tr>
<td>1.54 (2-770)</td>
<td>5 psig</td>
<td>2100</td>
</tr>
<tr>
<td>2.3 (3-770)</td>
<td>5 psig</td>
<td>3150</td>
</tr>
<tr>
<td>3.1 (4-770)</td>
<td>5 psig</td>
<td>4200</td>
</tr>
<tr>
<td>4.6 (6-770)</td>
<td>5 psig</td>
<td>6300</td>
</tr>
</tbody>
</table>

(Table 4.1.15)
4.1.16 Fuel pressure gauge IWC (inches of water column)

Pressure measurements in inches of water column

1 psi = 27.68 inches of water column, so 0.45 psi would be
27.68 * 0.45 = 8.3 inches of water column

**WARNING:** The Robertshaw gas valve is not intended for operation at higher than 14.0" W.C. (.5 psi) supply gas pressure. Exposure to higher supply pressure may cause damage and could result in fire.

4.1.17 Emerson 289L relief valve

This valve is set to relieve excess gas measurement at 14 inches water column.
Vent as per local codes.
Fuel gas assembly drawings can be found in Appendix J.
ALL DWGS MUST BE RETURNED TO QC DEPARTMENT ON COMPLETION
4.1.19 Pressure vacuum gauge

The vacuum gauge indicates the strength of vacuum. When the unit has a steam temperature of less that 140 degrees Fahrenheit, the gauge should be in the range of –20 to –25 inches HG.

*Note:* Heat transfer efficiency will increase with high vacuum.
4.1.20 High pressure coil gauge

Picture of pressure gauge above is the standard pressure gauge CWT uses on inlet and outlet of high pressure coils to determine the gas pressure.
4.1.21 Liquid level gauge

Pictured above is the liquid level gauge, which indicates the availability of the heat transfer fluid in the system.
4.1.22 Exhaust vent

The exhaust stack cap supplied with the CWT heater is a residential, B-Vent style stack cap. They come in six (6) inch, eight (8) inch, or twelve (12) inch, depending on the boiler model.

The six inch stack has a high-wind stack cap with bird screen, while the eight (8) and twelve (12) inch stacks are both equipped with the bird screen.

Stacks are to be cleaned out (blown out) periodically as part of the routine maintenance. B-vent stacks are double-walled galvalume and can dent very easily. Proper care when installing the vent stack should be taken to prevent damage.

Refer to Appendix D, E, and F for assembly details.
4.1.23 Emergency shutdown device

(Figure 4.1.23)

Pushing the emergency shutdown button will open contact, removing power from the control system. This will extinguish the main flame as well as the pilot.

To reset, turn the mushroom button clockwise. After this, a manual reignition will be required.
4.2 Condenser section (heat exchanger)

The condenser or heat exchanger is the part of the CWT Line Heater where the steam condenses on the pressure coil that contains the cold gas. When the steam contacts the cold pipe it releases latent heat by condensing to water. The water falls back to the boiler section by gravity. The energy released as the steam condenses to water is significant. Just as it takes a significant amount of energy to convert water to steam, a large amount of energy is released when the steam condenses back to water. **The inlet and outlet of the high-pressure piping is not defined, either flow direction will result in an acceptable heat exchange.**
4.2.1 The heat exchanger can

The condenser/heat exchanger can contains the pressure coil and provides the vessel in which the steam is allowed to condense on the coil.

Inside the condenser can (photo below) the receivers at the far end support the coil.

(Figure 4.2.1)
4.2.2 High-pressure process coil

The high-pressure coil is the device that contains the gas to be heated. It is a registered pressure device built and certified in accordance with ASME B31.3 (pressure piping). The coil is typically a serpentine device as pictured below, the cylindrical coils are helical spiral coils and adjacent to it are standard high-pressure coils.
(Figure 4.2.2b) Note the nubs on the end of the coil. These provide support and grounding for the coil inside the can and are not part of the pressure envelope.
5. **Start-up procedure**

On start up in very cold weather the line heater coil might be quite cold. Ensure the unit is warmed up to higher than 0°C (32°F) prior to pressuring up the coil.

If the line heater is down in very cold weather and there is no gas flow passing through the unit, the line heater should be isolated and the pressure reduced.

**WARNING:** Test atmosphere around the line heater prior to lighting (procedure also on control box door). If an explosive mixture exists locate and shut off the source of the fuel and ensure the flame arrestor is in place and secure.

1. Open main gas ball valve on the fuel gas supply.
2. Turn Robertshaw control valve to the “PILOT” position.
3. Depress pilot button.
4. Insert hand held ignitor into the ignition box in the control cabinet and depress the button, while still depressing the pilot button. This causes a spark to jump across the pilot assembly. You should hear the sparking. Once the pilot lights you will no longer hear the spark. It may take several minutes for the natural gas to reach pilot area, due to the length of fuel gas supply line and the amount of trapped air.
5. Hold pilot button down for 45 seconds or more and then release.
6. Look through the site glass to confirm the pilot remained lit. If not, check that the valves on the fuel supply are open and return to step four. If this problem persists press the reset on the ESD control and try again or check fuel gas.
7. With established pilot turn Robertshaw control to the “ON” position.
8. Change the setting of the line temperature switch to force heater to light. The main gas control valve should open and the heater should light. On first light you may get a slight burst of gas because of air in line. Turn to pilot for a second and then back to on. If the main burner does not light, confirm that all the dial type switches are calling for heat.
9. Once the boiler is operating, examine the flame and note any instability.
10. Use the CWT Line Heater checklist inspection form (section 7.16) to record the initial data.
6. Typical operation

During the first operating cycle of the line heater, allow the system to run. Monitor the pressure, the discharge temperature and the level of heat transfer fluid in the sight glass. During initial start up and during normal operation the level of heat fluid will vary widely in the sight glass.

While the system is warming up, you will hear clattering and clanking inside the evaporator, which is normal and due mainly to steam being produced in the fin tubes along the tube wall and partially to thermal expansion of steel inside the system.

Once the boiler is warm (the main flame bed turns on and off to keep the gas warm) note the duration of the on and off cycles and the maximum and minimum temperatures reached. The season and gas flow will determine the cycle times; slow flow means long cycles and high flow mean short cycles. Use the attached Inspection sheet (section 7.16) to record start-up data.

If the boiler appears not to be warming gas sufficiently consider increasing the fuel pressure at the Fisher HSR. Insufficient fuel gas will cause the unit to run constantly, and will not heat properly. If the heater cycles off and on it has sufficient energy to heat the gas.

6.1 Glycol

The glycol used in the CWT heater is a Dow Frost HD 50/50 pre blend. Our Heat Driven Loop technology does not use the glycol as the heat transfer medium. Glycol in the CWT system is only for freeze protection. Customers are advised that when sending glycol reports for lab tests that the following results may be identified:

1. Low to no corrosion inhibitors present: this condition is typical for CWT units as through the process of separation that the glycol undergoes, the inhibitors actually drop out and/or burn up.

2. High solids content: The presence of some residuals of the manufacturing process are typical, as we are not able to remove them all from the system. There are no pumps or moving parts that will be affected by small or trace amounts of residuals. However, if large amounts are found, refer to the maintenance section of this manual.

3. Discoloration of the glycol in CWT systems is typical and the amount will vary from site to site depending on the station loading. Do not be alarmed. Confirm the freeze protection is still lower than the lowest ambient condition for the location of the heater.
**Dow has a series of standard computer generated responses for every sample they check, the baseline for the responses is “New” DowFrost HD. Here are some examples and factory responses to each:**

“**This fluid has cloudy appearance and suspended solids**”: Typically the solids present are inherent to the manufacturing process at the factory level and should only become a concern if the iron level increases over future annual samplings.

“**The pH is above the maximum recommended level for Dow fluids**”: There is only a concern if the pH level exceeds 12 and the pH level of the glycol should decline over time.

“**Solids can be detrimental to pump seals**”: Our technology features no moving parts such as pumps and circulators.

“**Azole based copper inhibitor is low. Insufficient copper or copper alloy corrosion protection**”: The CWT heater operates in a vacuum and inherent corrosion protection is achieved by the lack of oxygen in our system and there are no copper or copper alloy components in the CWT systems.

“**High amounts of solids will significantly reduce the heat transfer properties of this fluid**”: Unlike conventional water bath heater technology the glycol found in our heater is not used for heat transfer.

“**Concentration and freeze point comments**”: As provided the 50/50 blend of glycol and water provides freeze protection to approximately –30 degrees Fahrenheit and the user should ensure this number stays below the minimal ambient temperature of the site.

### 6.2 Control settings

<table>
<thead>
<tr>
<th>CONTROL</th>
<th>SETTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating steam pressure switch</td>
<td>Factory setting - 5 psi</td>
</tr>
<tr>
<td>High-high steam pressure switch with ESD</td>
<td>Factory setting - 10 psi</td>
</tr>
<tr>
<td>Low fluid level switch</td>
<td>Factory setting</td>
</tr>
<tr>
<td>Low-low fluid level switch with ESD</td>
<td>Factory setting</td>
</tr>
<tr>
<td>Pressure safety valve (relief valve)</td>
<td>Factory setting - 15 psi</td>
</tr>
<tr>
<td>Line temperature</td>
<td>0°C/32°F to 5°C / 41°F</td>
</tr>
<tr>
<td>(HTSD)</td>
<td>Depending on the conditions and the nature of the gas set this as required (About 2°C / 35°F).</td>
</tr>
<tr>
<td>Gas bundle outlet temperature (HTSD)</td>
<td>24°C / 75°F to 43°C / 110°F</td>
</tr>
<tr>
<td></td>
<td>Depending on the season.</td>
</tr>
</tbody>
</table>

*(Table 6.1)*
Note: When multi-heating boilers are used on a heat exchanger, the line temperature switches should be rotated, so that the single boiler is not always the lead unit.

6.3 Tuning the CWT Line Heater

The CWT Line Heater has a significant advantage over conventional systems in that it has a high turndown capability. A CWT boiler can run with fuel inlet pressures varying between 3.5” WC (0.13 psi) and 14” WC (0.52 psi). This allows the operator to set the cycle time of the line heater to best fit the load. Ideally, a perfectly tuned heater would run 100 per cent of the time on the coldest day of the year. In practice, a well-tuned boiler will typically cycle three to four times per hour.

Cycle time is determined by firing rate and load. The “on”, or firing, portion of the cycle can be controlled by the firing rate. If the firing rate is increased this will shorten the on part of the cycle. Flow and pressure drop through the station controls the “off” part of the cycle.

Some general rules for tuning include:

- If possible, set the firing rate during high station load conditions and let the line heater stabilize (warm up) before continuing.
- Fire at a high enough rate that the line heater will cycle at least three times per hour.
- Fire at a high enough rate to ensure the stack temperature exceeds 130°C (266º F). Below this point incomplete combustion may occur and “raining” may occur in the stack.
- Fire at a low enough rate that the stack temperature does not exceed 250°C (482º F). Above this would impair the boiler or stack.
- Obtain a combustion analysis and optimize the combustion.

Observe the flame and address any lifting and/or hunting. Consult CWT for advice.

6.4 Cycles

The CWT Line Heater normally operates with cycles on and off (figure 6.3a). The nature of the cycle depends on the firing rate and load as well as the set points on the controls primarily the gas temperature control. (See section 6.1)

When the line heater fires in response to a call for heat by the gas temperature control the boiler begin the process of boiling the water. As the steam temperature and pressure increase more heat is delivered to the process gas. Eventually the temperature of the gas reaches the set point of the gas temperature control and the main burner shuts down. Upon shutdown, a large amount of energy remains in the boiler and the temperature of the gas will continue to climb for some time (depending on the load). As a result the heater tends to overshoot the set point by a few degrees.

Similarly when the heater is off, and the temperature is falling, when the gas line temperature control reaches the set point (plus the dead-band) it will call for heat and the boiler will fire. It might undershoot the set point before the boiler catches up.
TYPICAL OPERATION

Gas Temperature Profile with CWT Line Heater (Illustrative Purposes Only)

(Figure 6.3a)
7. Maintenance

**WARNING:** Never perform maintenance on the line heater when under operation or hot. Please ensure that the unit is shut and cooled down for a minimum of 25 minutes, and that all fuel gas to the device has been shut off prior to performing any maintenance operation.

**ALWAYS assume that there is pressure in the system.**

### 7.1 Maintenance schedule

It is suggested that the line heater should undergo a complete inspection, maintenance and cleaning at least semi-annually (spring and fall). Use the following maintenance checklist in conjunction with the CWT inspection sheet (section 7.16). The inspection can be done in connection with maintenance and can begin with a line heater that is operating; however sufficient time should be available to allow the boiler to cool prior to the maintenance activities.

**Inspection Checklist**

- Take pictures of the complete heater.
- Record heater serial number and coil serial number.
- Shut heater off and allow it to completely down.
- Ensure vacuum is between -20 inches and -26 inches.
- Check the glycol level in the sight glass.
- Open the burner box door and take pictures of burner tray and burner box.
- Remove stack and take pictures of stack walls and top of fin tubes.
- Remove burner tray gas line and disconnect pilot line from tray. Loosen off main pilot line nut. Burner tray may be difficult to remove as side walls can distort, slightly pinching the tray in place.
- When burner tray is removed take pictures of bottom of fin tubes. If possible, do a visual inspection.
- Use an air compressor to **blow off top and bottom of fin tubes**.
- Once complete, do a visual inspection. If not clean, then repeat.
- Use a vacuum cleaner to clean up the bottom of burner box and, if possible, the top of the fin tubes.
- Take pictures of cleaned-out burner box and top of fin tubes.
- Clean burners from tray with air and check orifices to see if they are clean. This may require disassembly.
- Clean flame arrestor cell with air or soapy water solution. Flame arrestor should be clean and free of debris.
- Reassemble burner tray and install back in burner box. Hook up gas line and pilot assembly.
- Check wires in burner box for defects. If necessary, replace.
- Close up burner box area.
- If heater has cooled down enough, take glycol samples.
- When complete, relight heater using start-up procedure.

---

**WARNING:**

Inspections and tests included in this section may be regulated by local, Federal, or other jurisdictions. Please review all applicable codes and regulations prior to conducting any activities on CWT equipment.

**WARNING:**

Performing pressure tests on the system can be hazardous, and should only be performed by trained professionals. Contact CWT if you have any questions.
Once inspection is complete, test controls using a dry block where required, or a multimeter and pressure station set-up for pressure switches:
- Operating steam pressure switch (5 psi)
- High-high steam pressure switch with ESD (10 psi). Will require relight.
- Line temperature control switch. Set to desired temperature.
- Low water cut-off. Will require relight.
- Low-low water cut-off with ESD. Will require relight.
- Emergency push button. Will require relight.

Once the heater is up and running, complete the final checks as follows:
- Check millivolt readings.
- Check temperature of gas at station outlet, as well as in and out of the coil.
- Check fuel pressure, in inches WC.
- Check steam and stack temperature.
- Perform combustion analysis, if possible.

7.2 Cleaning the flame arrestor

The flame arrestor on the boiler should be inspected and cleaned at least annually in order to ensure that it is in good working order and that enough air is provided to support proper combustion. In some cases more frequent cleaning may be required.

a. Ensure the boiler is off prior to removing the flame arrestor.

b. Remove the flame arrestor and examine the cell – ensure that it is not damaged. Examine the gasket around the flange and ensure it is intact and in good condition.

c. Using compressed air or nitrogen blow out any dust or contaminants that might be in the weave of the cell.

d. While the flame arrestor is removed inspect the burners – look specifically for signs of scale and or soot.

e. Replace the flame arrestor; ensure that the cell fits tightly against the back flange.

7.3 Swordfish burner cleanup

Assembly drawings of the burner trays can be found in Appendix G, H, and I.

1. Turn gas valve to pilot, then turn off main gas. Let cool for at least .5 hours.

2. Open heater door and disconnect main gas flex from burner manifold. Unhook pilot gas line at Hylok fitting and remove burners if possible. Disconnect pilot bracket from burner tray. This will allow operator to remove the burner tray without having to disconnect the wires.

3. Remove burners from unit

4. Check the burner venturi ports are free of foreign particles (dust, lint and debris)

5. Clean burners with bristle brush and/or vacuum cleaner. DO NOT alter burner ports or pilot location

6. If the fin tubes need to be inspected and cleaned move on to section 7.4 before reinstalling the burner.

7. Otherwise, reinstall burners in unit. Make sure front and rear of burners are installed correctly in burner support brackets.

WARNING:
Performing pressure tests on the system can be hazardous, and should only be performed by trained professionals. Contact CWT if you have any questions.
7.4 Inspecting and cleaning the fin tubes

The fin tubes should be inspected and cleaned semi-annually. It is suggested that this be done before and after peak times (spring and fall, possibly).

1. Perform steps 1 to 3 of swordfish burner clean-up (7.3).
2. The stack will need to be turned to the side or removed for inspection and cleaning of the top of the fin tubes.
3. Once the burner tray and stack have been removed, take pictures of the fin tubes above and below, if possible. Note any problem areas and contact CWT.
4. Use an air compressor or compressed air to blow out the fin tubes from the top down and then from the bottom up. Clean up any particles from bottom of the heater and any scale still on the top of the fin tubes. If needed, use a mirror to help in the inspection.
5. When cleaning is complete take pictures to note improvements.
6. Replace the stack and burner tray.

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WARNING:
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7.5 Glycol sample procedure

Most CWT heaters are equipped with a double valve system, which will allow you to take a glycol sample without losing an appreciable amount of vacuum.

The procedure is as follows:

1. Take the sample when the heater is cold, in summer if possible. During operation the water and glycol separate and a sample will have an unrepresentatively high amount of glycol.
2. Open the top valve and wait a minute or two.
3. Close the top valve and open the bottom to obtain the sample, close the bottom valve.
4. Repeat steps 2 and 3 three or four times. Such process would purge and remove the fluid standing in the low spot and to get a sample.
5. Open the top valve.
6. Open the bottom valve for 3 seconds only. This allows the system to pour back and bring fluid into the sample leg. Close both valves.
7. Repeat steps 2 and 3 and obtain the required sample.
8. Note the vacuum pressure when complete.
9. For older Series II 140s with a temperature probe in the sample port, sample times will be much greater.
10. **NOTE:** Glycol samples are acceptable if they meet the minimum ambient temperature of the site location.

**NOTE:**

All CWT heaters are flushed and cleaned at the factory prior to shipping to site. Despite standard cleaning processes, it is possible that some residuals from manufacturing may remain in the system. The amount of these residuals can vary, and it is recommended that the system be inspected after the first season of peak volume service. If the levels of residuals found during inspection are high and there are visible high amounts of contaminants, there is a chance that the float controls and pressure controls can be affected. In this situation, a boiler flush may be required to remove the majority of the contaminants.

You may also notice some glycol discoloration after the first peak season. This is typical for CWT heaters and the amount of discoloration will vary from site to site depending on station flow/loading and the amount of residuals remaining from the manufacturing process. This discoloration does not indicate that the primary function of the glycol (freeze protection) has be compromised. CWT heaters do not rely on the glycol for heat transfer.
7.6 Testing the powerpiles

Test the powerpile assembly using the following procedure:

**NOTE:** Use a voltmeter set at 1000 mV

![Diagram](image)

(Figure 7.6)

**Test 1 – Complete system**

Connect to terminals 2 and 3. Ensure the thermostats are calling for heat (turn them up). Power should be >100 mV. The main burner should fire. If the voltage >100 mV but the valve does not open replace the valve. If the power is <100 mV proceed to test 2.

**Test 2 – Thermopile output**

Connect to terminals 1 and 2. The thermostats should not be calling for heat (turn them down). The main burner is off the voltage should be > 325 mV. If it is less replace the thermopiles.

**Test 3 – Pilot dropout**

Connect to terminals 1 and 2. Hold the pilot until the power level stabilizes. Shut the pilot off and note at which point the magnet drops (should be between 120 and 30 mV (falling). If the dropout does not occur or occurs outside these points replace the gas valve.

**NOTE:** If through age or failure the thermopiles can no longer generate the power to operate the gas valve they can be replaced quite simply. In this case all the thermostats, controls and safeties would shut down.

**WARNING:**

Performing pressure tests on the system can be hazardous, and should only be performed by trained professionals. Contact CWT if you have any questions.

**WARNING:**

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7.7 Test procedure for boiler controls

**Testing of low fluid level switch and low-low fluid level switch with ESD**

1. This test can be performed with the heater on.
2. When boiler is running, gently insert a screwdriver or similar tool in the test opening below the switch.
3. Lift the linkage to cause the float to drop, thereby simulating a low water condition.
4. This will kill the pilot and a relight will be required.
5. This test will need to be performed on both low water cut-offs.
6. The low-low water cut-off has a reset on it and will need to be pushed after it has been tested.
7. Relight will be required.

Control can be tested on a hot water boiler by gently inserting a screwdriver or similar tool in the test opening below the switch (see illustration at right) and lifting linkage to cause float to drop, thereby simulating a low water condition.

7.8 Testing the emergency shut-down button

1. This is a simple procedure. As the boiler is running, push the button. This will kill all switches and the gas. The boiler will need to be relit.
7.9 Pressure switch tests

The above photograph illustrates what the boiler pressure switch regulator tool looks like. This tool is required to test the pressure switches on the boiler.

Using the tool to perform tests on pressure switches

1. The boiler will need to be turned off.
2. Let the boiler cool down for a minimum of 20 minutes.
3. Remove the lock-out wire from the 1/4" ball valve in the control cabinet and close the valve.
4. Remove the 3/8" Hylok cap on pressure gauge tee on the outside of the cabinet. A small amount of glycol may escape.
5. Connect boiler pressure switch regulator test hook-up tool to the fitting that the Hylok cap was on.
6. Ensure the valve is in the off position to ensure there is not too much pressure.
7. Hook up the hand pump or air compressor hose.
8. Keep in mind that the first switch (the operating steam pressure switch) is set to 5 psi, and the second switch (the high-high steam pressure switch with ESD) is set to 10 psi.
9. Connect a multimeter (set on continuity) to where the wires connect to the switches. This will allow the operator to know when the switches have been tripped.
10. Start to pressure up the system. The first switch should trip at 5 psi. If this is successful, disconnect the multimeter and hook it up to the high-high steam pressure switch (with ESD).

WARNING:
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WARNING:
Performing pressure tests on the system can be hazardous, and should only be performed by trained professionals. Contact CWT if you have any questions.
MAINTENANCE

**WARNING:**

Inspections and tests included in this section may be regulated by local, Federal, or other jurisdictions. Please review all applicable codes and regulations prior to conducting any activities on CWT equipment.

---

11. Continue to pressure up the system to 10 psi. The high-high steam pressure switch (with ESD) should then trip.

12. Once all pressure switches have been tested, remove the multimeter, release the pressure from the system, replace the Hylok cap on the tee, and open up the valves to the switches. Ensure valves are re opened and locked prior to reigniting the boiler.

13. Reset the ESD on the high-high steam pressure switch (with ESD).

13. The boiler will need to be relit and a start-up will need to be performed.

---

7.10 Testing PSV pressure safety valve

1. This will need to be tested based on State or Local jurisdiction.

---

7.11 Procedure to find possible leak

When required, the following checklist can be used to track down possible leaks.

- Turn heater off and let cool for one hour. This needs to be done or steam will leave the system.
- Remove vacuum from system.
- Drain the glycol from the system. Barrels will be required for this, so be sure to check the size of system for the amount needed.
- Using an air compressor, pressure system up to 10 psi ONLY.
- Soap all fittings and areas that might be affected.
- Inspect areas for bubbles. Testing may require up to an hour.
- Fix problem areas.
- Re-pull vacuum to -24 to -30 inches Hg.
- Pull in proper amount of glycol. Note, new glycol may be required, as old fluid may have lost its water.
- Restart heater using start-up procedure.

---

7.12 Pulling vacuum (when required)

1. Ensure that the system is cool and that neither the main burner nor the pilot is running.
2. Ensure the system is completely drained of glycol.
3. Connect the vacuum compressor (suction side) to the evaporator vacuum valve.
4. Turn on the compressor, and then open the valve.
5. Continue evacuation of air until the vacuum gauge reaches -24 to -30 inches Hg. (The higher the vacuum that is achieved in the system, the more efficiently the system will operate.)
6. Once sufficient vacuum is achieved, close the vacuum valve and shut down the compressor. Remove the compressor connections and re-install vacuum valve cap.
7. Record the pressure and temperature reading on the evaporator.
8. Allow unit to stand for 30 minutes.
9. Check to see if the pressure or temperature has dropped or varied in any way.
10. If the pressure has increased with no change in temperature, there is a leak in the system. If neither of the settings has changed, proceed to the trouble shooting section. Once this procedure is completed it is a good practice to take masking tape and put a strip inside the cabinet door and indicate the date the vacuum was pulled and to what vacuum pressure, this is a good reference point when checking vacuum on subsequent site visits.

**NOTE:** If there has been a vacuum leak on the heater you should assume that much of the water in the fluid has been lost – in these cases it is prudent to drain and replace the fluid.

### 7.13 Drawing glycol into system

New water-glycol mixture should be used when adding fluid to a system, or for new installs.

1. Remove the cap from the vacuum fitting.
2. Attach a vacuum hose to the fitting on the valve.
3. Insert the free end of the hose into the container of fluid mixture.
4. Open the valve to draw in fluid.
5. Close valve when the proper volume of fluid is drawn.

**NOTE:** Do not allow air to enter the system.

### 7.14 Recommended glycol volumes

The recommended glycol water volumes for the CWT Line Heater are as follows. In every case, when the boiler is operating there should be fluid in the site glass. If not please contact CWT.

<table>
<thead>
<tr>
<th>Heater</th>
<th>Style</th>
<th>Recommended fill volume 50/50 in US Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
<td>Boiler</td>
<td>9.58</td>
</tr>
<tr>
<td>385</td>
<td>Boiler</td>
<td>33.72</td>
</tr>
<tr>
<td>770</td>
<td>Boiler</td>
<td>40.62</td>
</tr>
</tbody>
</table>

*(Table 7.14)*

**NOTE:** Fluid volumes will change with multi-boilers.

---

**WARNING:**
Inspections and tests included in this section may be regulated by local, Federal, or other jurisdictions. Please review all applicable codes and regulations prior to conducting any activities on CWT equipment.

**WARNING:**
Performing pressure tests on the system can be hazardous, and should only be performed by trained professionals. Contact CWT if you have any questions.
**7.15 The gas bundle removal**

At least every 15 years the high-pressure coil should be removed and inspected (this period might vary depending on company policy or local codes). Prior to removing the coil contact CWT for a replacement gasket and recommended bolt torque values.

1. Ensure the heater is off and cooled. Pilot extinguished, Robertshaw gas valve to off and main gas valve shut and locked out.
2. Carefully remove the insulation around the coil flange. Do not dent the cladding and save all cladding and insulation for re-install.
3. Ensure that no pressure exists in the unit.
4. Remove the coil from the heater.
5. Visually inspect the coil and the can interior for signs of corrosion or damage.
6. Inspect coil as per appropriate codes (ASME, local corporate and other).
7. Install new gasket.
8. Install studs and nuts, torque to appropriate specifications (call CWT) and establish vacuum (see section 7.12).
9. Install all insulation and cladding as per original installation. install all sheet metal screws in original positions and caulk all seams and openings to ensure a proper seal is provided.
## 7.16 Inspection checklist

### CWT Boiler Inspection Sheet

<table>
<thead>
<tr>
<th>Company</th>
<th>Technician</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Date</td>
</tr>
<tr>
<td>Model</td>
<td>Coil Serial Number</td>
</tr>
<tr>
<td>Serial Number</td>
<td>Coil CRN</td>
</tr>
</tbody>
</table>

Heater Status on arrival (running, on pilot, off, cold, etc.)

Steam temperature (degrees F when firing and warm)

Steam pressure ("Hg when firing and warm)

Gas in temperature (degrees F when firing and warm)

Gas out temperature (degrees F when firing and warm)

Stack temperature (degrees F when firing and warm)

Station outlet temperature (degrees F when firing and warm)

Glycol fluid level (trace, 1/4, 1/2, 3/4, full)

Glycol appearance

Down stream fuel pressure (PSI)

Fuel pressure (inches WC)

Inspect flame arrestor (clean as needed)

Photos taken (burners, fine tubes)

Blow out cell and fin tubes

### Millivolt Reading

<table>
<thead>
<tr>
<th>Side 1</th>
<th>Side 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

### Control Settings

1. Operating steam pressure switch (PSI)
2. Operating steam pressure switch (PSI)
3. High-high steam pressure switch with ESD (PSI)
4. Line temperature (down stream temperature) degrees F
5. Emergency push button (check if needed)
6. Low water cut-off (check if needed)
7. Low-low water cut-off with ESD (check if needed)

*Do not tamper with the operating steam temperature switch or the high-high steam temperature switch settings unless you have a way to reset them properly.

### Combustion Analysis

<table>
<thead>
<tr>
<th>O2 (%)</th>
<th>CO2 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CO (ppm)</th>
<th>Efficiency</th>
<th>Stack temperature (degrees F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Boiler firing rate (BTR/hr)

Note condition of insulation, any scale or sign of moisture

Note condition of B-vent to steel transition piece

Comments, please note any work done or adjustments made:
8. Troubleshooting

The following is a list of common problems associated with the operation of the HDL line heater. This list is by no means all-inclusive. Please, feel free to contact Cold Weather Technologies to assist with any problems that occur.

8.1 Heater inspection checklist

Please ensure that you completely fill out a copy of the CWT Heater Inspection Checklist, found in section 7.16, as part of your troubleshooting efforts.
8.2 Common problems and possible solutions

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>COMMON CAUSES</th>
<th>POSSIBLE CORRECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>If pilot is out</td>
<td>Loss of fuel gas supply</td>
<td>Check fuel gas supply.</td>
</tr>
<tr>
<td></td>
<td>Excessive pressure in system caused high-high steam pressure switch with ESD to activate</td>
<td>Review pressure shown on gauge. If excessive, diagnose cause and fix.</td>
</tr>
<tr>
<td></td>
<td>High-high steam pressure switch with ESD issue</td>
<td>Check switch ESD, and test functionality.</td>
</tr>
<tr>
<td></td>
<td>Low fluid level in heater has caused low fluid level switch and/or low-low fluid level switch with ESD to trip</td>
<td>Check for fluid movement in sight glass. Diagnose cause and fix. Reset ESD if necessary.</td>
</tr>
<tr>
<td></td>
<td>Low fluid level switch issue and/or low-low fluid level switch with ESD issue</td>
<td>Check switches and ESD, and test functionality of each.</td>
</tr>
<tr>
<td></td>
<td>System has exceeded allowable pressure, and the relief has failed, allowing water to escape.</td>
<td>Inspect pressure relief and barrel for exited water. Diagnose cause of over-pressure and fix. Replace or repair pressure relief system.</td>
</tr>
<tr>
<td></td>
<td>Unsteady or fluctuating flame</td>
<td>Examine the flame. Is it steady or fluctuating? Is it lifting off the burners? If so, the combustion may need tuning. Contact CWT for advice.</td>
</tr>
<tr>
<td></td>
<td>Weak powerpile voltage</td>
<td>Test the voltage to each powerpile. See section 7.6.</td>
</tr>
<tr>
<td></td>
<td>Robertshaw gas valve magnet not holding</td>
<td>Use test 4 (pilot dropout) in section 7.6</td>
</tr>
<tr>
<td>If main burner will not fire</td>
<td>Line temperature control switch not wired correctly</td>
<td>Check wiring diagrams (found in section 4.1.5).</td>
</tr>
<tr>
<td></td>
<td>System not requiring heat</td>
<td>Check line temperature control switch to see if it is turning on and off at desired temperature. Set to appropriate temperature.</td>
</tr>
<tr>
<td></td>
<td>Problem with line temperature switch</td>
<td>Test functionality of switch. Repair or replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>Steam temperature exceeds setting of discharge temperature switch</td>
<td>Review steam temperature settings. May need review with CWT. Possible low- or zero-flow situation.</td>
</tr>
<tr>
<td></td>
<td>Loss of fuel gas supply</td>
<td>Check fuel gas supply.</td>
</tr>
<tr>
<td></td>
<td>Weak powerpile voltage</td>
<td>Test the voltage to each powerpile. See section 7.6.</td>
</tr>
<tr>
<td></td>
<td>Robertshaw gas valve magnet not holding</td>
<td>Use test 4 (pilot dropout) in section 7.6</td>
</tr>
<tr>
<td>If system won’t fire pilot or main flame</td>
<td>Loose wiring connection</td>
<td>Check ESD push button wiring and ensure connections are tight.</td>
</tr>
</tbody>
</table>
## TROUBLESHOOTING

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>COMMON CAUSES</th>
<th>POSSIBLE CORRECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater has lost vacuum</td>
<td>Malfunctioning vacuum gauge</td>
<td>Ensure that vacuum is lost and that vacuum gauge is accurate.</td>
</tr>
<tr>
<td></td>
<td>Evaporator is hot with high steam pressure due to operation</td>
<td>Record steam pressure and steam temperature from heater. Using these values, review table 10.19.</td>
</tr>
<tr>
<td></td>
<td>System has exceeded internal pressure and relief has failed.</td>
<td>Inspect pressure relief barrel for exited fluid. If present, diagnose overpressure cause. Fix and replace pressure relief system and all fluid.</td>
</tr>
<tr>
<td></td>
<td>Possible leakage of fittings, PRV, switches, etc.</td>
<td>Test system for leakages using procedure 7.11.</td>
</tr>
<tr>
<td><strong>Failure or release of pressure relief system</strong></td>
<td><strong>Possible leakage in pressure relief system</strong></td>
<td>Test system for leakages using procedure 7.11.</td>
</tr>
<tr>
<td></td>
<td>System has exceeded allowable internal pressure setting of relief system</td>
<td>Diagnose overpressure cause. Repair or replace relief system and replace all fluids.</td>
</tr>
<tr>
<td><strong>Gas is not being heated to proper temperature</strong></td>
<td>Line temperature switch settings</td>
<td>Check switch settings. Function test switches. Settings can be found on page 50. Check local codes.</td>
</tr>
<tr>
<td></td>
<td>Fuel gas pressure</td>
<td>Check fuel gas pressure. It may need to be turned up or down, depending on requirements.</td>
</tr>
<tr>
<td></td>
<td>Line temperature switch location</td>
<td>Check line temperature switch for proper location. Is the switch placed just past the final pressure cut?</td>
</tr>
<tr>
<td></td>
<td>Gas piping insulation</td>
<td>It is recommended that the piping be insulated. If it is not, then the switch in the gas piping may pick up ambient temperature.</td>
</tr>
<tr>
<td></td>
<td>Gas flow</td>
<td>Check gas flow through coil. Potential zero- or low-flow through coil. See section 8.3.</td>
</tr>
<tr>
<td></td>
<td>Safety switch operation</td>
<td>Inspect switches in system to ensure no settings have been exceeded.</td>
</tr>
<tr>
<td></td>
<td>Lost water/fluid</td>
<td>Inspect glycol site glass for fluid level. Find cause and fix.</td>
</tr>
</tbody>
</table>
8.3 Potential zero-flow application

The CWT Line Heater’s application is typically designed to sense the temperature of the gas as it exits the gate station after the last pressure cut. If a zero-flow situation exists (where no, or very little gas is flowing through the system) the probe that is downstream from the facility can be subjected to ambient temperatures below the set point of the control.

As there is minimal or zero flow, the now-heated gas will not flow past the probe, and will not signal the heater to stop its firing sequence. With the external insulation on the evaporators being very efficient, the heat being generated cannot escape and the overall temperature and pressure within the evaporator and heat exchanger will increase.

As this occurs certain safety devices will begin to operate:

1. The steam temperature will increase beyond the acceptable temperature of the HTSD, causing the safety device to open the circuit and stop the main flame from firing.
   a) If the unit can release enough heat to the surroundings, the temperature will drop and the HTSD will automatically reset, allowing the heater to resume firing as directed by the still cold downstream temperature probe.

2. If the heat can not be released then the pressure within the evaporator and condenser will continue to increase, ultimately surpassing the 5 psi range of the pressure switch. This will open the electrical circuit, stopping the gas to the main burners, keeping the unit from firing.

   **NOTE:** The pilot light will remain lit, allowing it to re-fire once the pressure had dropped below the 3 psi set point.

3. Finally, as the unit continues to release the heat and generates steam (even without a flame but potentially from the heat stored in the steel of the housing etc.) the pressure may build to 15 psi at which time the pressure relief valve will release.

**NOTE:**
If the line temperature probe is installed at the outlet of the high-pressure coil “the set temperature” must be set accordingly.

The general rule is that for every 100 psi of pressure drop 7°F/-13.9°C temperature drop. For example, if a 500 psi pressure drop is to occur the outlet temperature of the coil should be initially set 30°F above the temperature required after the last pressure drop i.e if a temperature at 35°F/1.67°C is required after the last pressure drop, the line temperature control should initially be set to 70°F/3.34°C.

The line heater should then be monitored for proper operation.

**WARNING:**
Performing pressure tests on the system can be hazardous, and should only be performed by trained professionals. Contact CWT if you have any questions.
9. Optional equipment and accessories

9.1 High-temperature shut down

There are three options.
9.2 High-temperature shut down installation drawing

[Diagram of high-temperature control package installation wiring]

A: EVAPORATOR/BOILER CONTROL BOX.
B: STANDARD DOWN STREAM TEMPERATURE CONTROL BOX.
1-B: BLACK WIRE OF SET NUMBER 1.
1-W: WHITE WIRE OF SET NUMBER 1.
2-B: BLACK WIRE OF SET NUMBER 2.
2-W: WHITE WIRE OF SET NUMBER 2.

DETAIL-A1: Shows the connections for the add on controller package in a single burner unit (140, 315, 385) heating system. Note that the 1-B & 1-W stand for the number 1 pair and the BLACK & WHITE wires.

DETAIL-A2: Shows the connections for the add on controller package in a dual burner unit (770) heating system. Note that the 1-B & 1-W stand for the number 1 pair and the BLACK & WHITE wires, same applies for set 2.

DETAIL-B: Shows the installation of the teck connector & cable into the heater control box.

DETAIL-C & DETAIL-D: Show the removal of the existing wire on the gas valves main burner control point (DISCONNECT STEP 1). The installation of the BLACK wire from the new cable onto the gas valve (CONNECT STEP 2). Then the connection of the old gas valve wire to the new WHITE wire from the new cable (JOIN STEP 3). Repeat this procedure for the second gas valve & set 2 wires if dual burner unit.

WARNING: A butt connector is show for illustration, consult the local jurisdiction electrical code for the proper procedure to make this connection.
10. **Glossary**

10.1. **Low-pressure evaporator**
An evaporator is a closed vessel in which water or other fluid is heated to a gaseous state for heating applications. In the CWT evaporator the pressure produced is less than 15 psi, hence it’s a low-pressure evaporator.

10.2. **Inches of mercury:**
In Hg or “Hg is a measuring unit for pressure”. It is defined as the pressure exerted by a column of mercury of 1 inch in height at 32°F (0°C) at the standard acceleration of gravity.

1 in Hg = 3,386.389 pascals at 0°C.
In English units: 1 inHg = .491098 psi, or 2.036254 inHg = 1 psi.

10.3. **Pascal (pa):**
It is a measure of force per unit area i.e. equivalent to one newton per square meter or one joule per cubic meter.

10.4. **Pressure (P):**
Is the force per unit area applied to an object in a direction perpendicular to the surface.

10.5. **Gauge pressure:**
Is the pressure relative to the local atmospheric or ambient pressure.

10.6. **Inches water column:**
Instead of using pressure as units of measurement, inches of water are commonly used in airflow applications in HVAC (Heat, Ventilating and Air Conditioning) because the pressure measurements are very minute.

10.7. **British Thermal Unit (BTU):**
The British Thermal Unit (BTU or Btu) is a unit of energy used in the power, steam generation, heating and air conditioning industries. The term “BTU” is used to describe the heat value (energy content) of fuels, and also to describe the power of heating and cooling systems. One BTU is approximately 1,054 - 1,060 joules (J).

10.8. **MBTU:**
One thousand BTU

10.9. **MMBTU:**
One million BTU
10.10. Latent heat:
is the amount of energy released or absorbed by a chemical
substance during a change of state (i.e. solid, liquid, or gas), or a
phase transition

10.11. Vacuum:
A vacuum reference can be thought of as the opposite of a gage reference.
Vacuum references are notated with “V”, for example PSIV or “HgV”

10.12. Differential:
Differential pressure measurement is the difference between two unknown
pressures. Output is zero when the two pressures are the same, regardless
of magnitude. Differential pressures are notated as “D” (PSID).

10.13. Absolute:
As previously described, the zero point of an absolute reference is the
absence of all matter. There is no pressure at absolute zero. All absolute
pressure measurements made are therefore positive. Absolute pressure
measurements are abbreviated with an “A”. For example, 0 PSIA or 6”HgA.

10.14. Gage:
To ignore the effects of changing weather, altitude or depth, a “Gage”
pressure reference is sometimes useful. This reference measures
pressure relative to the local atmosphere. Changes in local atmospheric
pressure occur due to weather, or if the instrument is moving because of
changes in altitude and/or depth. Gage pressure is denoted as “G” or PSIG.

10.15. Heat required to raise the temperature of a material:

\[ Q_{1} (\text{Btu}) = W \cdot C_p \cdot \Delta T \quad \text{or} \quad Q_{1} (\text{kWh}) = \frac{W \cdot C_p \cdot \Delta T}{3412} \]

\[ Q_{1} = \text{Heat required to raise temperature} \]
\[ W = \text{Pounds of material} \]
\[ C_p = \text{Specific heat of material (Btu/lb} \cdot \text{ºF}) \]
\[ \Delta T = \text{Temperature rise of material} \]
\[ (T_{\text{Final}} - T_{\text{Initial}}) \text{ºF} \]
10.16. SCFH:
Standard Cubic Feet per Hour

1 PSI = 27.68”WC (inches of water column)
1 PSI = 2.036”Hg (inches of mercury)
1 PSI = 51.715 mmHg or Torr
1 PSI = 0.068947 Bar
1 PSI = 0.06804 Atmospheres
(Note that 1 Bar is not exactly 1 atmosphere)
1 PSI = 6.8947 KiloPascals or KPa
1 PSI = 0.0703 Kg/cm2
1 PSI = 2.307 feet of water

10.17. Peak load:
Measurement of the maximum amount of energy delivered at a point of time

10.18. Flue gas:
Combustion gases that are vented to the atmosphere. The equation below provides an approximation of the pressure difference, $\Delta P$, (between the bottom and the top of the flue gas stack) that is created by the draft.

$$\Delta P = C a h \left( \frac{1}{T_o} - \frac{1}{T_i} \right)$$

$\Delta P$ = Available pressure difference, in Pa
$C = 0.0342$
$a$ = Atmospheric pressure, in Pa
$h$ = Height of the flue gas stack, in m
$T_o$ = Absolute outside air temperature, in K
$T_i$ = Absolute average temperature of the flue gas inside the stack, in K
10.19 CWT pressure and temperature chart

This chart can also be used as a diagnostic tool as the pressure and temperature of the CWT Line Heater steam chamber should fall on this line. If the steam temperature and pressure do not meet the line, there might be a problem, which requires further investigation.

The CWT Line Heater typically operates with negative pressure (vacuum), and is usually in the operating range of –6 to –26 In Vacuum Hg or below 0 psig. If a CWT heating boiler is operating at close to 0 psig and close to 100°C (212°F) it may be the result of very low process load or an indication of a loss of vacuum.

In every case, the most important indicator of the condition of a CWT Line Heater is the pressure and temperature in the evaporator. Another very important measure is the temperature of the process gas in and out of the evaporator. There should be a significant increase in the temperature of the high-pressure gas as it passes through the evaporator.
## 11. Spare parts list

<table>
<thead>
<tr>
<th>Associated Boiler Model</th>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>140, 385, 770</td>
<td>BAR-PLA-30</td>
<td>30 Gal Plastic Barrell c/w Lid</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>BOL-LYNCHPIN-.188</td>
<td>3/16” Lynch Pin</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>BUR-B-.438-27</td>
<td>7/16” Spud Orifice Brass</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>BUR-SFB-098044-000</td>
<td>Swordfish Burner Orifice Cover</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>BUR-SFB-098047-000</td>
<td>Swordfish Burner B&amp;G</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-BAR-142400-63</td>
<td>McD&amp;M Series 63 LWCO</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-BAR-143100-63-M</td>
<td>Series 63-M w/reset LWCO</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-CT-BBQ-IGN</td>
<td>Canadian Tire Ignitor System</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-PADTHERM</td>
<td>Pilot Ass Double Thermopile</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SP-289H-41</td>
<td>289 BP Fisher Reg 1”npt 1-4.5p</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SP-HSR-CDGBMYN</td>
<td>HSR 1/4 orifice”-12.5”-20” WC</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SP-PRV-13-202-08</td>
<td>Conbraco 1” PSV 15psig</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SS-700-C506</td>
<td>700-C506 Robertshaw Gas Valve</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SS-L404F1060</td>
<td>Honeywell switch 2-15psi</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SS-L4079B1033</td>
<td>Honeywell w/man reset 15psi</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>FIE-ZB4BS54</td>
<td>Mush PB Operator 40MM</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>FIE-ZB4BZ009</td>
<td>PB Mounting Bezel</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>FIE-ZBE102</td>
<td>Contact block 1-N/C</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>FIE-ZBY9330</td>
<td>E-Stop Legend plate</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>GAU-2.5-.25B-M30-30P-L</td>
<td>2-1/2” x 1/4” 30-30 Psi Gauge</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>GAU-4-.5B-2000P</td>
<td>4” x 1/2” 0-2000 Psi BM Gauge</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>GAU-INCH-2.5-.25-0-15</td>
<td>2-1/2” x 1/4” 0-15 Inch Gauge</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>HEA-IGNBOX-ASSY</td>
<td>4” x 4” x 2” CWT Ignition Box</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>HEA-IGHH-ASSY</td>
<td>CWT Portable Hand Held Ignitor</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>HOS-GFAH-.75-18</td>
<td>3/4” x 18” F x F Flex hose</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>VAV-NDL-MXF-.5</td>
<td>1/2” CS MxF Needle Valve</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>WIR-SHCAB-1P-18G</td>
<td>18 Ga x 1 Pair Shielded Cable</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>WIR-SPW-7MM-HD</td>
<td>7mm HD Spark Plug Wire</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>THR-SS-1-.5-9-.250</td>
<td>1” x 1/2” x 9” .250 SS THR</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>GAU-3-9-50-500-S</td>
<td>3” x 9” 50-500 Deg Gauge</td>
</tr>
<tr>
<td>140, 385</td>
<td>CTR-T675A-1565</td>
<td>Honeywell 0-100F American Cust</td>
</tr>
<tr>
<td>385, 770</td>
<td>FLA-FAFBC-20-4C</td>
<td>20” Flame Arr Flash Back Cell</td>
</tr>
<tr>
<td>385, 770</td>
<td>GSK-304SS-FLEX-150-4</td>
<td>4” 150# 304SS Flex Gasket</td>
</tr>
<tr>
<td>385, 770</td>
<td>GSK-NA1001-RD-20-18.625</td>
<td>20&quot;ODx18.625&quot;ID Gasket</td>
</tr>
<tr>
<td>385, 770</td>
<td>HEA-10-SGLASS-PAI-ASSY</td>
<td>10” Sight Glass Paint Assembly</td>
</tr>
<tr>
<td>140</td>
<td>FIR-BVENT-6-5</td>
<td>6” x 5” B-Vent Section</td>
</tr>
<tr>
<td>140</td>
<td>FIR-BVENT-HWCAP-6</td>
<td>6” Hi-Wind Cap</td>
</tr>
<tr>
<td>140</td>
<td>FLA-FAFBC-15-4C</td>
<td>15” Flame Arr. Flash Back Cell</td>
</tr>
<tr>
<td>140</td>
<td>HEA-140-3-1100</td>
<td>140 Boiler Stack Support Assm.</td>
</tr>
<tr>
<td>Associated Boiler Model</td>
<td>Part Number</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>140</td>
<td>GSK-NA1001-RD-14.875-13.5</td>
<td>15&quot; A-Fire flame cell gasket</td>
</tr>
<tr>
<td>140</td>
<td>GSK-GR-RD-20.5-14.125-26</td>
<td>20.5 ODx14.125ID 26H Graphite</td>
</tr>
<tr>
<td>140</td>
<td>HEA-6-SGLASS-PAI-ASSY</td>
<td>6&quot; Sight Glass Paint Assembly</td>
</tr>
<tr>
<td>140</td>
<td>THR-SS-.75-.5-.250</td>
<td>3/4&quot; x 1/2&quot; x .250 SS THR</td>
</tr>
<tr>
<td>140</td>
<td>GAU-3-4-M40-160-S</td>
<td>3&quot; x 4&quot; 40-160 Deg Gauge</td>
</tr>
<tr>
<td>140</td>
<td>GSK-N1001-RD-10.625-6.625-8</td>
<td>EXHAUST STACK GASKET</td>
</tr>
<tr>
<td>385</td>
<td>FIR-BVENT-8-3</td>
<td>8&quot; x 3' B-Vent Section</td>
</tr>
<tr>
<td>385</td>
<td>FIR-BVENT-8-5</td>
<td>8&quot; x 5' B-Vent Section</td>
</tr>
<tr>
<td>385</td>
<td>FIR-BVENT-RAINCAP-8</td>
<td>8&quot; B-Vent Rain Cap</td>
</tr>
<tr>
<td>385</td>
<td>HEA-BVENT-SUPPORT-8</td>
<td>8&quot; Bvent Stack Support</td>
</tr>
<tr>
<td>385</td>
<td>GSK-NA1001-RD-12.5-8.625-8</td>
<td>12.5&quot; Od x 8.625&quot;id 8 hole gasket</td>
</tr>
<tr>
<td>385</td>
<td>FIR-BVENT-12-3</td>
<td>12&quot; x 3' B-Vent Section</td>
</tr>
<tr>
<td>385</td>
<td>FIR-BVENT-RAINCAP-12</td>
<td>12&quot; B-Vent Rain Cap</td>
</tr>
<tr>
<td>385</td>
<td>GSK-NA1001-RT-47/43-24/20</td>
<td>New 770 Square Gasket</td>
</tr>
<tr>
<td>385</td>
<td>HEA-770-2C-800A</td>
<td>Stack Adapter Assembly</td>
</tr>
<tr>
<td>385</td>
<td>CTR-SS-T678A-1015</td>
<td>100 F 20&quot;Capillary-US only</td>
</tr>
<tr>
<td>385</td>
<td>GSK-NA1001-RD-16-12.625-12</td>
<td>16&quot;OD X 12.625&quot;ID 12 HOLE GASKET</td>
</tr>
</tbody>
</table>

### Options

<table>
<thead>
<tr>
<th>Associated Boiler Model</th>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>140, 385</td>
<td>CTR-COIL-HTSD-1F</td>
<td>High temp shut-down, Farenheit</td>
</tr>
<tr>
<td>770</td>
<td>CTR-COIL-HTSD-2F</td>
<td>High temp shut-down, Farenheit</td>
</tr>
<tr>
<td>140, 385</td>
<td>CTR-COIL-HTSD-1C</td>
<td>High temp shut-down, Celsius</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SS-93560</td>
<td>6 cfm vacuum pump - 93560</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SS-19310</td>
<td>6 cfm vacuum pump hose 3/8 inch</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>COS-VAC-OIL</td>
<td>Oil for vacuum pump, 4 litre container</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SP-T14399T0012</td>
<td>HSR spring, 6&quot; wc to 8&quot; wc (Yellow)</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SP-T144005T0012</td>
<td>HSR spring, 8&quot; to 10&quot; wc (Black)</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SP-T144000T0012</td>
<td>HSR spring, 10&quot; wc to 12.5&quot; wc (Silver)</td>
</tr>
<tr>
<td>140, 385, 770</td>
<td>CTR-SP-T14401T0012</td>
<td>HSR spring, 12.5&quot; to 20&quot; wc (Gray)</td>
</tr>
</tbody>
</table>
12. Equipment warranty - repair and return procedure

This warranty shall apply to items manufactured by Grit, and supplied to Buyer for use within a Grit authorized distribution territory. Items manufactured by Grit and supplied to the Buyer for use in locations within Canada or the United States are subject to the equipment warranty as applicable.

Warranty

During the warranty period subject to the limitations herein, Grit warrants that the product manufactured by any Grit company and supplied to Buyer by Grit or through an authorized Grit distributor shall be free from defects in materials and workmanship and will conform to applicable specifications and drawings. This warranty extends only to the original end use customer and is not transferable. Grit’s liability herein, whether based upon breach of warranty or contract or negligence in manufacture, shall be limited to replacement, repair or refund of a prorated purchase price paid by Buyer at Grit’s election of all such defective or nonconforming items, provided that this warranty shall apply only where Buyer has given Grit written notice of such defects or nonconformity within the applicable warranty period after delivery by Grit of such items to the Buyer. In no event shall Grit’s total liability hereunder exceed the price paid by Buyer to Grit for such item. Grit shall have the right prior to return to inspect at Buyer’s facility any items claimed to be defective or nonconforming.

Warranty Period

The warranty period for Grit manufactured products commences from the date of shipment to the Buyer (however, in the case of resale by a Grit distributor, commences not more than ninety (90) days after the original shipment by Grit) and except as noted below, continues for a period of one (1) year (the Warranty Period). Exceptions to this warranty period are as follows: items not manufactured by Grit will carry the remaining warranty and related terms and conditions of the original manufacturer, where enforceable.

The foregoing constitutes the sole and exclusive remedy of the Buyer and exclusive liability of Grit and is in lieu of any and all other warranties expressed or implied or statutory as to merchant liability, fitness for purpose sold, description, quality, productiveness or any other matter. Without limiting the foregoing, in no event shall Grit or its suppliers be liable to Buyer for any incidental, special, punitive, exemplary or consequential damages experienced by either Buyer or a third party (including, but not limited to loss of profits or loss of use). Grit is not liable for damages for any cause whatsoever (whether based in contract, tort, or otherwise) in excess of the amount paid for the item.
Returns
Repair of all defective or malfunctioning products by Grit will be made at a location
determined solely by Grit. Return authorization must be obtained in writing from Grit
including those for repair, Buyer’s rights to repair or replacement are governed by
this warranty.

Shipping
The Buyer shall pay the cost of shipping the products from the Buyer’s facility to a
Grit designated repair location. Grit will return repaired or replaced equipment at
Buyer’s cost to the Buyer’s facility. Buyer shall be responsible for payment of
customs duties, importation fees, VAT or other like charges.

Repair Charges
In-warranty period repairs will be made at no charge to Buyer provided that failure
is not due to misuse, mishandling or act of God. An in-warranty product that is
returned for repair and found not to be defective or malfunctioning or for which
failure is caused by misuse, mishandling or act of God, shall be subject to Grit’s
actual costs for testing and handling.

The costs of out-of-warranty repairs including return shipment are subject to charges
as quoted by Grit. Buyer’s acceptance of these charges is necessary before repairs
will be made. Return shipping shall use the most economical shipment means
available. Upon request of the Buyer, Grit will use other means of shipment, in
which case Buyer shall pay the cost of shipping directly.

Repair Warranty
Repair work performed on in-warranty products is warranted for the remainder of
the original warranty period or six (6) months, whichever is greater. Repair work
performed on out-of-warranty equipment is warranted for six (6) months from the
date of shipment of the repaired unit from Grit. This six (6) month period covers only
the actual repair(s) made to the product and is exclusive of potential non-related
faults that may occur during the six (6) month period.

Alteration to Equipment Purchased
Modification or alteration to purchased products by anyone, other than that
specifically authorized by Grit, shall void and nullify, in its entirety, all warranty
provisions set forth in the preceding.

Engineering Changes
Grit reserves the right to upgrade and modify product items ordered without prior
approval or modification to Buyer and without incurring any obligation or liability to
make the same or similar changes in items previously manufactured.

Post-Sale Support
Please contact your authorized Grit distributor or call Grit Technical Support at
1-877-879-4748.
## APPENDIX A:

### CWT 140,000 BTU/HR BOILER DRY LINE HEATER PACKING LIST

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PART NUMBER</th>
<th>PART TITLE</th>
<th>PART DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CTR-SP-289H-41</td>
<td>289 BP FISHER REGULATOR</td>
<td>1” NPT, 1-4.5p</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>CTR-SP-HSR-CHCBMY</td>
<td>HSR REGULATOR</td>
<td>HSR-1/2” ORIFICE, 10”-12.5” w.c.</td>
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</tr>
<tr>
<td>3</td>
<td>FIC-CMC1216N-S316</td>
<td>CONNECTOR</td>
<td>3/4” T x 1” MNPT SST CONNECTOR</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>FIT-SST-BUSH-1-25</td>
<td>BUSHING</td>
<td>1” x 1/4” SCH40 SST BUSHING</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
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<td>NIPPLE</td>
<td>1” x 2” SCH40 SST NIPPLE</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>FIT-SST-NIP-1-4</td>
<td>NIPPLE</td>
<td>1” x 4” SCH40 SST NIPPLE</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>FIT-SST-NIP-1-6</td>
<td>NIPPLE</td>
<td>1” x 6” SCH40 SST NIPPLE</td>
<td>1</td>
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<tr>
<td>8</td>
<td>FIT-SST-TEE-150-1</td>
<td>TEE</td>
<td>1” 150#NPT 316 TEE</td>
<td>2</td>
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<tr>
<td>9</td>
<td>GAU-INCH-2.5-.25-0-15</td>
<td>GAUGE</td>
<td>2-1/2” x 1/4” 0-15 INCH GAUGE</td>
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<tr>
<td>10</td>
<td>VAV-SS-B-1-2000-T-FP</td>
<td>BALL VALVE</td>
<td>1” 2000# SS FP BALL VALVE</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>FIR-BVENT-6-3</td>
<td>EXHAUST STACK</td>
<td>6” x 3’ B-VENT SECTION</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>FIR-BVENT-6-5</td>
<td>EXHAUST STACK</td>
<td>6” x 5’ B-VENT SECTION</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>FIR-BVENT-HWCAP-6</td>
<td>EXHAUST STACK</td>
<td>6” HI-WIND CAP</td>
<td>1</td>
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<tr>
<td>14</td>
<td>HEA-140-3-1100</td>
<td>EXHAUST STACK</td>
<td>STACK SUPPORT ASSM. 140 BOILER</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>BOL-GR5-.5-1.5</td>
<td>BOLT</td>
<td>NC, GRADE 5, 1/2” x 1-1/2”</td>
<td>12</td>
</tr>
<tr>
<td>16</td>
<td>NUT-GR5-.5</td>
<td>NC NUT</td>
<td>1/2” GRADE 5 NC NUT</td>
<td>12</td>
</tr>
<tr>
<td>17</td>
<td>WAS-GR5-F-.5</td>
<td>WASHER</td>
<td>1/2” GRADE 5 FLAT WASHER</td>
<td>24</td>
</tr>
<tr>
<td>18</td>
<td>CTR-HIGH-TEMP-SHUT-DOWN</td>
<td>ASSEMBLY</td>
<td>HI-TEMPERATURE SHUT DOWN ASSEMBLY</td>
<td>AS REQUIRED</td>
</tr>
<tr>
<td>19</td>
<td>CTR-SS-T675A-1565</td>
<td>ASSEMBLY</td>
<td>1/2” x 2000 PSI BM GAUGE</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>ELE-A10P8</td>
<td>ELECTRICAL PANEL</td>
<td>PANEL, 8” x 6”</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td>ELE-BOX-A1086CHQRFG</td>
<td>ELECTRICAL BOX</td>
<td>HOFFMAN 10x8x6 FIB JB</td>
<td>1</td>
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<tr>
<td>22</td>
<td>FIE-5232</td>
<td>CONDUIT</td>
<td>C16104 STR LIQ TIGHT CON 1/2”</td>
<td>2</td>
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<tr>
<td>23</td>
<td>FIE-AL-NIP-.5-C</td>
<td>NIPPLE</td>
<td>1/2” x CLOSE ALUMINUM NIPPLE</td>
<td>1</td>
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<tr>
<td>24</td>
<td>FIE-CSA050-30</td>
<td>FLEX CONDUIT</td>
<td>1/2” LIQUID TITE FLEX CONDUIT</td>
<td>5.25 m</td>
</tr>
<tr>
<td>25</td>
<td>FIE-GK50N</td>
<td>ENCLOSURE</td>
<td>1/2” GK50N ENCLOSURE 35/85 GSK</td>
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<tr>
<td>26</td>
<td>FIE-K50A</td>
<td>BACK PLATE</td>
<td>1/2” ALUM K50A BLANK BACKPLATE</td>
<td>1</td>
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<tr>
<td>27</td>
<td>FIE-LB50A</td>
<td>ALUMINUM CONDUIT</td>
<td>1/2” LB50A ALUMINUM COND BODY</td>
<td>1</td>
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<tr>
<td>28</td>
<td>FIE-ST-050-464</td>
<td>CONNECTOR</td>
<td>1/2” ST050-464 STAR TECK CONN</td>
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<td>FIE-UNY50NRA</td>
<td>UNION</td>
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<td>30</td>
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<td>TDB BY SALES</td>
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<tr>
<td>35</td>
<td>WIR-SHCAP-1P-18G</td>
<td>CABLE</td>
<td>18 GAUGE x 1 PAIR SHIELDED CABLE</td>
<td>35 m</td>
</tr>
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**Fuel Gas Header Assembly - P103-140-3**

Fuel Gas Header Assembly

Exhaust Stack Assembly

Hi Temp Shut Down Assembly
### APPENDIX B:

**CWT 385,000 BTU/HR BOILER DRY LINE HEATER PACKING LIST**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PART NUMBER</th>
<th>PART TITLE</th>
<th>PART DESCRIPTION</th>
<th>QTY</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>HEA-GAS-HEADER-ASSM</td>
<td>GAS TRAIN</td>
<td>JOB SPECIFIC GAS HEADER ASSEMBLY</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>FIR-BVENT-8-3</td>
<td>EXHAUST STACK</td>
<td>8” x 3’ B-VENT SECTION</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>FIR-BVENT-8-5</td>
<td>EXHAUST STACK</td>
<td>8” x 5’ B-VENT SECTION</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>FIR-BVENT-RAINCAP-8</td>
<td>EXHAUST STACK</td>
<td>8” B-VENT RAIN CAP</td>
<td>1</td>
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<tr>
<td>5</td>
<td>HEA-BVENT-SUPPORT-8</td>
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<td>8” BVENT STACK SUPPORT</td>
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<td>BOL-GR5-.5-1.5</td>
<td>BOLT</td>
<td>NC, GRADE 5, 1/2” x 1-1/2”</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>NUT-GR2-.5</td>
<td>NC NUT</td>
<td>1/2” GRADE 2 NC NUT</td>
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<td>8</td>
<td>WAS-GR5-F-.5</td>
<td>WASHER</td>
<td>1/2” GRADE 5 FLAT WASHER</td>
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<tr>
<td>9</td>
<td>CTR-HIGH-TEMP-SHUT-DOWN</td>
<td>ASSEMBLY</td>
<td>HI-TEMPERATURE SHUT DOWN ASSEMBLY</td>
<td>AS REQUIRED</td>
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<tr>
<td>10</td>
<td>GAU-3-6-50-500-S</td>
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<td>HONEYWELL TEMP CON. 0 - 100F</td>
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<tr>
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<td>ELE-A10P8</td>
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<td>PANEL, 8” x 6”</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>ELE-BOX-A1086CHQRFG</td>
<td>ELECTRICAL BOX</td>
<td>HOFFMAN 10x8x6 FIB JB</td>
<td>1</td>
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<tr>
<td>14</td>
<td>FIE-S232</td>
<td>CONDUIT</td>
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<td>FIE-AL-NIP-.5-C</td>
<td>NIPPLE</td>
<td>1/2” x CLOSE ALUMINUM NIPPLE</td>
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<tr>
<td>16</td>
<td>FIE-CSA050-30</td>
<td>FLEX CONDUIT</td>
<td>1/2” LIQUID TITE FLEX CONDUIT</td>
<td>5.25 m</td>
</tr>
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<td>FIE-GK50N</td>
<td>ENCLOSURE</td>
<td>1/2” GK50N ENCLOSURE 35/85 GSK</td>
<td>1</td>
</tr>
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<td>FIE-K50A</td>
<td>BACK PLATE</td>
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</tr>
<tr>
<td>19</td>
<td>FIE-LB50A</td>
<td>ALUMINUM CONDUIT</td>
<td>1/2” LB50A ALUMINUM COND BODY</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>FIE-ST-050-464</td>
<td>CONNECTOR</td>
<td>1/2” ST050-464 STAR TECK CONN</td>
<td>2</td>
</tr>
<tr>
<td>21</td>
<td>FIE-UNY50NRA</td>
<td>UNION</td>
<td>1/2” XP ALUM. UNION UNY50NRA</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>GAU-4-.5B-2000P</td>
<td>GAUGE</td>
<td>4” x 1/2” 0-2000 PSI BM GAUGE</td>
<td>2</td>
</tr>
<tr>
<td>23</td>
<td>HEA-BOI-MANUAL-006</td>
<td>MANUAL</td>
<td>BOILER MANUAL REVISED, REV 6</td>
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</tr>
<tr>
<td>24</td>
<td>HEA-QA-MANUAL</td>
<td>MANUAL</td>
<td>QUALITY ASSURANCE MANUAL</td>
<td>3</td>
</tr>
<tr>
<td>25</td>
<td>THR- THERMOWELL</td>
<td>TBD BY SALES</td>
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<td></td>
</tr>
<tr>
<td>26</td>
<td>WIR-SHCAP-1P-18G</td>
<td>CABLE</td>
<td>18 GAUGE x 1 PAIR SHIELDED CABLE</td>
<td>31 m</td>
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<tr>
<td>27</td>
<td>NUT-GR5-LOC-.75</td>
<td>NUT</td>
<td>3/4” NYLON LOCK NUT</td>
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</tbody>
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**FUEL GAS HEADER ASSEMBLY - P103-385**

**EXHUAST STACK ASSEMBLY**

**HI TEMP SHUT DOWN ASSEMBLY**
## APPENDIX C:

### CWT 770,000 BTU/HR BOILER DRY LINE HEATER PACKING LIST

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PART NUMBER</th>
<th>PART TITLE</th>
<th>PART DESCRIPTION</th>
<th>QTY</th>
</tr>
</thead>
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<td>HEA-GAS-HEADER-ASSM</td>
<td>GAS TRAIN</td>
<td>JOB SPECIFIC GAS HEADER ASSEMBLY</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>FIR-BVENT-12-3</td>
<td>EXHAUST STACK</td>
<td>12” x 3’ B-VENT SECTION</td>
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<td>FIR-BVENT-RAINCAP-12</td>
<td>EXHAUST STACK</td>
<td>12” B-VENT RAIN CAP</td>
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<td>HEA-770-2-800</td>
<td>EXHAUST STACK</td>
<td>770 BOILER/EVAP STACK SUPPORT</td>
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</tr>
<tr>
<td>5</td>
<td>BOL-GR5-.5-1.5</td>
<td>BOLT</td>
<td>NC, GRADE 5, 1/2” x 1-1/2”</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>NUT-GR2-.5</td>
<td>NC NUT</td>
<td>1/2” GRADE 2 NC NUT</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>WAS-GR5-L-.5</td>
<td>LOCK WASHER</td>
<td>1/2” GRADE 5 LOCK WASHER</td>
<td>24</td>
</tr>
<tr>
<td>8</td>
<td>CTR-HIGH-TEMP-SHUT-DOWN</td>
<td>ASSEMBLY</td>
<td>HI-TEMPERATURE SHUT DOWN ASSEMBLY AS REQUIRED</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>GAU-3.12-50-500-S</td>
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<td>1</td>
</tr>
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<td>T678A-1015 Honeywell Temp. Con.</td>
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<td>PANEL, 8” x 6”</td>
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</tr>
<tr>
<td>12</td>
<td>ELE-BOX-A1086CHQRFG</td>
<td>ELECTRICAL BOX</td>
<td>HOFFMAN 10x8x6 FIB JB</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>FIE-5232</td>
<td>CONDUIT</td>
<td>C16104 STR LIQ TIGHT CON 1/2”</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>FIE-AL-NIP-.5-C</td>
<td>NIPPLE</td>
<td>1/2” x CLOSE ALUMINUM NIPPLE</td>
<td>1</td>
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<td>FIE-CSA050-30</td>
<td>FLEX CONDUIT</td>
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<td>17</td>
<td>FIE-K50A</td>
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<td>1/2” ALUM K50A BLANK BACKPLATE</td>
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<td>FIE-LB50A</td>
<td>ALUMINUM CONDUIT</td>
<td>1/2” LB50A ALUMINUM COND BODY</td>
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<td>FIE-ST-050-465</td>
<td>CONNECTOR</td>
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<td>FIE-UNY50NRA</td>
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<td>21</td>
<td>GAU-4-.5B-2000P</td>
<td>GAUGE</td>
<td>4” x 1/2” 0-2000 PSI BM GAUGE</td>
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<td>22</td>
<td>HEA-BOI-MANUAL-006</td>
<td>MANUAL</td>
<td>BOILER MANUAL REVISED, REV 6</td>
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<td>HEA-QA-MANUAL</td>
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<td>QUALITY ASSURANCE MANUAL</td>
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<td>THR-THERMOWELL</td>
<td>TBD BY SALES</td>
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<td>25</td>
<td>WAS-GR5-F-.5</td>
<td>WASHER</td>
<td>1/2” GRADE 5 FLAT WASHER</td>
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<td>26</td>
<td>WIR-SHCAP-2P-18G</td>
<td>CABLE</td>
<td>18 GAUGE x 2 PAIR SHIELDED CABLE</td>
<td>35 m</td>
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FUEL GAS HEADER ASSEMBLY - P103-770
EXHUAUST STACK ASSEMBLY
HI TEMP SHUT DOWN ASSEMBLY
APPENDIX D:

CWT 140 Boiler Stack Assembly
APPENDIX E:

CWT 385 Boiler Stack Assembly
APPENDIX F:

CWT 770 Boiler Stack Assembly
APPENDIX G:

CWT 140 Burner Assembly and Cross-Section Drawings
APPENDIX H:

CWT 385 Burner Assembly and Cross-Section Drawings
APPENDIX I:

CWT 770 Burner Assembly and Cross-Section Drawings
APPENDIX J:

CWT 140 Fuel Gas Train