

**NESLAB STEELHEAD 0
HEAT EXCHANGER
Model 620000000015**

Thermo Manual P/N U00241
Rev. 04/02/04

Instruction and Operation Manual



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STEELHEAD HEAT EXCHANGER

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Preface

Compliance

Product is compliant to:

- CE Marking Directive:
 - LVD to IEC/EN61010-1, Safety Requirements for Electrical Equipment for Laboratory, Control & Measurement Use
 - EMC to IEC/EN61326-1, Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements

Product is designed to meet:

- UL61010A-1 (formerly UL3101-1), Safety Requirements for Electrical Equipment for Laboratory, Control & Measurement Use
- CSA C22.2 #1010.1, Safety Requirements for Electrical Equipment for Laboratory, Control & Measurement Use

After-sale Support

Thermo Electron Corporation is committed to customer service both during and after the sale. If you have questions concerning the operation of your unit, contact our Sales Department. Before calling, please refer to the serial number label on the rear of the unit to obtain the following information (see Section II, Description for serial number label location):

- unit BOM number _____
- unit serial number _____

Nameplate Data

| | |
|--------------------------------------|-------------------|
| MODEL: STEELHEAD 0 | PHASE: 3/PE 4WIRE |
| FREQUENCY: | 50/60 HERTZ |
| FULL LOAD AMPS: | 23/25 |
| HEATER: 6KW @ 208VOLTS | PUMP: 3.0 HP |
| LARGEST LOAD HEATER | 16.7 AMPS |
| INTERRUPT CAPACITY: | 10KA PER EN60898 |
| 10KAIC W/MAX 120 AMP FUSE PER UL1077 | |
| MASS: | 385LBS 174KG |
| ELECTRICAL DIAGRAM: | 6.2664 |

Unpacking

Retain all cartons and packing material until the unit is operated and found to be in good condition. If the unit shows external or internal damage contact the transportation company and file a damage claim. Under ICC regulations, this is your responsibility.

Feedback

We appreciate any feedback you can give us on this manual. Please e-mail us at neslabmanuals@thermo.com. Be sure to include the manual part number and the revision date listed on the front cover.

Section I Safety

Warnings

Make sure you read and understand all instructions and safety precautions listed in this manual before installing or operating your unit. If you have any questions concerning the operation of your unit or the information in this manual, please contact our Sales Department (see After-sale Support).

Performance of installation, operation, or maintenance procedures other than those described in this manual may result in a hazardous situation and may void the manufacturer's warranty.

Transport the unit with care. Sudden jolts or drops can cause damage.

Do not attempt to move the unit without proper lifting or moving equipment — serious injury can occur.

Do not lift unit by the filter.

Observe all warning labels.

Never remove warning labels.

Never operate damaged or leaking equipment.

Never operate the unit without fluid in the reservoir.

Always lock the main circuit breaker in the OFF position, turn off the unit and disconnect the power supply from the power source before performing any service or maintenance, or before moving the unit.

Never operate equipment with damaged power cords.

Refer service and repairs to a qualified technician.

Some circuits in the enclosure will remain energized even with the line cord disconnected. Control voltages will be present. If repairs are authorized inside the enclosure, the main power and 15-pin plug must be removed from the unit.

In addition to the safety warnings listed above, warnings are posted throughout the manual. Read and follow these important instructions. Failure to observe these instructions can result in permanent damage to the unit, significant property damage, or personal injury or death.

Material Safety Data Sheets

| | |
|--------------------|--|
| Ethylene Glycol | Union Carbide Chemicals and Plastics Company Inc. Industrial Chemicals Division 39 Old Ridgebury Road Danbury, CT 06819-000 307-744-3487 |
| Teflon® Paste | Hercules Chemical Company Passaic, NJ 07055-7398 1-800-221-9330 |
| De-Ox Anti-Oxidant | IlSCO 4730 Madison Road Cincinnati, OH 45227 513-871-4000 |

If you have Internet access, you can access numerous MSDS forms via the EPA Chemical Substances Database.

Cornell Univ. has ~325,000 on line searchable MSDS at
<http://www.pdc.cornell.edu/issearch/msdssrch.htm>

Section II General Information

Description

The heat exchanger system consists of a thermal fluid recirculating system which provides a constant fluid flow. A second loop consists of a facilities water loop which recirculates through a plate heat exchanger for fluid cooling. A 6 kilowatt heater is located in the fluid recirculating system.

The recirculating fluid loop has a deionizing package with a replaceable cartridge and a 20 micron particulate filter with a replaceable filter element.

Throughout the manual, you will be asked to consult the unit's serial number label for specific information. The label is located on the right of the control box.

Specifications

| | |
|---|--|
| Temperature Range | 30°C to 80°C |
| Reservoir Volume | 5 Gallons 19 Liters |
| Unit Dimensions Outer Envelope (H x W x D) | 32 x 20 ³ / ₈ x 31 ³ / ₈ Inches 812.8 x 517.5 x 796.9 Millimeters |
| Frame Dimensions (H x W X D) | 28 ¹ / ₂ x 20 x 25 Inches 723.9 x 508.0 x 635.0 Millimeters |
| Cooling Capacity¹ | 8KW @ 5.0 GPM Facility Water Flow Rate |
| Heating Capacity² | 6KW @ 208V |
| Flow ³ | 8.0 Gallons/Minute 30.3 Liters/Minute |
| Pressure | 30 to 60 PSI - 130 PSI Max |

1. 22°C facility water with 2 - 8 GPM process water flow rate. 8°C or greater difference between process water and facility water.

2. 39 watts per square inch.

3. 15 meters from unit through ³/₈ inch ID hose. Flow split equally between flow channels.

\Section III Installation

Site

Locate the unit in a laboratory or clean industrial environment where ambient temperatures are inside the range of +10°C to +40°C (+50°F to +104°F).



Never place the unit in a location where excessive heat, moisture, or corrosive materials are present.

Excessively dusty areas should be avoided and a periodic cleaning schedule should be instituted.

Install the Steelhead unit on a level surface. The unit is equipped with locking casters on the front left and right rear of the unit to prevent movement. The unit is also equipped with adjustable leveling feet.



To prevent damage, raise the leveling feet to the full up position when not in use. Secure the leveling feet by securing the jam nut on the leveling foot shaft to the case bottom.

The unit is designed to stand alone or can also be stacked with another Steelhead unit. See the Fork Lift Channel Dimension Diagram in Section VII.

Electrical Requirements



The unit construction provides protection against the risk of electrical shock by grounding appropriate metal parts. It is the user's responsibility to assure that a proper ground connection is provided to the unit.

Rated Voltage: 200 to 208VAC, 50/60Hz, 3Ø

Rated Circuit: 30Amps

Make sure the voltage of the power source meets the specified voltage, ±10%.

Safety Control Requirements

EMERGENCY OFF guarded mushroom push-button with pull reset is provided to turn off the unit in case of an emergency. An EMERGENCY OFF connector is provided on the top left portion of the rear of the unit to include the system into the emergency off circuit. An isolated set of normally closed contacts is provided for the EMERGENCY OFF safety circuit. Contact rating is 60AMP make and 10AMP break at 24VAC.

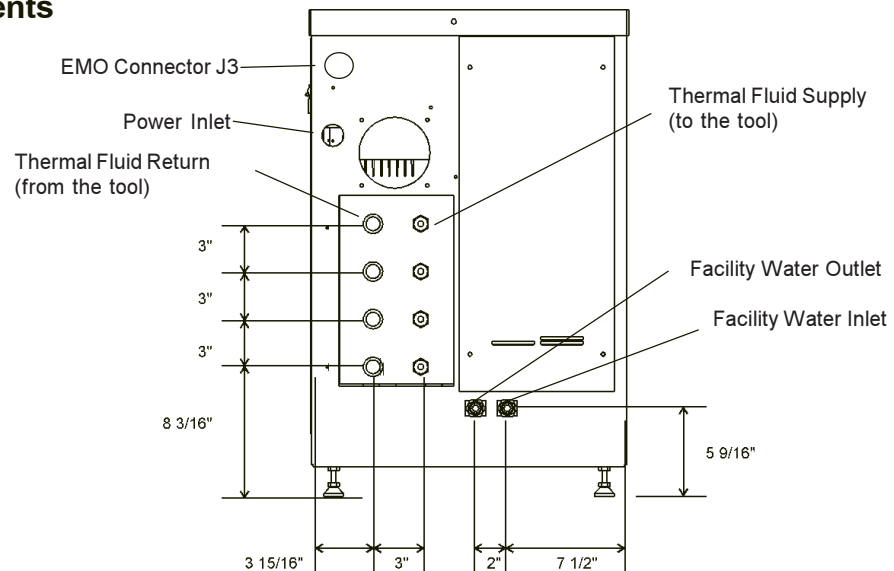
The EMERGENCY OFF safety connector receptacle port is part number AMP 206061-1. The mating plug part number is AMP 206060-1 which uses sockets part number AMP 66101-1.

Plumbing Requirements

The plumbing connections are located on the bottom rear of the unit and are labelled THERMAL FLUID CHAMBER #1, #2, #3, #4. The four THERMAL FLUID SUPPLY (to the tool) connections have ½" quick disconnect nipples. The four THERMAL FLUID RETURN (from the tool) connections have ½" quick disconnect couplers.

Keep the distance between the heat exchanger system and your application as short as possible, and use the largest diameter tubing practical. Tubing should be straight and without bends. If diameter reductions are needed make them at the inlet and outlet of your application, not at the heat exchanger system.

Facility Water Requirements



Facility water connections are located at the bottom-center-rear of the unit and are labelled FACILITY WATER. The facility water connections are ¾" (Parker push-loc male hose nipples).

Fluids



Never use flammable or corrosive fluids with this unit. Do not use automobile anti-freeze. Commercial anti-freeze contains silicates that can damage the pump seals and cause leaks. Use of automobile anti-freeze will void the manufacturer's warranty.

The unit is designed to use a **50/50 mixture of distilled water and electronic grade ethylene glycol** as the thermal fluid. Change the fluid as required, see Section V.

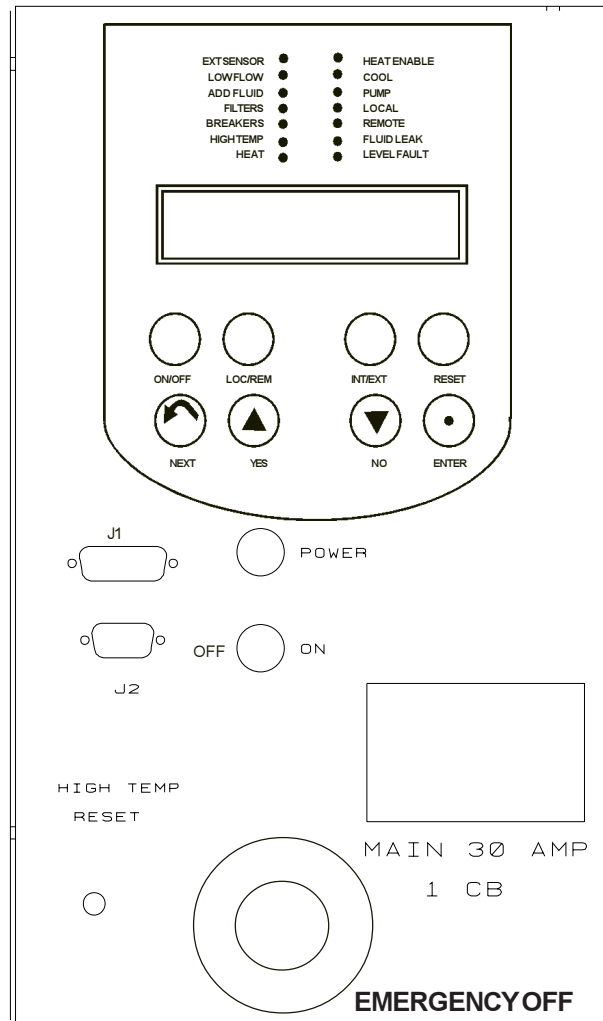
Front Panel Gauges

1. Pump Pressure. Reads the pressure at the outlet of the unit.
2. Filter Pressure Gauge. The filter cartridge should be cleaned/replaced when the gauge reads 1Bar (15psi) more than the pump pressure gauge.

Front Panel Controls

Main Disconnect Circuit Breaker

30 Amp, 3 Pole 10 KAIC used to locally disconnect main power at the unit.



Pad Lock - Lockout

When the unit is not in use or is being serviced, the Pad Lock - Lockout should be used. The lockout requires a padlock with a ¼" diameter shackle.

POWER - Amber

The POWER light indicates that the main disconnect circuit breaker is on, power is available, and the control and secondary circuit breakers (in the electrical enclosure) are on.

ON/OFF

Turning the ON/OFF rotary switch to the ON position enables the unit. The controller illuminates and runs a diagnostic test, and then the unit enters the standby mode.

Turning the ON/OFF rotary switch to the OFF position disables the unit.

NOTE: The machine circuit is interlocked to the electrical enclosure so the removal of the panel will turn off the unit and the controller.

HEATER HIGH TEMPERATURE MANUAL RESET

The HEATER HIGH TEMPERATURE MANUAL RESET button allows the heater high temperature switch to be reset once the temperature is below the Heater High Temperature setting.



Resetting the button will automatically start the unit if the unit is in the ON mode.

J1

DB-15 female connector designed for heat exchanger interface.

J2

DB-9 Female Connector. J2 connects to an approved temperature probe for external temperature control, display and temperature feedback signal.

Low Profile Membrane Key Functions

ON/OFF

The **ON/OFF** key toggles the controller from on to off and vice versa. The controller will not switch to the ON mode unless proper conditions exist inside the unit. See Error Messages in this section.

LOC/REM

The **LOC/REM** key toggles the unit from local to remote operation.

INT/EXT

The **INT/EXT** key switches between the internal and external RTD probe. Display #1 will alternate from INT T XXC to EXT T XXC. The control of the fluid temp will switch from internal RTD probe to the external RTD probe. If there is no external probe the controller will continue to display and to control from the internal RTD probe.

RESET

The **RESET** key will attempt to clear the Add Fluid or Change Filter condition status.

NEXT

The **NEXT** key is used to sequence through the controller displays.

YES

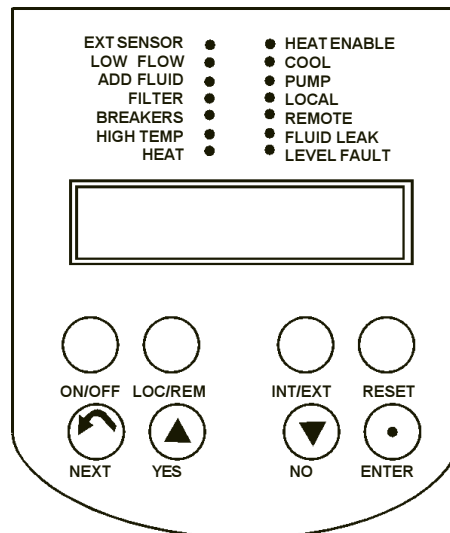
The **YES** key is used to increment values displayed on the controller.

NO

The **NO** key is used to decrement values displayed on the controller.

ENTER

The **ENTER** key is used to accept values displayed on the controller.



LED Indicators

EXT SENSOR - Amber

When this is lit the controller is using the external RTD probe to control the fluid temperature and Display #1 EXTT XXXC is shown. When it is not lit the controller is using the internal RTD probe.

LOW FLOW - Amber

This LED is lit whenever any flow drops below the flow setpoint. Also, whenever a low flow condition exists a signal is sent to the tool through P1. The low flow condition status and LOW FLOW LED is turned off automatically when the low flow condition returns to above the setpoint, or when the flow is disabled in the setup mode.

ADD FLUID - Amber

This LED is lit and an add fluid signal is sent to the tool whenever there is approximately 3¼ gallons left in the tank. The ADD FLUID LED goes out and the signal to the tool is automatically removed when the add fluid condition is corrected.

NOTE: When the ADD FLUID LED is on and the digital signal to the tool goes high (open circuit), fill the unit using the procedures and cautions mentioned in this manual or equipment damage or safety shut down of the heat exchanger could occur.

FILTER - Amber

This LED is lit when the particulate fluid filter has been in service for six months. This signals the operator to change the filter. The LED goes out and the filter timer is reset when the **RESET** key is depressed. **NOTE:** The **RESET** key will not reset the filter timer unless the FILTER LED is lit.

BREAKERS - Amber

This LED is lit whenever the pump circuit breaker or the heater circuit breaker is tripped. An ERROR message PUMP TRIP or HEAT TRIP will also flash on the display. The BEAKERS LED will go out and the error message will stop flashing whenever the error condition is corrected.

A heat breaker trip condition will light the BREAKERS LED and flash the HEAT TRIP warning message. A heat breaker condition will clear itself automatically when the condition is corrected.

A pump breaker trip condition will light the BREAKER LED, flash the PUMP TRIP warning message and turn off the HEAT ENABLE LED. The BREAKER LED will go out, the PUMP TRIP warning message will stop and the HEAT ENABLE LED will turn on when the pump breaker trip condition is corrected.

HIGH TEMP - Amber

This LED is lit whenever a high temperature condition exists. When this condition is detected the controller turns off the unit and illuminates the HIGH TEMP LED. When the high temperature condition is corrected press the heater high temperature reset switch to automatically restart the unit.

HEAT - Amber

This LED is on steady when the controller is supplying 100% heat. The HEAT LED is off when the controller is not supplying any heat. The HEAT LED flashes when the controller is controlling the temperature inside the heat PID proportional band.

HEAT ENABLE - Green

This LED is lit whenever the controller is on and conditions are proper for allowing heat to be supplied to the fluid.

The following conditions are needed for the HEAT ENABLE LED to light.

1. **ON/OFF** mode must be **ON**
2. There is no high temperature condition
3. Pump signal on

COOL - Green

This LED is on steady when the controller is supplying 100% cooling to the fluid. The LED is off when the controller is not supplying any cooling to the fluid. The LED flashes when the controller is controlling temperature by cooling inside the cool PID proportional band.

PUMP - Green

This LED indicates the status of the pump control logic.

In the REMOTE mode, the LED is lit whenever the pump on signal from the tool is on and the controller ON/OFF status is ON. 24VDC must be supplied to pin 10 of P1.

In either the LOCAL or REMOTE mode, pressing the control ON button will turn on either the LOCAL or REMOTE LED (whichever has been previously selected). Pressing the controller ON button again will turn both the LOCAL and REMOTE LED off.

NOTE: The machine circuit is interlocked to the electrical enclosure so the removal of the panel will turn off the unit and the controller.

LOCAL - Green

This LED is lit whenever the controller is in the local mode and is off when the controller is in the remote mode, as selected by the **LOC/REM** key (ON mode only).

REMOTE - Green

This LED is lit whenever the controller is in the remote mode and is off when the controller is in the local mode, as selected by the **LOC/REM** key (ON mode only).

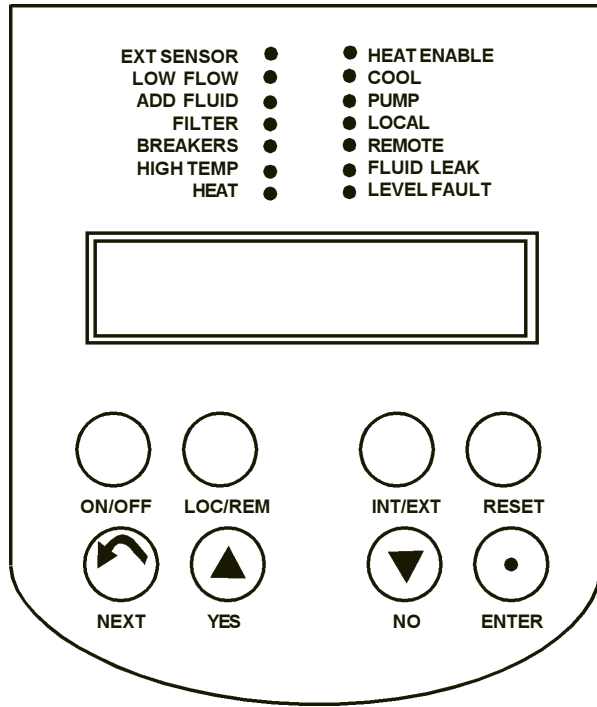
FLUID LEAK - Amber

This LED is lit whenever a leak is detected by the controller.

LEVEL FAULT - Amber

This LED is lit when the controller detects two gallons remaining in the tank. When a low level condition is detected the controller disables the heater and turns off the HEAT ENABLE LED. Once the condition is corrected it must be cleared with the **RESET** key before the heater will be enabled.

Controller Loops



Two controller loops allow the operator to display and/or alter different parameters of the controller. The loops can be accessed from the temperature display by pressing and holding the key combinations shown on Figure 1 below.

When the controller is first powered up it goes through a short self test and then enters the Operator's Loop, displaying the reservoir fluid temperature.

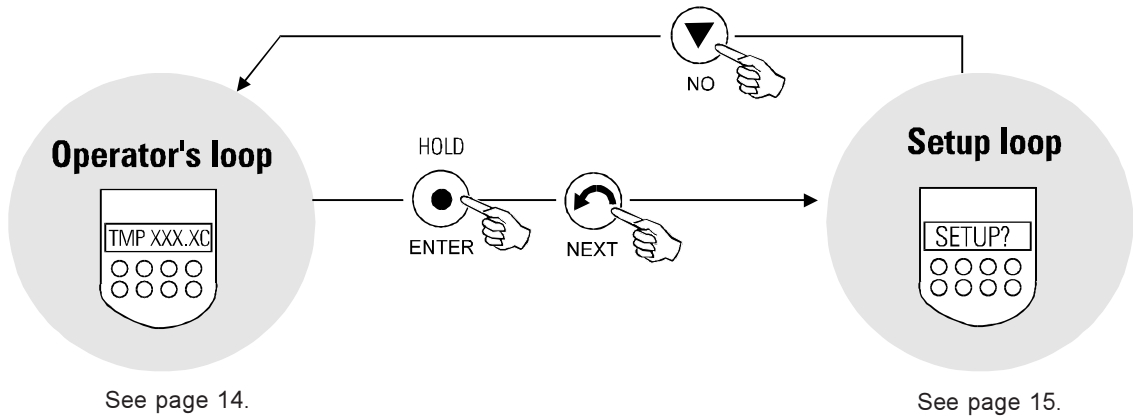


Figure 1 Changing Loops

Operator's Loop

When the controller is first powered it goes through a short self test and then enters the Operator's Loop, displaying the reservoir temperature as measured by either the internal or external RTD probe.

By pressing the NEXT key the controller will step through the menu shown below.

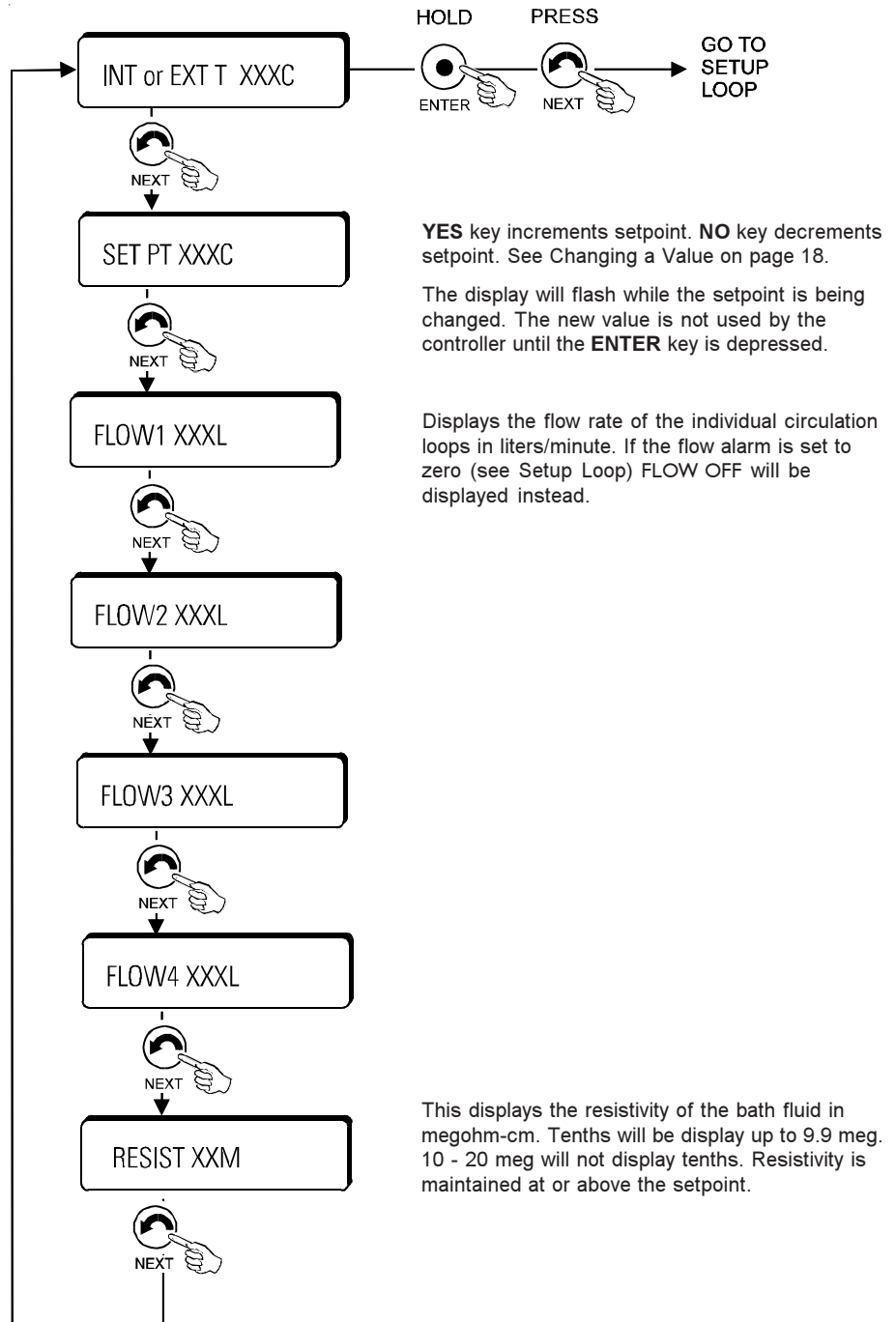


Figure 2 Operator's Loop

Setup Loop

The Setup Loop allows the operator to change the flowrate setpoints. To enter this loop you must be in the Operator's Loop and displaying the temperature. Depress and hold the ENTER key while pressing the NEXT key. Follow the menu shown in Figure 3.

Each of the four flows can be set independently. The controller compares this value to the actual flow of the circulation loop. If the actual flow drops below the alarm value, the controller signals a low flow condition. If the alarm is set to zero, the flow checking for the circulation loop will be disabled and the operators loop display will display FLOW X OFF.

Adjust values with the UP and DOWN arrows. See Changing a Value on page 18. Press ENTER then NEXT for the controller to accept each new entry.

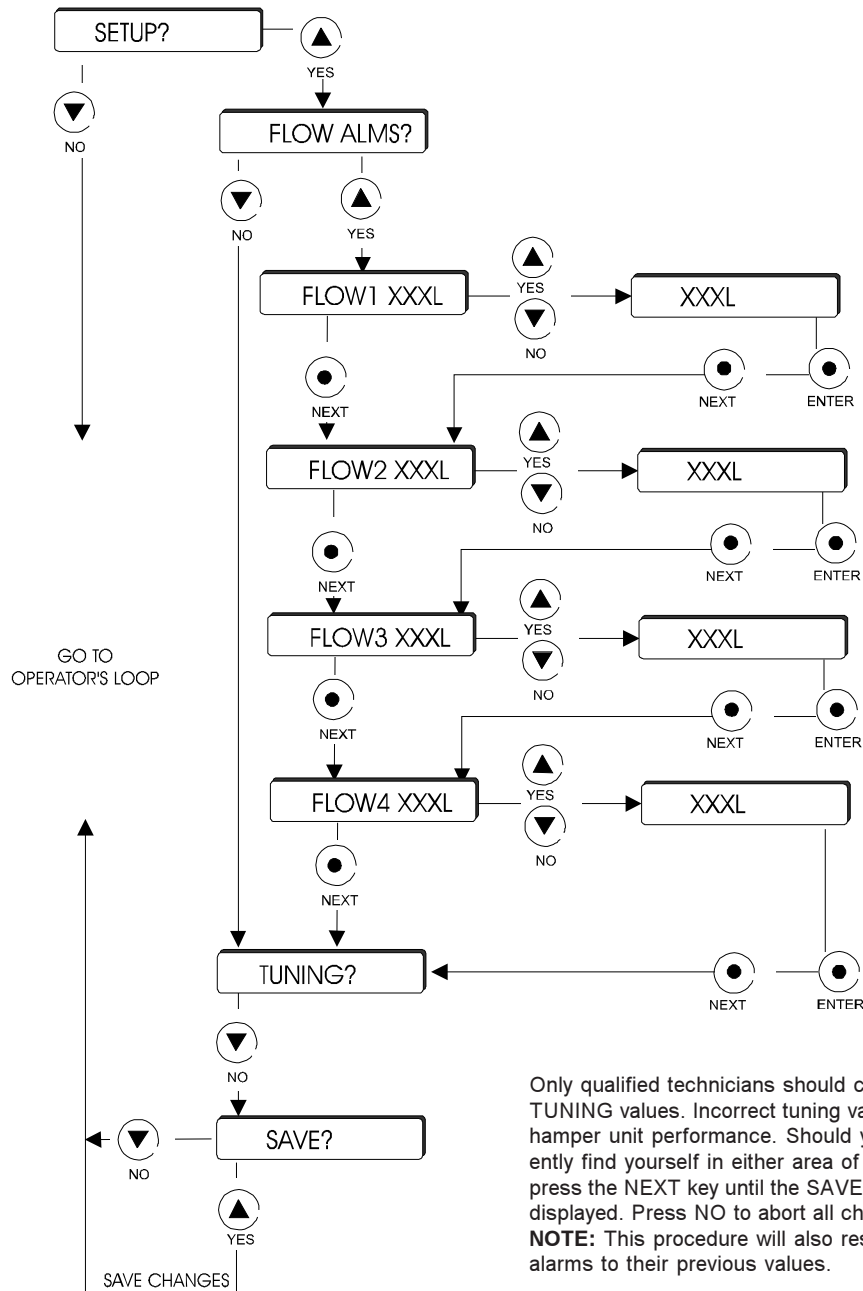


Figure 3 Setup Loop

ERROR Messages

Error messages are displayed whenever certain conditions are detected. When this occurs the error message will be displayed by alternating the error message and the normal display. The keys and menus will perform normally.

All error messages, except for OVER TEMP, disappear when the error condition is corrected. Corrective action for all error messages is listed in the Maintenance Section of this manual.

PHASEERR

This message is displayed whenever the controller senses a phase error or missing phase coming into the unit. This condition will not allow the controller to switch to ON.

24V OFF (Remote Mode Only)

This message is displayed whenever the controller loses the 24 volt input signal from the tool. This signal loss turns off the unit and will not allow the controller to switch to ON.

PUMPTRIP

This message is displayed whenever the controller senses the pump circuit breaker has tripped.

PUMPOVRLD

This message is displayed whenever the controller senses a pump motor overload condition.

HEATTRIP

This message is displayed whenever the controller senses the heater circuit breaker has tripped.

PUMPCNTL

This message is displayed whenever the controller senses a pump controller error condition. This condition causes the heater to be disabled and turns off the PUMP LED.

HEATCNTL

This message is displayed whenever the controller senses a heat control error condition. This condition disables the heater.

RTD FAIL

This message is displayed whenever the internal temperature probe has failed, i.e. shorted or opened, and the probe is controlling (displaying) temperature at the time of failure. This condition stops heating and cooling but the pump continues to operate. This condition automatically resets.

OVER TEMP

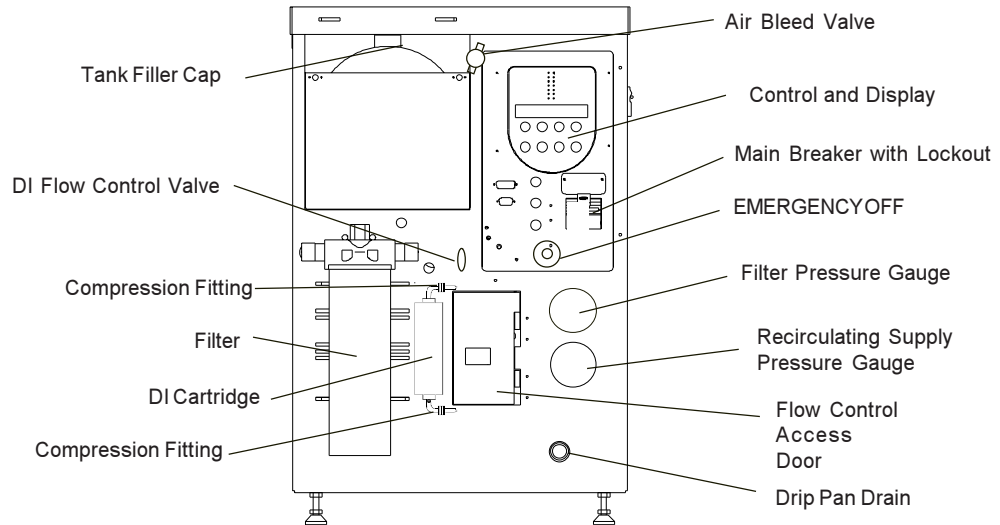
This message is displayed whenever the controlling temperature, i.e. INT T or EXT T, goes beyond 90°C. This condition will turn off the heat exchanger. The unit will be in the standby mode and will not restart until power is cycled to the controller.

Section IV Operation

Pre Start Up & Filling Requirements



Whenever removing the fill cap or refilling the unit release any built up pressure in the reservoir by opening the manual air bleed valve. When refilling the heat exchanger should be running or the chamber quick disconnects detached from the unit so fluid will not run back from the lines or application to the reservoir and create an over-spill condition.



Ensure that the deionizer (DI) cartridge is installed and that the DI flow control valve is in the OPEN position. **NOTE:** Use the flow meter, located on the rear of the unit, to regulate flow control to meet your DI requirements.

Turn the main breaker on and the amber POWER LED will light. Turn the ON/OFF rotary switch to ON.

Remove the 1¼" filler cap from the top of the reservoir. Using a funnel, carefully fill the reservoir with recirculating fluid. If the units are stacked, the lower unit will need a funnel with an extended flexible neck (due to the proximity of the filter on the upper unit).

NOTE: Immediately stop filling when the ADD FLUID LED extinguishes.

Replace the filler cap on the reservoir. Also, close the manual bleed valve located to the right of the tank fill fitting.

Depress the RESET button to remove the level fault and extinguish the LEVEL FAULT LED.

The amount of recirculating fluid needed depends on the total requirements of your system. Also, if substantial lengths of recirculating lines are used, add enough fluid to compensate for their volume. The maximum reservoir volume is 5 gallons (19 liters).

NOTE: When refilling, the heat exchanger should be running or the chamber quick disconnects detached from the unit so fluid will not run back from the lines or tool to the reservoir to create an over-spill condition.

Start Up & Shut Down



Before starting unit make sure the flow control valve located behind the access door on the front of the unit is closed to prevent excessive start-up pressures. The valve handle should be in the upright position. After the unit has started, open the valve until the desired flow and pressure is observed on the front panel displays.

Before starting check all electrical connections and ensure the plumbing connections are correctly made to the ten fittings on the rear of the unit. Ensure that the DI flow control valve is the OPEN position.



Ensure cooling water is always available to the unit.

Turn the main breaker on and the amber POWER LED will light.

Turn the OFF/ON rotary selector switch to ON. The controller will initiate a self-diagnostic with all segments of the display flashing and all LEDs sequentially lighting. After the last LED lights, the controller should display INT T XXXC (XXX is the temperature after the pump discharge). The LOCAL or REMOTE LED illuminates to indicate the unit is in the ON mode. If an error message appears and flashes see Error Messages on page 15.

The LOW FLOW LED will be lit. If more fluid is needed both the LEVEL FAULT and ADD FLUID LEDs will flash. To turn the unit on press the ON/OFF button on the controller membrane.

NOTE: The unit will not start until the LEVEL FAULT and ADD FLUID conditions are cleared and the ON/OFF button is depressed.

In LOCAL the unit will start immediately, if there are no faults. In REMOTE the unit will only start when the appropriate interface connections are made.

Certain other fault error messages will also inhibit start up. They are: PHASE, PUMP TRIP, PUMP OVERLOAD, PUMP CONTROL, RTD FAIL, and OVERTEMP. A heater high temperature, indicated by the HIGH TEMP LED illuminating, will also inhibit start up.

NOTE: The unit may need additional fluid as the plumbing starts to fill.



To avoid premature depletion of DI cartridge resins, always run the unit with the tank filler cap on and the bleed valve shut.

With the unit running use the Operator's Loop to view the fluid temperature, change the setpoint (LOCAL mode only) and monitor flow. Scroll through the Operator's Loop using the NEXT key.

Turn the unit off by depressing the ON/OFF controller membrane button.

Changing a Value

The **YES** key increments the value. The **NO** key decrements the value.

The display will flash as soon as either key is depressed, and continue to flash until the **ENTER** key is pressed to accept the new value.

The new value will not be used by the controller until the **ENTER** key is depressed and the display stops flashing.

If the **NEXT** key is pressed while the value is flashing, the new value will not be accepted. The display will stop flashing and the original value will be displayed. In this case the **NEXT** key is used to abort data entry. The display will not sequence unless the **NEXT** key is depressed.

For large values the display can be changed by manipulating the individual digits. Press the **YES** key and the **NO** key at the same time. The most significant digit will start to flash. Press the **YES** key to increment, or the **NO** key to decrement the digit. Press the **ENTER** key to accept the digit and to move to the next least significant digit. Repeat until all the digits are entered. Pressing the **NEXT** key before entering all the digits will abort the procedure and return the display to the original value.

The controller will not allow you to enter a value above the maximum or below the minimum values, or any illegal value. If you try to enter an illegal value the display will revert to its original value when the last digit is entered.

Remote Operation



Verify that the remote interface cable is connected to the correct interface port on the tool. If the interface cable is plugged into the incorrect port on the tool, the Steelhead controller can be damaged.

When the controller is in the ON mode and the REMOTE pushbutton is depressed, the controller will relinquish PID control of temperature. The unit can be turned on and off by the remote interface.

In addition to remote control the interface provides digital indication of the add fluid level, the flow status, and an analog signal of recirculating fluid temperature and resistivity.

Temperature Control

Fluid temperature control is achieved by activating a chilled-water solenoid valve and a tank heater. PID microprocessor algorithms control both the valve and heater, unless in the remote mode where control of the valve and heater is from the host unit.

Flow Control

Flow control is achieved by adjusting the flow control valve to the desired flow and pressure. The valve is located behind the front bottom access door.

Flow Monitors

Each recirculating THERMAL FLUID RETURN line is each equipped with a flow sensor. The sensor confirms proper flow returning from your application.

The flow sensor provides an opto-isolated current sinking transistor output at the P1 connector for flow rates above one gallon per minute. The signal is absent at flow rates below one gallon per minute.

Each channel's flow setpoint value can be changed or turned off for the full operating range of the flow monitor, see page 14.

Low Level Monitors

There are two level switches in the reservoir. When the fluid level drops to 3¾ gallons, the ADD FLUID lamp on the side of the unit will illuminate and a signal is sent to the tool. If the fluid level should drop to 2.0 gallons, the LEVEL FAULT LED illuminates and the heater is disabled.

If a LEVEL FAULT occurs within three minutes after an ADD FLUID fault, the unit shuts down and the LEVEL FAULT LED will flash. It is not possible to start the unit in any mode with an active LEVEL FAULT. The fault clears automatically once the reservoir is refilled. The ON/OFF button must be pressed to start the unit.

Resistivity & Temperature Sensor

A resistivity and temperature sensor is located in the recirculating process fluid outlet line. The sensor provides output voltages to J1 pins 7 and 8 which are proportional to temperature and resistivity respectively.

Section V Preventative Maintenance



For personal safety and equipment reliability, the following procedures should only be performed by a qualified technician. Contact our Service Department for assistance (see Preface, After-sale Support).



Shut down the system and lock the main circuit breaker in the OFF position before attempting any preventative maintenance.



Do not remove the bleed off resistors from the capacitor filter. Capacitors carry a residual charge after power down.

Service Contracts

Thermo offers on-site Service Contracts that are designed to provide extended life and minimal downtime for your unit. For more information, contact our Service Department (see Preface, After-sale Support).

General Guidelines

NOTE: Each chiller/tool application contains its own set of variables, potentially increasing or decreasing the frequency of action items. See Fluid Degradation Risk Assessment Chart on the next page.



Uninhibited Ethylene glycol (EG) degrades over time and starts to corrode metal. Draining the system alone will not remove corrosion by-products. Use system pressure to flush all the components.



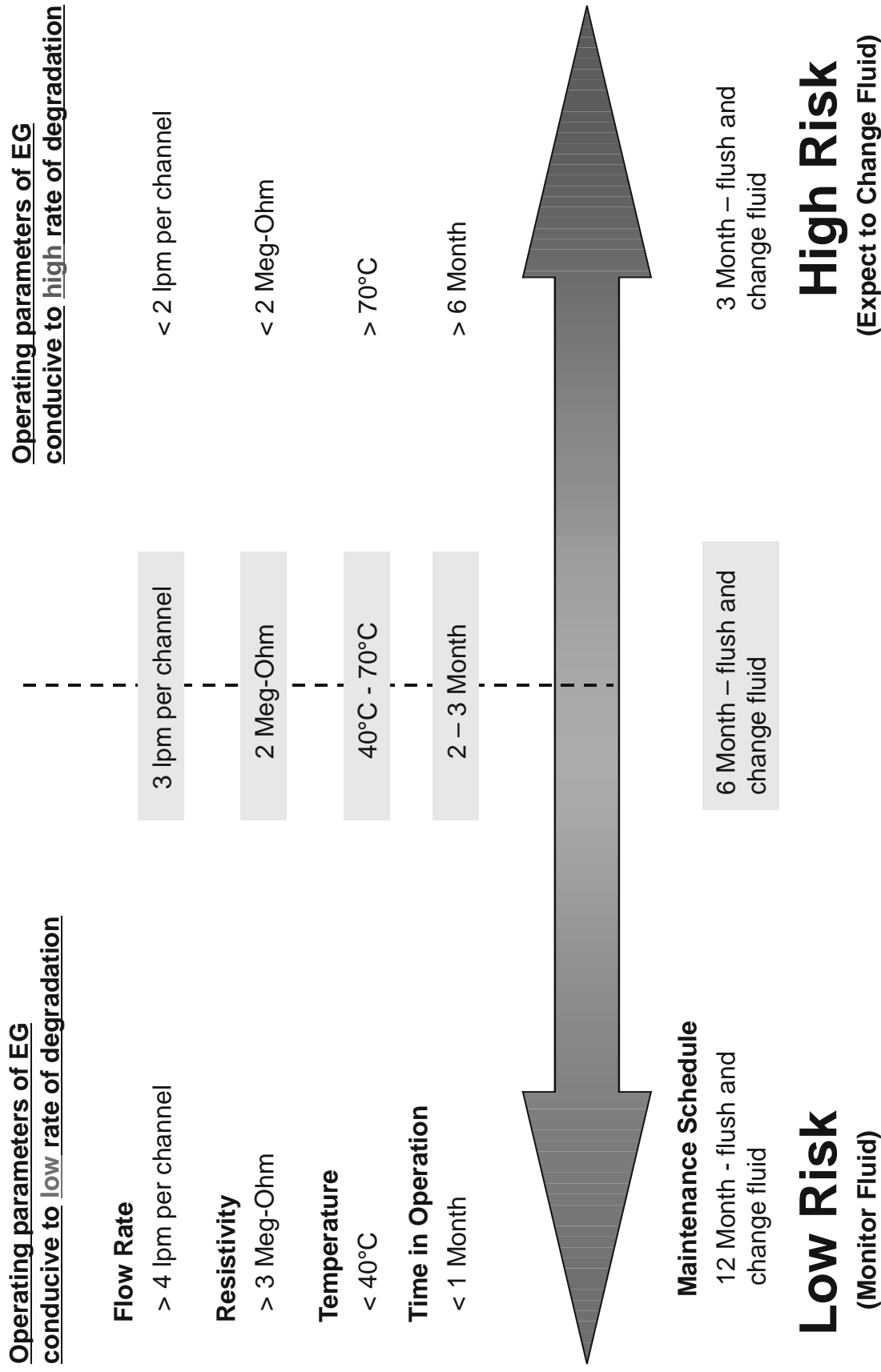
EG is hygroscopic, it will absorb water from its environment. This can affect the freezing point and boiling point of the fluid over time. This may result in system failure.



Top-off with 50/50 Uninhibited EG/water. Do not “top-off” with water. Topping-off with plain water (see Water Quality and Standards in this section) can severely effect the freezing point and boiling point of the fluid. This may result in system failure.

Fluid Degradation Risk Assessment Chart *

Uninhibited Ethylene Glycol in Steelhead Heat Exchanger



* Contact Thermo for further details supporting fluid issues in high temperature applications.

| ACTION | Daily | Weekly | Every 3mos | Every 6mos | Every 12mos |
|----------------------------------|-------|--------|--------------------------------------|---|--------------------------------------|
| Check Controller | x | | | | |
| Check Flow Indicators | x | | | | |
| Check ADD Fluid LED | x | | | | |
| Check Drip Pan | x | | | | |
| Check Fault Indicator | x | | | | |
| Inspect Fluid | | x | | | |
| Measure Fluid pH | | x | | | |
| Clean Particulate Filter Element | | | | x or $\Delta P > 15 \text{psi}$ see text | |
| Change Barnstead DI Filter | | | x or RES < desired level see text | | |
| Change Culligan DI Filter | | | | | x or RES < desired level see text |
| Lubricate Pump Motor Bearings | | | | x | |
| Clean Reservoir | | | | | x |

Daily Preventative Maintenance

CONTROLLER DISPLAY Check for any error messages.

LOW FLOW Normal indication if one of the loops is not in use, otherwise at least one of the flows is below its alarm setpoint. Check that flow setpoints are correct. Check for correct pump operation. Check for flow obstructions.

ADD FLUID Check for leaks and improper tank sealing. Add fluid until LED extinguishes.

FLUID LEAK The unit drip pan is accumulating facility water or recirculating fluid. Immediately locate the cause of the leak and turn off the unit if a failure is eminent. Repair leak or replace unit.

LEVEL FAULT Verify there are no leaks in the system. Add fluid until LED extinguishes. Run unit and recheck for leaks.

Fluid Inspection/Draining



Failure to remove corrosion by-products or particles in your system may rapidly lower resistivity, clog the particulate filter, and result in damage to the mechanical seals contained in the unit's pump.

Because Uninhibited EG contains no corrosion inhibitors, the fluid must be inspected weekly for visual signs of degradation. New, Uninhibited EG should be clear and colorless. The fluid should be replaced at the first sign of deviation from its clear and colorless appearance.



Before changing the fluid, lower the operating temperature of the unit to prevent injury from contact with the hot temperature fluid. Use proper fluid handling and disposal techniques.

Drain & Flush Protocol

1. Drain the Thermo unit, connection lines, and tool. If necessary, use system pressure to flush the Thermo unit, connection lines, and tool.
2. Clean new or lightly corroded existing systems (chiller, connection lines, and tool) with a 1-2% trisodium phosphate solution. Flush with Uninhibited EG if trisodium phosphate is not available.
3. Repeat if necessary until there are no signs of particles exiting from the system.
4. Perform a final rinse with your application Uninhibited EG.
5. For extensively corroded existing systems that is beyond self-help, contact a professional industrial cleaning company, one who has experience in cleaning industrial machinery and in performing repairs or replacement of components.

Fluid pH



Uninhibited ethylene glycol can become corrosive in as little as three weeks. This is a function of the temperature, oxygen concentration, and metals exposed to the fluid.

Uninhibited EG normally has a pH of 5.5 - 8.0, *depending on the specific glycol manufacturer*. Please refer to your specific manufacturer of Uninhibited EG for their recommendation for fluid change-out.

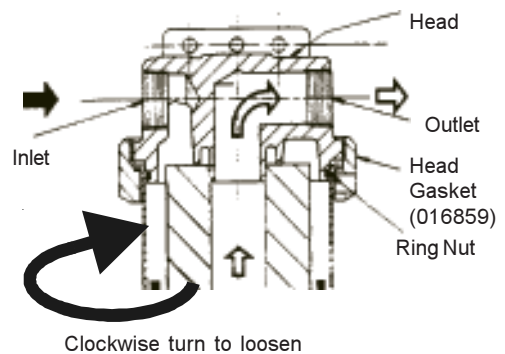
Particulate Filter Element (Part# 004559)

If debris is drawn into the system, the filter prevents the material from being ingested into the fluid loop. As the filter collects particles, it creates a pressure drop in the flow loop. This pressure drop is measured by comparing the filter pressure with the main pressure on the gauges located on the front of the unit. Clean the filter if the pressure difference is greater than 15 psi (1.1 kg/cm²).

Before replacing the filter element, relieve any tank pressure by activating the bleed valve located just right of the filler port. Close the flow control valve located behind the front access door and disconnect the supply lines from the rear of the unit.

Drain the cannister. The drain is located on the bottom of the cannister.

Using the filter tool attached to the side of the unit, loosen the ring nut on the filter head clockwise until free. *Slowly* lower the cannister towards you to remove it from the unit. **NOTE:** A small amount of fluid may drain from the line. Remove and replace the filter element.



Install a new head gasket (016859) on the filter head. Reinstall the cannister.

Replace the ring nut. Tighten using the filter tool until the housing contacts the filter head. Check for leaks.

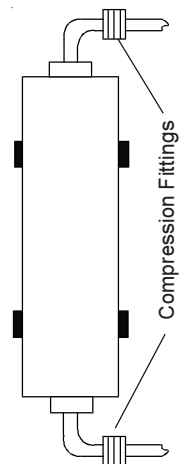
Barnstead DI Filter (Part# 008699)

Change the Barnstead deionization (DI) filter when the resistivity of the fluid drops below the desired level. Typical cartridge life is 3 months. Actual cartridge life depends on the system application, fluid quality and the desired minimum DEI level.

The DI flow valve controls flow to and from the cartridge. The DI flow control valve is above the unit's DI cartridge. The valve has a small green handle, see illustration on page 16. Close the valve handle.

Relieve any tank pressure by activating the bleed valve. The valve is located just right of the filler port, see illustration on page 16.

Loosen the compression fitting nuts on the top and bottom of the cannister. Remove the fittings from the old cartridge and



wrap threads with 3 - 4 turns of Teflon® tape. Install the fittings on the new cartridge.

Reconnect the compression nuts. *Do not overtighten.*

Open the valve and check for leaks. If leaks are present, slightly tighten the compression nuts and check again. Repeat as necessary.

NOTE: To avoid premature depletion of the DI resins, always run the unit with the tank filler cap on tight and the bleed valve shut.

Culligan DI Filter (Part# 026272)

Not all units are equipped with this filter. Change the Culligan deionization (DI) filter when the resistivity of the fluid drops below the desired level. Typical cartridge life is 12 months. Actual cartridge life depends on the system application, fluid quality, and the desired minimum DEI level.

If the resistivity remains low the resistivity probe may need cleaning/replacement. Contact Thermo.

NOTE: Excessive flow through the DI will prevent the unit from reaching higher temperature set points. Thermo recommends monitoring the DI level and adjusting the flow rate to produce the desired value.

Pump Motor Bearings Lubrication

Lubricate the pump motor bearings every six (6) months. Two bearing lubrication Alemite fittings are located at the top front and bottom rear of the motor. Clean tip of fittings and apply grease gun, use one to two full strokes per fitting.

Tools Required: Screw driver to remove the left side panel, grease gun with long flexible hose.

Grease Type: Polyurea

Typical Grease: Shell Dolium BRB

Reservoir Cleaning

Clean the reservoir every twelve (12) months or sooner if visual inspection shows signs of contamination. If cleaning is necessary, flush the reservoir with a cleaning fluid compatible with the circulating system and the recirculating fluid.

Water Quality Standards and Recommendations

| | Permissible (PPM) | Desirable (PPM) |
|-----------------------------------|-------------------|-----------------|
| Microbiologicals | | |
| (algae, bacteria, fungi) | 0 | 0 |
| Inorganic Chemicals | | |
| Calcium | <40 | <0.6 |
| Chloride | <250 | <25 |
| Copper | <1.3 | <1.0 |
| Iron | <0.3 | <0.1 |
| Lead | <0.015 | 0 |
| Magnesium | <12 | <0.1 |
| Manganese | <0.05 | <0.03 |
| Nitrates\Nitrites | <10 as N | 0 |
| Potassium | <20 | <0.3 |
| Silicate | <25 | <1.0 |
| Sodium | <20 | <0.3 |
| Sulfate | <250 | <50 |
| Hardness | <17 | <0.05 |
| Total Dissolved Solids | <50 | <10 |
| Other Parameters | | |
| pH | 6.5-8.5 | 7-8 |
| Resistivity | 0.01* | 0.05-0.1* |
| * Megohm-Cm (Compensated to 25°C) | | |

Unfavorably high total ionized solids (TIS) can accelerate the rate of galvanic corrosion. These contaminants can function as electrolytes which increase the potential for galvanic cell corrosion and lead to localized corrosion such as pitting. Eventually, the pitting could become so extensive that leaking will occur between the process water and facility water diminishing the System's heat transfer capability.

High water hardness (Calcium and Manganese) can also produce scaling. Scaling will inhibit heat transfer between the process and facility side by building up a deposit layer on metal surfaces. As an example, raw water in the United States averages 171 ppm (of NaCl). The recommended level for use in a water system is between 0.5 to 5.0 ppm (of NaCl).

Recommendation: Do not use untreated tap water as the total ionized solids level may be too high.

Section VI Troubleshooting

Facilitization Problem Troubleshooting

Customer-related problems have occurred on Steelhead Heat Exchangers during facilitization or start up. Although there were no defects with the Steelhead units, Thermo has developed the following reference guide to help minimize reoccurrence of these problems. This guide lists potential facilitization problems, possible causes for these problems, and lists several items to check before rejecting the unit or contacting our service department.

If the problem remains, if you have any questions regarding the information in this table, or if you require assistance from us, contact our Service Group at (800) 258-0830.

| Problem | Possible Cause | Recommendation |
|---|--|---|
| Unit will not heat above a certain temperature (i.e., ~30°C) | <ol style="list-style-type: none"> 1. The facility water lines are hooked up incorrectly. If the inlet and outlet lines are reversed, the facility water will flow continuously in heat mode, especially with a high temperature setpoint. 2. Excessive flow through DI loop. | <ol style="list-style-type: none"> 1. Verify that the facility water lines are correctly hooked up. 2. Regulate DEI valve towards the off position. Monitor flow rate using the flow meter on the rear of the unit. |
| In Remote Mode, the temperature output signal reads a constant temperature (0-15°C), that is not equal to the setpoint. | <ol style="list-style-type: none"> 1. The remote interface cable is connected incorrectly at the tool. If the voltages supplied through the remote interface are incorrect, the main control board in the unit may be damaged. | <ol style="list-style-type: none"> 1. Verify that the remote interface cable is correctly connected at the tool. If incorrectly installed, contact our service department to replace the damaged main control board. |
| Pump pressure or flow is deteriorated. | <ol style="list-style-type: none"> 1. The filter cartridge may be dirty. If the filter is clogged this will reduce pump performance. Filter changing is part of routine maintenance. 2. The flow control valve may not be set to meet the tool's needs. This valve allows adjustment of the flow and pressure. | <ol style="list-style-type: none"> 1. Check the filter pressure gauge on the front of the unit. If the pressure reading is outside the tolerance listed in this manual, the filter may need to be changed. 2. Adjust the flow control valve to the desired setting. |
| The unit will not maintain a resistivity level, or the resistivity level is always zero. | <ol style="list-style-type: none"> 1. The resistivity cartridge is exhausted or the thermal fluid is heavily contaminated. Replacing the resistivity cartridge to maintain a resistivity level is part of routine maintenance. | <ol style="list-style-type: none"> 1. Install a new resistivity cartridge. If an increase in resistivity does not occur, flush out the thermal fluid system (including lines to the tool), and fill with new fluid. |

Continued on next page.

| Problem | Possible Cause | Recommendation |
|---|---|---|
| Flow alarm will not clear. | 1. Thermo factory sets all four flow alarms to 3.8 lpm. It is possible that flow alarm setpoints for loops not in use are not set to zero, or flow alarm for loops in use may be set too high. | 1. Verify the alarm setpoint for the process loops not in use are set to zero (off). Verify that the alarm setpoints for the process loops in use are set to the desired value. |
| Unit leaks at the facility inlet/outlet, reservoir drain, filter cartridge drain, or the DEI cartridge. | 1. The fittings may not be tight enough or Teflon® tape is not applied, causing leakage. | 1. These fittings are used during facilitization should be prepared and tightened in accordance with the instructions in this manual. |
| Fluid in filter cannister or DEI cartridge appears contaminated. | 1. The thermal fluid specified for use in the Steelhead unit family naturally degrades over time. This degradation can cause fluid contamination and possible damage to the unit if the fluid is not regularly replaced. Fluid replacement is part of routine maintenance for the unit. | 1. Flush out the thermal fluid loop (including the lines to the tool) and replace with new fluid as specified in this manual. |
| Temperature calibration appears to be off, either in remote or local mode. | 1. Because of temperature gradients inside the unit and heat transfer to the environment through the fluid lines, the temperature at the tool may be different than the temperature at the unit. | 1. Contact our service department for a field verification of temperature calibration . |
| Unit has missing or bent leveling foot. | 1. Leveling foot jam nut not tightened securely to case. This could cause foot shaft to loosen and lower. The lowered leveling foot could become bent during movement of the unit or could fall out completely. | 1. Ensure all leveling foot jam nuts are securely tightened to the case. |
| CB trips during ramp to set point. | 1. Excessive flow through DI loop, causing excessive heater draw. | 1. Regulate DEI towards off position. |

Error Message Troubleshooting



Actions listed below should be performed only by a qualified technician. Contact Thermo Service for assistance.

| Error Message | Type | Indication | Action |
|-------------------------------|-------------|---|---|
| OVER TEMP | Failure | Unit will not run, Unit turned off due to fluid temperature limit exceeded. | Check that pump is running, check cooling solenoid operation, verify actual temperature of fluid and temperature display. |
| PHASE ERR | Failure | Unit will not run, Incorrect phase rotation, Low voltage, Voltage unbalance, Loss of phase. | Check for correct voltages, reverse main power phasing if necessary. |
| 24V OFF (Remote mode only) | Failure | Unit will not run, 24Vdc return not available from interface. | Check that customer 15 pin interface is properly connected and that 24 Vdc is across pins 10 and 9. |
| PUMP TRIP | Failure | Unit will not run. Pump circuit breaker tripped or opened. | Check for shorts on the pump circuit, or if circuit breaker is closed and error persists, |
| PUMPOVRLD | Failure | Unit will not run. Pump motor overload relay has tripped, BREAKERS led is lit. | Check that motor overload setting is at least FLA of motor and less than SFA of motor, adjust if needed. Reset motor overload and measure motor current for each phase line under normal running conditions. Investigate pump overload. |
| RTD FAILED | Failure | Unit will continue to run in the on mode with heat and cool functions disabled. In the off mode the controller indicates the failure. | Check that the RTD probe is not shorted or opened. Check the RTD board input by placing a resistor in place of the RTD. |
| PUMPCNTL | Failure | Controller will not start or will not stop the pump. | Check main control board pump triac for short or open, check pump control circuit wiring. |
| HEAT TRIP | Failure | Heater will not enable. Heater circuit breaker tripped or opened, BREAKERS led is lit. | Check for shorts on the heater circuit. Check heater current on each phase line, normal rating is 16.7 Amps at 208 Volts. |
| HEATCNTL | Failure | Controller will not enable or disable the heater contactor. | Check main control board heater triac for short or open, check heater control circuit wiring. |

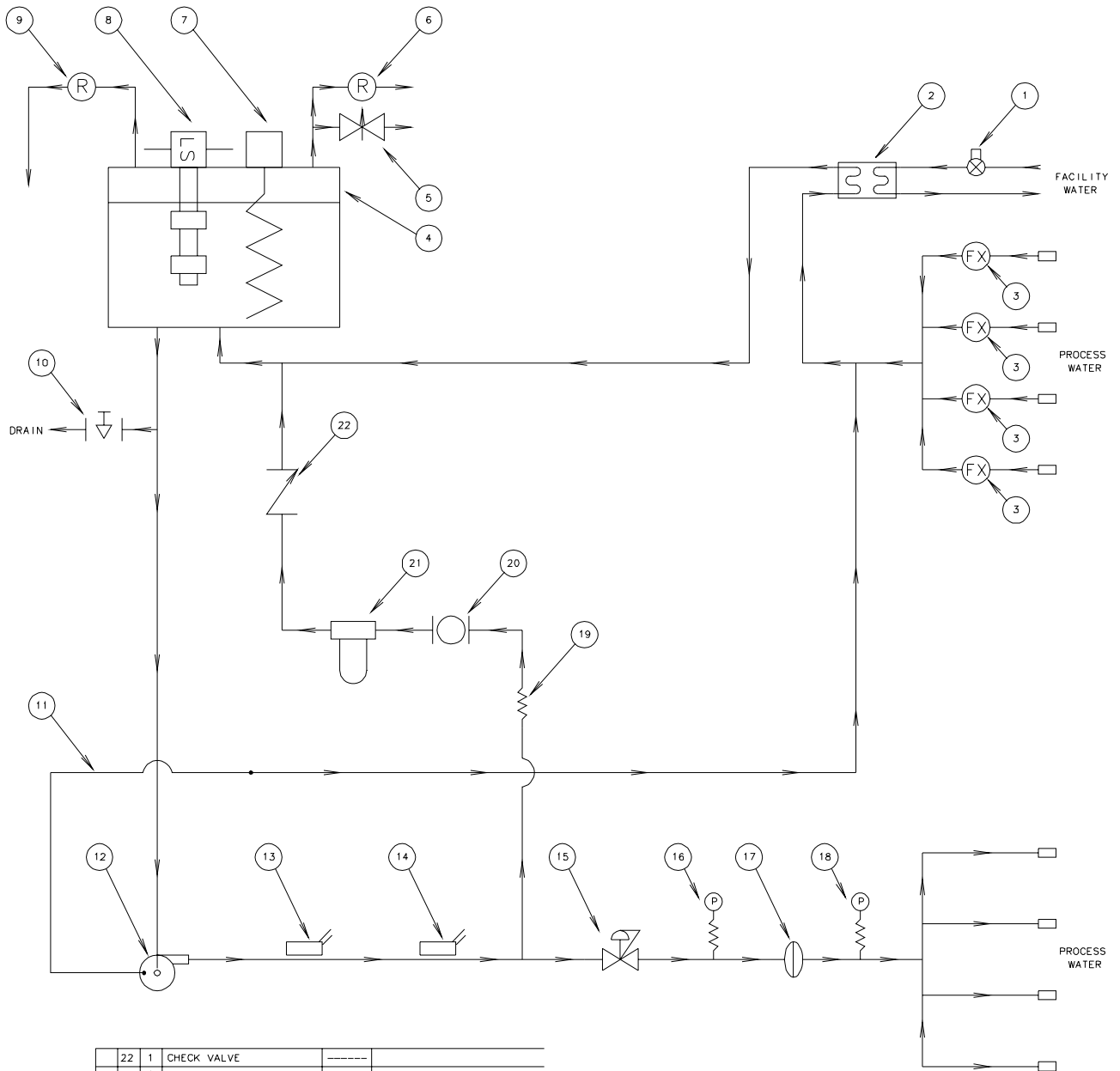
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| Error Message | Type | Indication | Corrective Action |
|----------------------|-------------|---|---|
| BAD CAL | Warning | Flashes BAD CAL for several seconds after a calibration has been performed outside of the calibration zone allowed for a standard RTD. Protects against potential calibration errors. | Redo calibration of RTD until values are acceptable. |
| EXT SENSOR | Status | Unit is controlling temp with a remotely located RTD probe. | None. |
| LOW FLOW | Warning | At least one of the flows is below its alarm setpoint. | Assure that flow loops not used are turned off. Check that flow setpoints are correct. Check for correct pump operation. Check for flow obstructions. |
| ADDFLUID | Warning | Fluid level is low in reservoir. | Check for leaks. Check for improper sealing of the tank. Add fluid. |
| FILTER | Warning | Six months since filter has been cleaned or replaced. Counts as long as controller has power. | Clean or replace filter, Perform 6 month PMI. |
| BREAKERS | Failure | Heater and/or pump breaker is open. | See Error Message. |
| HIGH TEMP | Failure | Heater HTC tripped or malfunctioned, the unit will not run. | Adjustable HTC: Increase HTC setting and reset Fixed Temp. HTC: Reset HTC and check operation. |
| HEAT | Status | Controller is asking for the heater solid state relays to turn on. | None. |
| HEAT (Flashing) | Status | Controller is maintaining temp control within the proportional band by asking the solid state relays to turn on and off. | None. |
| HEAT ENABLE | Status | Controller is asking for the heater contactor to turn on. | None. |

| Error Message | Type | Indication | Corrective Action |
|------------------------|-------------|---|--|
| COOL (Steady) | Status | Controller is asking for the cooling solenoid to turn on. | None. |
| COOL (Flashing) | Status | Controller is maintaining temperature control within the proportional band by asking the solenoid valve to turn on and off. | None. |
| PUMP | Status | The pump is on either locally or remotely. | None. |
| LOCAL | Status | The unit is on and in the local mode. | None. |
| REMOTE | Status | The unit is on and in the remote mode. | None. |
| FLUIDLEAK | Failure | The unit drip pan is accumulating facility water or recirculating fluid. | Immediately locate the cause of the leak and turn off the unit if a failure is eminent. Repair leak or replace unit. |
| LEVEL FAULT (Steady) | Failure | Heater is disabled, unit will continue to operate. If unit is off the unit will not turn on. | Add Fluid until the ADD FLUID led goes out when reset. |
| LEVEL FAULT (Flashing) | Failure | Unit is off and will not turn on. Fluid level went from an ADD FLUID warning to a LEVEL FAULT within three minutes. | Check for fluid leak in system. The fault will reset once the reservoir is filled past the ADD FLUID level. |

Flow Diagram

Section VII Diagrams



| | | | |
|----|---|-------------------------|-------------------|
| 22 | 1 | CHECK VALVE | ----- |
| 21 | 1 | DEIONIZER TANK | ----- |
| 20 | 1 | BALL VALVE | ----- |
| 19 | 1 | CAPILLARY TUBE | METERING CAP TUBE |
| 18 | 1 | PRESSURE GAUGE, SYSTEM | ----- |
| 17 | 1 | FILTER | ----- |
| 16 | 1 | PRESSURE GAUGE, FILTER | ----- |
| 15 | 1 | FLOW & PRESS REG. VALVE | ----- |
| 14 | 1 | SENSOR, TEMPERATURE | ----- |
| 13 | 1 | SENSOR, DEIONIZER | ----- |
| 12 | 1 | PUMP | ----- |
| 11 | 1 | PUMP SEAL FLUSH | ----- |
| 10 | 1 | PLUG, DRAIN | ----- |
| 9 | 1 | RELIEF VALVE | OVER PRESSURE |
| 8 | 1 | LEVEL SWITCH, HIGH/LOW | ----- |
| 7 | 1 | HEATER | 6KW |
| 6 | 1 | RELIEF VALVE, VACUUM | 1/3 PSI |
| 5 | 1 | VALVE, AIR BLEED | ----- |
| 4 | 1 | TANK, CLOSED | ----- |
| 3 | 4 | FLOW TRANSDUCER | ----- |
| 2 | 1 | HEAT EXCHANGER, PLATE | ----- |
| 1 | 1 | WATER REGULATING VALVE | ----- |

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1 OF 1

Fork Lift
Channel Dimensions

