System V
Liquid to Liquid
Heat Exchanger

Thermo NESLAB Manual P/N U00202
Rev. 06/03/03

Instruction and Operation Manual

System V Liquid to Liquid Heat Exchanger Instruction and Operation Manual

Table of Contents

PREFACE

Compliance 3
After-sale Support 3
Warranty 3
Unpacking 3

SECTION I
Safety

Warnings 4

SECTION II
General Information

Description 5
Specifications 5

SECTION III
Installation

Site 6
Facility Water Requirements 6
Electrical Requirements 6
Fluids 6
Filling Requirements 6
Water Quality Standards and Recommendations 7
Plumbing Requirements 8

SECTION IV
Operation

Start Up 9
Temperature Adjustment 9
Flow Control 9
Controller Keypad 10
Status Indicators 11
Changing a Value 12
Controller Displays 12

SECTION V
Special Features

Emergency Motor Off (EMO) 15
High Temperature Safeties 15
Low Liquid Level Safety 15
Pump Motor Overload Protector 15
Resistivity Monitor 15
Fault Response Modes 16

SECTION VI
Maintenance

Service Contracts 17
Pump Strainer 17
Particulate Filter 17
Algae 17

SECTION VII
Service

Pressure Relief Valve 18
Phase Rotation 18
Dispalying Software Version 18

SECTION VIII
Troubleshooting

Checklist 19
Parts List 20
Service Assistance 21
Technical Support 21
Pump Flow Diagram 22
Wiring Diagram 23

SECTION IX
Warranty

Preface

Compliance

Products tested and found to be in compliance with the requirements defined in the EMC standards defined by 89/336/EEC as well as Low Voltage Directive (LVD) 73/23/EEC can be identified by the CE label on the rear of the unit. The testing has demonstrated compliance with the following directives:

LVD, 73/23/EEC	Complies with UL 3101-1:93
EMC, 89/336/EEC	EN 55011, Class A Verification EN 50082-1:1992 IEC 1000-4-2:1995 IEC 1000-4-3:1994 IEC 1000-4-4:1995

For any additional information refer to the Letter of Compliance that shipped with the unit (Declaration of Conformity).

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. If your unit fails to operate properly, or if you have questions concerning spare parts or Service Contracts, contact our Service Department. Before calling, please obtain the following information from the unit's serial number label on the rear of the unit:

- *BOM number* _____
- *Serial number* _____
- *Software version (see page 18)* _____

Warranty

Units have a warranty against defective parts and workmanship for one full year from date of shipment. See back page for more details.

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.

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, 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.

Observe all warning labels.

Never remove warning labels.

Never operate damaged or leaking equipment.

Never operate the unit without cooling fluid in the reservoir.

Always turn off the unit and disconnect the line cord from the power source before performing any service or maintenance procedures, or before moving the unit.

Always empty the reservoir before moving the unit.

Never operate equipment with damaged line cords.

Refer service and repairs to a qualified technician.

In addition to the safety warnings listed above, warnings are posted throughout the manual. These warnings are designated by an exclamation mark inside an equilateral triangle with text highlighted in bold print. Read and follow these important instructions. Failure to observe these instruction can result in permanent damage to the unit, significant property damage, or personal injury or death.

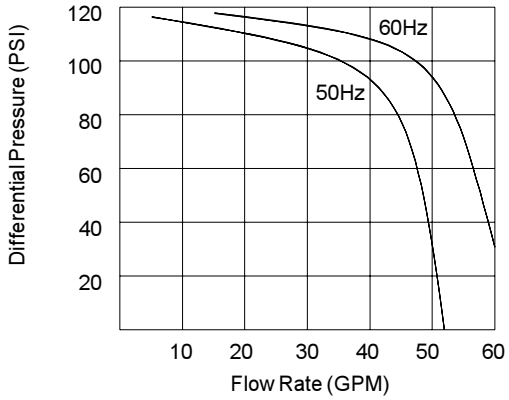
Section II General Information

Description

The System V Liquid to Liquid Heat Exchanger is designed to remove heat from water-cooled instruments.

The unit consists of a heat exchanger, recirculation pump, stainless steel reservoir and a microprocessor temperature controller.

Specifications

Temperature Range	+5°C to +40°C
Temperature Stability	±1.0°C
Pumping Capacity[1]	
Cooling Capacity[2]	150 KW
Reservoir Volume *Gallons* *Liters*	 5.0 18.9
Unit Dimensions *(H x W x D)* *Inches* *Centimeters*	 55½ x 28 x 37 141.0 x 71.1 x 94.0

1. Relief valve open.
2. Cooling capacity is based on a 10°C difference between the temperature of the cooling water supply and the process fluid leaving the System V to the instrument being cooled and a 34 gpm facility water flow rate.

Section III Installation

Site

The unit should be placed in a laboratory or clean industrial environment with easy access to a facility cooling water and a drain.

Facility Water Requirements

A control valve, located in the FACILITY WATER SUPPLY line, regulates the flow rate of the cooling water supply as it enters the unit. The valve regulates the flow rate based on the heat load. Flow through the unit stops automatically when the unit is shut off.

The flow display on the controller measures the flow rate of the cooling fluid to the instrument being cooled.

Electrical Requirements

Refer to the serial number label on the rear of the unit to identify the specific electrical requirements of your unit.

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

The unit construction provides protection against the risk of electric shock by grounding appropriate metal parts. The protection may not function unless the power cord is connected to a properly grounded outlet. It is the user's responsibility to assure a proper ground connection is provided.

NOTE: To reduce the large inrush current normally required for pump start up, units are equipped with a starting torque controller.

Fluids

Filtered tap water is the recommended cooling fluid. See Fluid Standards and Recommendations on the next page.

Filling Requirements

Open the reservoir access panel on the rear left corner on the top of the unit. Remove the fill hole cover. Fill the reservoir with cooling 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)

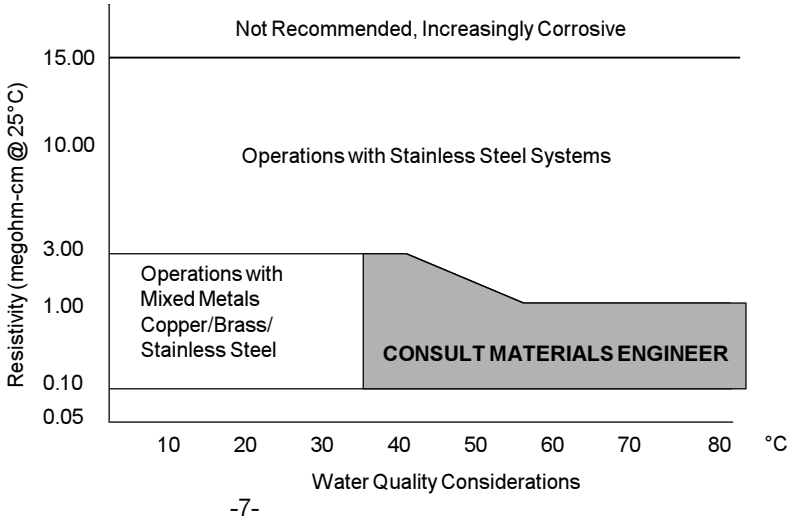
Unfavorably high total ionized solids (TIS) can accelerate the rate of galvanic corrosion. These contaminants can function as electrolytes which increase the potential for galvanic cell corrosion and lead to localized corrosion such as pitting. Eventually, the pitting could become so extensive that leaking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

High water hardness (Calcium and Maganese) 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: Initially fill the tank with distilled/deionized water. Do not use untreated tap water as the total ionized solids level may be too high.

Maintain this water quality at a resistivity of between 1 to 10 megohm-cm (compensated to 25°C) by using a purification system. Although the initial fill may be as high as 10 megohm-cm (compensated to 25°C), the desired level for long time usage is 1 to 3 megohm-cm (compensated to 25°C).

The above two recommendations will reduce the electrolytic potential of the water and prevent or reduce the galvanic corrosion observed.



Plumbing Requirements

The plumbing connections are located on the rear of the unit. They are labelled FACILITY WATER and RECIRCULATING WATER. The FACILITY WATER connections and the RECIRCULATING WATER connections are 1½ inch female pipe thread.

Before installing the unit to an instrument that previously used tap water as a cooling fluid, flush the instrument several times to remove any rust or scale that has built up. The manufacturer of the instrument should be able to recommend a cleaning fluid for their equipment.

Connect the FACILITY WATER SUPPLY to the cooling water source. Connect the FACILITY WATER RETURN to the drain.

Limit the facility water inlet pressure to less than 80 psi (5,5 Bar) and limit the facility water inlet pressure to outlet pressure differential across the System V to less than 35 psid (2,4 Bar).

Connect the RECIRCULATING WATER SUPPLY to the inlet of the instrument being cooled. Connect the RECIRCULATING WATER RETURN to the outlet of the instrument being cooled.

Connect the auto refill line to a house water supply.

Flexible tubing, if used, should be of heavy wall or reinforced construction. All tubing should be rated to withstand 135 psi at +40°C. Make sure all tubing connections are securely clamped. Avoid running tubing near radiators, hot water pipes, etc. If substantial lengths of tubing are necessary, insulation may be required to prevent loss of cooling capacity.

Tubing and insulation are available from Thermo. Contact our Sales Department for more information (see Preface, After-sale Support).

It is important to keep the distance between the unit and the instrument being cooled as short as possible, and to use the largest diameter tubing practical. Tubing should be straight and without bends. If reductions must be made, they should be made at the inlet and outlet of the instrument being cooled, not at the unit.

If substantial lengths of cooling lines are required, they should be pre-filled with cooling fluid before connecting them to the unit.

Section IV Operation

Start Up

Before starting the unit, double check all electrical and plumbing connections and make sure the circulating system (the System V, the instrument being cooled, and the tubing that connects them) has been properly filled with cooling fluid.

Turn the RECIRCULATING FLOW CONTROL handle to the vertical position (full closed). To start the unit press the controller's START.

The low fluid level monitor in the reservoir prevents the unit from operating if the fluid in the reservoir is below the safe operating level. By slightly and/or intermittently opening the RECIRCULATING FLOW CONTROL toward the horizontal position (full open) and using extra cooling fluid to keep the unit topped off, the system can be filled without repeated tripping of the low fluid level monitor.

If the unit shuts down, top off the reservoir and restart the unit. When the system is full, the reservoir level will no longer drop when the RECIRCULATING FLOW CONTROL valve is opened.

Temperature Adjustment

The temperature is set in the controller's Setup Loop, see page 14. The temperature control system actuates a control valve in the FACILITY WATER SUPPLY line. The control valve adjusts the flow of the cooling water supply to produce the desired operating temperature.

The cooling fluid temperature can be monitored on the controller's display.

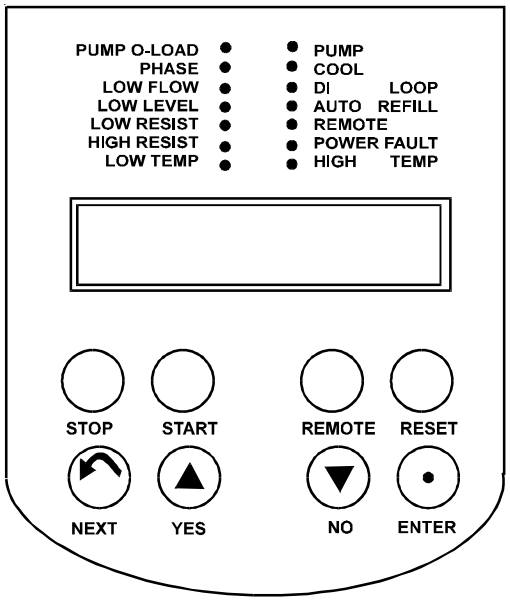
When selecting an operating temperature, remember that the lowest achievable temperature is a function of the available flow rate, the temperature of the cooling water supply and the heat load.

The green COOL light on the controller provides an indication of the control valves status. When the temperature control valve is wide open (for maximum cooling), the COOL light is on steady. When the control valve is closed, the COOL light is off. As the control valve moves between these extremes, the light will flash with varying on-time to indicate the approximate position of the control valve.

Flow Control

The unit's RECIRCULATING FLOW CONTROL handle controls the flow of the cooling fluid to the instrument being cooled. When the handle is in the full horizontal position all available fluid is being supplied. When the handle is in the full vertical position no cooling fluid is being supplied. Read the controller to read and adjust the desired flow rate.

Controller Keypad



START
Depressing **START** energizes the channel contactor which starts the circulating pump and brings the reservoir temperature to the current setpoint.

STOP
Depressing de-energizes the channel contactors and stops the pump.

REMOTE
Enables remote operation. **NOTE:** Pins 11 and 12 on the INTERFACE (J25) connector are used for remote start/stop. See Wiring Diagram.

RESET
Clears alarm indications after fault condition has been corrected. Alarm LEDs will remain lit after problem is eliminated to provide indication of problem cause for operator. RESET clears these indicators.

NEXT
Scrolls forward through the menus.

YES, ▲
Answers Yes to Y/N questions, increments numerical values upward for setting numeric values.

NO, ▼
Answers NO to Y/N questions, increments numerical values downward for setting numeric values.

ENTER
Confirms entry of numeric values.

Status Indicators

Status indicators are provided to show the state of various functions.

PUMP O-LOAD
Indicates a pump overload.

PHASE
Indicates improper phase to the unit.

LOW FLOW
Indicates low process flow.

LOW LEVEL
Indicates that the reservoir level is too low.

LOW RESIST
Indicates resistivity is below setpoint.

HIGH RESIST
Indicates resistivity is above setpoint.

LOW TEMP
Indicates temperature is below setpoint.

PUMP
Indicates pump is running.

COOL
Illuminates when the heat exchanger is removing heat from the fluid in the reservoir. Flashes when the channel is operating in the cool proportional band.

DI LOOP
Indicates flow through the resistivity cartridge.

AUTO REFILL
Indicates auto refill is in operation.

REMOTE
Indicates unit is in REMOTE mode of operation.

POWER FAULT
Indicates a system fault.

HIGH TEMP
Indicates temperature is above setpoint.

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 will 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 can be used to abort data entry. The display will not sequence unless the **NEXT** key is depress again.

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. The **YES** key increments or the **NO** key decrements the digit. Press the **ENTER** key to accept the digit and to move to the next most significant digit. Repeat until all digits are entered. Pressing the **NEXT** key before all digit are entered 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 (+40°C) or below the minimum (+5°C). If you try to enter an illegal value outside the operating range, the display will revert to its original value.

Controller Displays

An alphanumeric display presents numeric readings of various operating conditions within the chiller. Display function is selected by pressing the appropriate keys to move through a menu of available information.

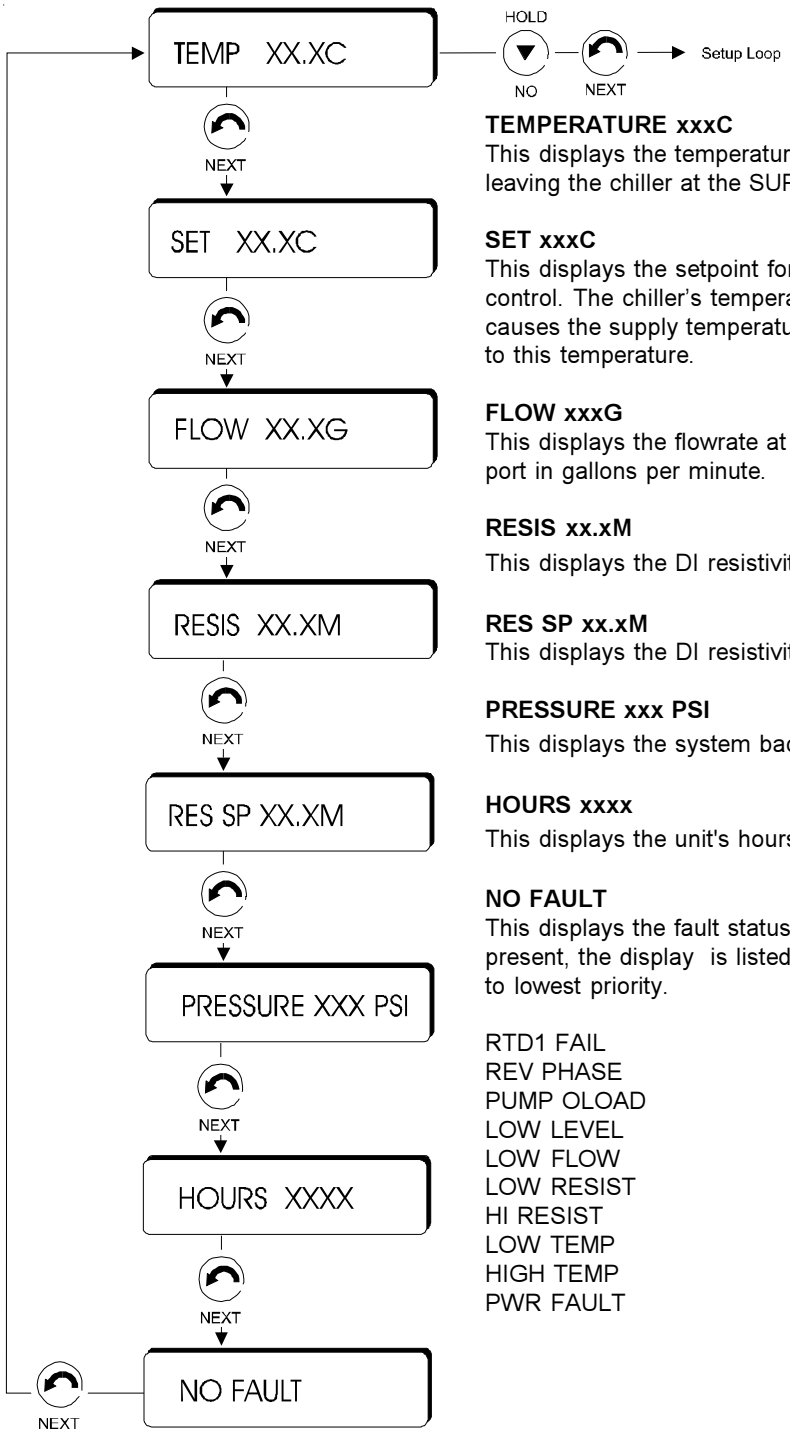
Various controller loops allow the operator to display and/or alter different parameters of the controller. The various controller loops can be accessed from the temperature display by pressing and holding the key combinations shown on Figure 1 on the next page.

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.

Operators Loop

When the controller is first powered it goes through a short self test and then enters the Operator's Loop, displaying the temperature of coolant leaving the chiller at the SUPPLY port.

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



TEMPERATURE xxxC
This displays the temperature of coolant leaving the chiller at the SUPPLY port.

SET xxxC
This displays the setpoint for temperature control. The chiller's temperature controller causes the supply temperature to be equal to this temperature.

FLOW xxxG
This displays the flowrate at the RETURN port in gallons per minute.

RESIS xx.xM
This displays the DI resistivity.

RES SP xx.xM
This displays the DI resistivity setpoint.

PRESSURE xxx PSI
This displays the system back pressure.

HOURS xxxx
This displays the unit's hours of operation.

NO FAULT
This displays the fault status. If a fault is present, the display is listed from highest to lowest priority.

RTD1 FAIL
REV PHASE
PUMP OLOAD
LOW LEVEL
LOW FLOW
LOW RESIST
HI RESIST
LOW TEMP
HIGH TEMP
PWR FAULT

Figure 1 Operator's Loop

Setup Loop

The Setup Loop allows the operator to change the flow alarm setting, low and high temperature limits, and the resistivity alarm limits. Use this loop to determine if the unit will cutout or not with a fault condition.

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.

Adjust values with the UP and DOWN arrows. Press ENTER for the controller to accept each new entry.

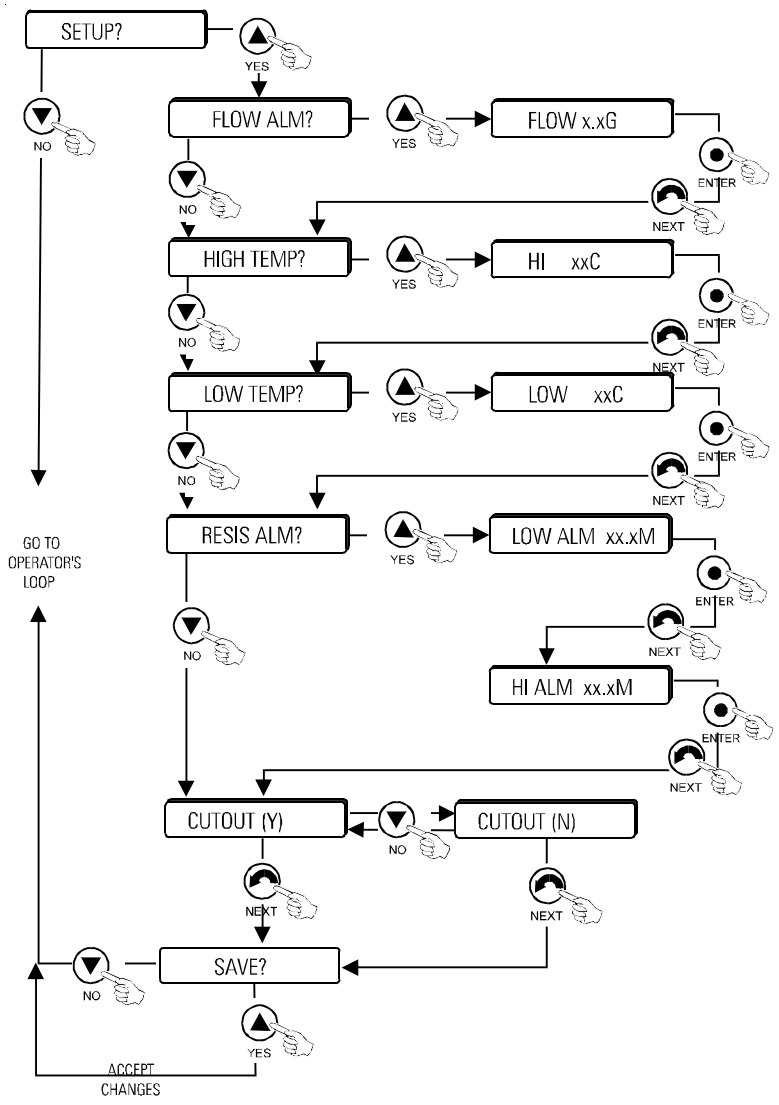


Figure 2 Setup Loop

NOTE: Should you desire to return to the temperature display and abort *all* changes, keep pressing the **NEXT** until the display reads **SAVE?** Press **NO.**

Section V Special Features

Emergency Motor Off (EMO)

When the EMO is depressed power is disconnected from the unit, with the exception of the control board. The EMO is also routed to 2RECP for connection to a remote EMO. In order for the unit's EMO to be effective, 2RECP should be connected in series with the remote EMO.

High Temperature Safeties

In the event of a high temperature fault, the POWER FAULT lamp will light and the unit will shut down. The cause of the fault must be identified and corrected before the unit can be restarted.

Low Liquid Level Safety

The low liquid level safety is connected to a float switch in the reservoir. A low liquid level fault occurs when the cooling fluid in the reservoir drops below the operating level.

In the event of a low liquid level fault, the amber LOW LEVEL lamp will light and the unit will shut down. The cause of the fault must be identified and corrected before the unit can be restarted.

Pump Motor Overload Protector

The unit has a pump motor overload protector. The overload protector prevents the pump motor from exposure to excessively high current. If an overload fault occurs, due, for example, to a heavy work load, the amber PUMP O-LOAD light will light and the unit will shut down. The overload protector will automatically reset after about two minutes. The unit must be manually restarted by pressing the reset on the controller.

Resistivity Monitor

The monitor is factory preset at 2.7 megohm-cm. See Controller IV Setup Loop for instructions on changing this value and setting low and high alarms.

NOTE: The controller IV RESISTIVITY MONITOR energizes a solenoid coil, allowing water to flow through the cartridges. The monitor has +0.20 megohm, -0.30 megohm hysteresis. When the resistivity drops to 0.30 megohms below the setpoint the solenoid is energized. It stays energized until the resistivity reaches 0.20 megohms above the setpoint.

Fault Response Modes

In the event of a low fluid level or high temperature fault, two modes of response to a fault are possible: SHUTOFF and ALARM ONLY.

In the SHUTOFF mode, if either fault occurs, the FAULT light will light and the unit will shut down.

In the ALARM ONLY mode the FAULT light will light, but the unit will continue to operate. This mode is available for users who prefer to accept the risk of damage to the System in order to continue to provide all available cooling fluid to thir application in the event of a failure.

The unit is shipped from the factory with the ALARM mode selected.

Section VI Maintenance

Service Contracts

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

Pump Strainer

A wire mesh pump strainer is located in the unit. If debris is drawn into the system, the strainer will prevent the material from being drawn into the pump and damaging the pump vanes.

After initial installation, the strainer may become clogged with debris and scale within the first week. Therefore, the strainer must be cleaned after the first week of installation. After this first cleaning, the frequency of cleaning depends on the purity of the cooling water. It is recommended that a visual inspection of the reservoir be made monthly after the initial cleaning. After several months, the cleaning frequency will be established.

If the strainer is visibly clogged, cleaning is required.

Disconnect the power cord from the power source and drain the reservoir before cleaning the strainer.

Remove the strainer by unscrewing it.

Clean the strainer by rinsing it with water.

Refer to Section III, Filling Requirements for instructions on replacing the cooling fluid.

Never operate the unit with the strainer removed.

Particulate Filter

To change the filter open the front access door. Turn the valve on the inlet (right) side of the filter perpendicular to the plumbing. Grip the cannister and turn counterclockwise. Replace the used filter.

Replace the cannister and hand tighten. Return valve to the original position.

Algae

To restrict the growth of algae in the reservoir, it is recommended that the reservoir fill plug be kept in place and that all circulation lines be opaque. This will eliminate the entrance of light which is required for the growth of most common algae.

We recommend the use of Chloramine-T, 1 gram per 3.8 liters.

Section VII Service

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

Pressure Relief Valve

A pressure relief valve is located on the pump discharge line. The relief valve establishes the maximum operating pressure of the unit. If the pressure of the fluid leaving the pump exceeds the valve setting, the relief valve will bypass the fluid within the unit to relieve the pressure. The relief valve does not determine the actual operating pressure; the actual operating pressure is determined by the flow control valve setting and pressure drop through the instrument being cooled.

The valve is factory preset at 135 psi. If adjustment is necessary, call our Customer Service Department (see Preface, After-sale Support).

Phase Rotation

Three phase units with three phase pump motors are equipped with a phase rotation interlock. The amber PHASE light on the controller will illuminate if there is an error.

This interlock prevents the unit from starting if the phase rotation is wrong. If the phasing is wrong, the PHASE light will light and the unit will not start.

Unplug the unit. Reverse any two power cord wires in the power cord plug.

Never remove the green ground wire.

Plug in the unit. The PHASE light should be off and the unit should start.

Displaying Software Version

To display the software version ensure the controller is in the Operator's Loop and displaying the reservoir fluid temperature. Depress and hold the enter key ( ). Press the YES NO YES keys and the display will indicate CALIBRATE? While continuing to hold the enter key press the YES NO YES keys again. The display will now indicate the software version, for example 000550.36h.

Section VIII Troubleshooting

Checklist

Unit does not start, FAULT light does not come on when START button is pushed.

- Check the position of the EMO.
- Check the voltage of the power source. Refer to the serial number on the rear of the unit for the specific electrical requirements of your unit. Make sure the voltage of the power source meets the specified voltage, ±10%.
- Check the fuses (see Section VII, Fuses).

When START switch is pushed, unit does not run, FAULT light comes on (SHUTOFF mode)

- Check the position of the EMO.
- Check fluid level in the reservoir. The low fluid level monitor prevents the unit from starting if the fluid level is below the safe operating level.
- Make sure the TEMPERATURE CONTROL setting is less than the HIGH TEMPERATURE LIMIT setting.

Unit runs, but FAULT light is on (ALARM ONLY mode)

- Check fluid level in the reservoir. The low fluid level monitor indicates a fault if the fluid level is below the safe operating level.
- Make sure the TEMPERATURE CONTROL settings are less than the HIGH TEMPERATURE LIMIT settings.

Unit continues to run for a short period and then stops

- Check fluid level in the reservoir. If low, check the system for leaks.
- Make sure the heat load is not greater than the cooling capacity (see Section II, Cooling Capacity).
- Make sure the cooling water supply meets the requirements outlined in Section III, Facility Water Requirements.
- Possible power interruption has occurred causing “latch” relay to unlatch. Attempt to restart.

COOL light always on, temperature is not dropping

- Make sure the heat load is not greater than the cooling capacity (see Section II, Specifications).
- Make sure the cooling water supply meets the requirements outlined in Section III, Facility Water Requirements.
- Clean the pump strainer.

Spare Parts List

Part #	Description
008700	VALVE, SOLENOID, 1.5” SLOW, 208VAC
008899	VALVE, CHECK, ½” SWT, BRZ, WTR
008995	TRANSDUCER, PRESSURE, 0-200 PSI
013057	CASTER, 3”, W/MOUNT BRAKE
013058	CASTER, 3”, W/BRAKE, W/MOUNTING PLATE
014744	VALVE, MTR, NC, 1” FPT, BRZ 6-9V
024677	FLOW TRANS, 1”, BRASS, 10-60 GPM
051737	COIL ASSY, OMKC1, 120VAC, HXII
052860	OUTLET, DEI FLOW METER
003282	VALVE RELIEF, 40-125 PSI, ¾” BR
009217	GAUGE, PRESSURE, 0-160 PSI, STEM
053937	TANK ASSY, SYS 5
003224	SCREEN, SUCTION, 20 MESH, 1¼”
008342	VALVE, CHECK, 1” FPT, BRZ, SWING, Y
008415	VALVE, RELIEF, 60-150 PSI
008899	VALVE, CHECK, ½” SWT, BRZ, WTR
009856	VALVE, CHECK, BRZ, 1.5”, SWING
014530	VALVE, 3WAY BALL, 1-1/2 FPT
024928	PUMP, TU RGTC9, 208/60, 200/50/3
000239	DIODE, BIPOLAR ARC SUP, 48VDC
000241	SWITCH, CONT BLOCK, 2NC, 800E
000410	LAMP, 24V POWER IND, 800E
000500	SENSOR, 3/16” X 6” X 10FT LD SHLD
000545	RELAY SOCKET, SCREW TERM G2R
000546	RELAY, SPDT, 24VDC, 21MA W/DIOD
000689	RECEPTACLE, 50A, PANEL INLET
000940	CONT, 3P+1NO, 24VAC, 20A, FUJI
001696	SWITCH, MUSHROOM, 2NC, P-P, RED, 800T
005599	SWITCH, FLOAT, HORIZ 5/8” SHIELD
005663	LAMP, PILOT, AMBER STD AB800E
005807	CKT BRKR, 30A RT 3P
005808	CKT BRKR, 20A RT 3P
006520	RELAY, BIMETAL O-LOAD, 10-16A
010187	PLUG, 250V, 15A, 3P, PANL, ML-3P
010188	RECPT, 250V, 15A, 3P, CORD, ML-3R
010855	FUSE, 1.0A, 250V, FNM, SLO, 35AI
010881	FUSE, 0.5A, 250V, FNM, SLO, 34AI
010882	FUSE, 2.0A, 250V, FNM SLO, 100AI
014517	TRANSFORMER, 208V, 24/24V, 8/158VA
014692	SWITCH, SELECT, 2POS, BLK, 800E
059909	KEYPAD ASSY, SYS4 D4
009242	VALVE, BALL, ½” FPT, SS BALL & STEM
006056	RELAY, DPDT, 24DC, 10A/240V, FLMT
009114	COIL, SOLV, 115VAC, MKC1, 26” CON

009013	VALVE, SOLENOID, W6P1, NC MKC-1
026521	PROBE, RESISTIVITY SS FTG
026714	CARTRIDGE, DEI, 14", ¼" NPT
009116	COIL, SOLV, 220VAC, MKC1, 26" JBOX
009725	VALVE, SOLENOID, ¼ FPT MKC1
013006	RUBBER BUMPER, .50 SQ X .25 H STICK
U00202	INSTRUCTION MANUAL
008634	FILTER, CARTRIDGE, 1", 40 MIC

Service Assistance

If, after following these troubleshooting steps, your units fails to operate properly, contact our Service Department for assistance (see Preface, After-sale Support). Before calling please obtain the following information:

Part number

Serial number

Voltage of unit

Voltage of power source

Technical Support

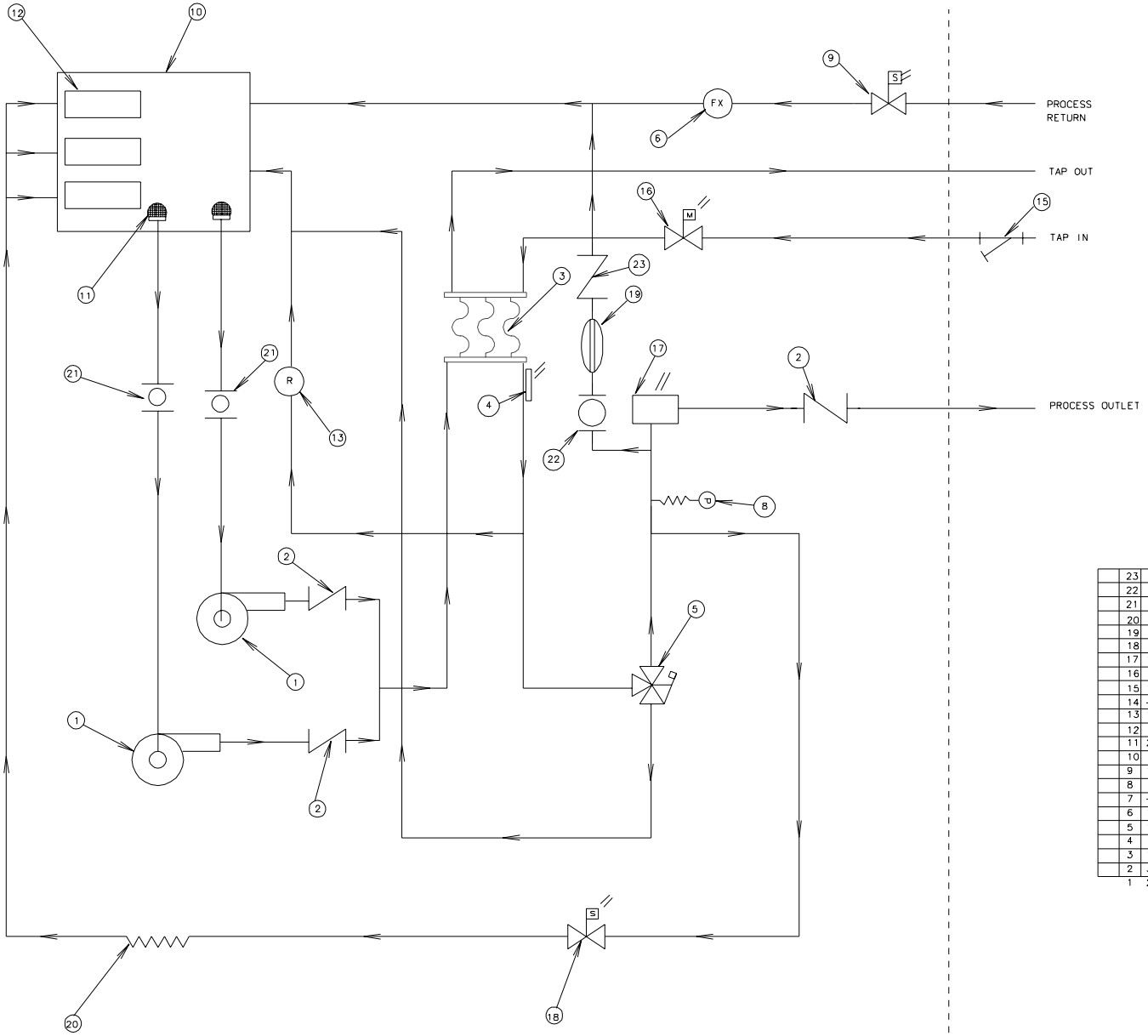
Our Service Department can provide you with a complete list of spare parts for your unit (see Preface, After-sale Support). Before calling, please obtain the following information:

Part number

Serial number

Pump Flow Diagram

	A	ADDED ITEMS 22&23. ITEM 4 WAS HTC 6 WAS FLOWMETER. MOVED 2,7,&8. ITEMS 2,7,&8 ARE MOVED. (PCO 6826)	2-11-97	JCH	AK	LTB
B3	B	CHANGED: SYM #19 P/L SPEC WAS 50 MICRONS. DELETED: SYM #7 (THERMOMETER) AND SYM #14 (HTC) WERE BETWEEN SYM #4 AND #5. ECO 14612	3-6-00	BAJ		



	23	1	FILTER CHECK VALVE		
	22	1	FILTER BALL VALVE		
	21	2	BALL VALVE		
	20	1	DEI CAP TUBE		
	19	1	FILTER		40 MICRON
	18	1	DEI SOLENOID VALVE		
	17	1	DEI SENSOR		
	16	1	MODULATING VALVE		
	15	1	BASKET STRAINER		
	14	–	DELETED		
	13	1	RELIEF VALVE		
	12	1	DEI CARTRIDGE		
	11	2	SUCTION SCREEN		
	10	1	TANK		
	9	1	SOLENOID VALVE		
	8	1	PRESSURE GAUGE		
	7	–	DELETED		
	6	1	FLOW TANSDUCER		1/8"MPT
	5	1	BALL VALVE, 3-WAY		
	4	1	HTC BULB		
	3	1	PLATE EXCHANGER		
	2	3	CHECK VALVE		
	1	2	PUMP		

J HOLWAY 1-14-97
K LILLY 1-14-97
BEDARD 1-14-97

AS SHOWN

FLOW DIAGRAM
SYSTEM V

C F00691 B

F00587 NTS 1 OF 1