

NESLAB System I Liquid to Liquid Heat Exchanger

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Instruction and Operation Manual



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Thermo
ELECTRON CORPORATION

System I Liquid to Liquid Heat Exchanger

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Preface

Compliance

Units 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 or the information in this manual, 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* refer to the name plate label on the rear of the case top to obtain the following information:

- BOM number _____

- Serial number _____

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, or does not operate properly, contact the transportation company and file a damage claim. Under ICC regulations, this is your responsibility.

Warranty

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

- Extend parts and labor coverage for an additional year.
- Worry-free operation.
- Control service costs.
- Eliminate the need to generate repair orders.
- No unexpected repair costs.

Other contract options are available. Please contact Thermo for more information.

NES-care Extended Warranty Contract

ThermoElectron Corporation is committed to customer service both during and after the sale. If you have questions concerning the operation of your unit or the information in this manual, 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* refer to the name plate label on the rear of the case top to obtain the following information:

- *BOM number* _____

- *Serial number* _____

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, contact our Sales Department (see After-sale Support).

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.

Always empty the reservoir before moving the unit.

Always turn off the unit and disconnect the line cord from the power source before moving the unit.

Never operate equipment with damaged line cords.



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. 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.

Section II General Information

Description

The NESLAB System I Liquid to Liquid Heat Exchanger uses building recirculating or tap water as the secondary cooling medium to remove heat from the cooling fluid in the closed recirculation loop.

The unit consists of a heat exchanger, recirculation pump, PVC reservoir, and an analog temperature controller.

Specifications

Temperature Range
Temperature Stability¹
Cooling Capacity^{1,2}

	+5°C to +35°C
	±1.0°C
Reservoir Volume	
<i>Gallons</i>	1.0
<i>Liters</i>	3.8
Unit Dimensions	
<i>(H x W x D)</i>	25½ x 14¼ x 20½
<i>Inches</i>	64.7 x 36.2 x 52.1
<i>Centimeters</i>	

1. Specifications listed are for a standard unit, operating at +20°C fluid temperature, with tap water as the cooling fluid.

2. Cooling capacity is based on a 10°C difference between the temperature of the cooling water supply (house water) and the cooling fluid as it leaves the System I (see Section III, Facility Water Requirements).

Section III Installation

Site

The unit should be placed in a location with easy access to a cooling water source and a drain. Never place the unit in a location where excessive heat, moisture, or corrosive materials are present.

Facility Water Requirements



Limit the facility water inlet pressure to a maximum of 150 psi. For proper stability and temperature control the differential pressure across the System I inlet and return/drain must not exceed 65 psid. For example, if the inlet pressure is 120 psi the return pressure must be at least 55 psid (120 - 65) for the system to work reliably.

Refer to the Cooling Capacity chart in Section II, Specifications. The flow rate of the cooling water supply must meet or exceed these requirements for the unit to operate at its full rated capacity. If the cooling water does not meet these standards, the cooling capacity will derate. The chart is based on a 10°C difference between the temperature of the cooling water supply (facility water) and the cooling fluid as it leaves the System I.

As the heat load increases, the required flow rate of the cooling water supply increases. For example, if the heat load is 12 kilowatts, only 4 gallons per minute at 12.5 psi is required to remove the heat. However, if the heat load is 16 kilowatts, about 5.5 gallons per minute at 21.5 psi is required.

Electrical Requirements

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

Ensure the voltage of the power source meets the specified voltage, $\pm 10\%$.



Make sure an adequate ground connection is provided.

Plumbing Requirements

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.

The plumbing connections are located on the rear of the unit and are labelled COOLING WATER and RECIRCULATING WATER. The top fittings are inlets and the bottom fittings are outlets. The COOLING WATER connections are $\frac{3}{4}$ inch FPT. The RECIRCULATING WATER connections are $\frac{1}{2}$ inch MPT.

Connect the COOLING WATER connections to the cooling water supply.

Connect the RECIRCULATING WATER connections to the instrument being cooled.

Flexible tubing, if used, should be of heavy wall or reinforced construction. All tubing should be rated to withstand 80 psi at +35°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 diameter 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.

Fluids



Never use flammable or corrosive fluids with this unit.

The selected fluid must have a viscosity of 50 centistokes or less at the lowest operating temperature.

Filtered tap water is the recommended fluid for normal operation.

Refer to the Water Quality and Recommendations on the next page.

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)

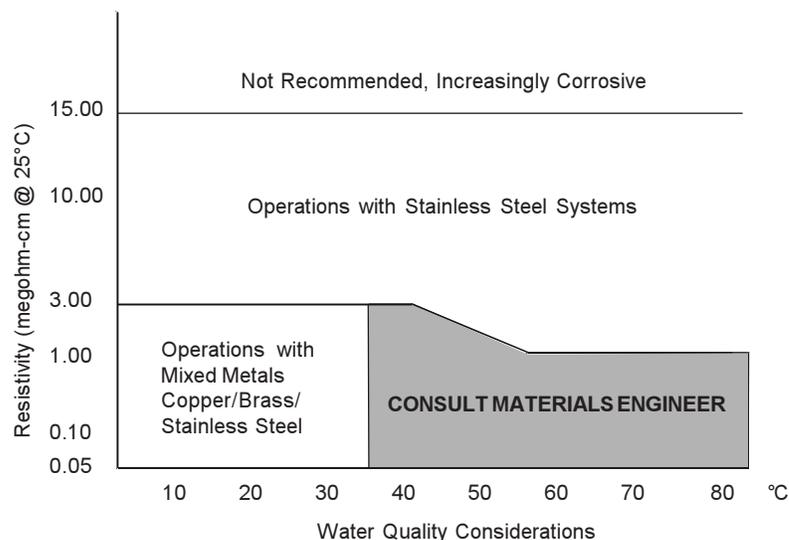
Unfavorably high total ionized solids (TIS) can accelerate the rate of galvanic corrosion. These contaminants can function as electrolytes which increase the potential for galvanic cell corrosion and lead to localized corrosion such as pitting. Eventually, the pitting could become so extensive that leaking 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: 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.



Filling Requirements

The reservoir access cover is located on top of the unit. Remove the reservoir access cover and locate the reservoir plug (square nut). Remove the plug and fill the reservoir to the bottom of the fill hole flange. Keep extra cooling fluid on hand until the entire system (the System I, the instrument being cooled and the tubing that connects them) is filled.

Do not replace the reservoir plug until the unit is circulating fluid through the instrument being cooled (see Section IV, Start Up).

Pump Purging

Units with PD-2 pumps may require pump purging. Refer to the identification label on the rear of the unit to identify the specific pump.

Pump purging is necessary to purge air trapped in the pump head cavity. When the unit is started, if there is no flow in the RECIRCULATING SUPPLY tube, or if the flow is restricted (see Section II, Pumps to review the pump flow and pressure specifications), purging is necessary.

Place a container under the SUPPLY connection. Start the unit. Loosen the hose clamp on the SUPPLY connection and partially remove the hose from the connection. **Do not completely remove the hose from the SUPPLY connection.** Allow the air to escape. After a few moments, cooling fluid should flow from the connection.

If fluid does not flow on its own accord, attach a short piece of tubing to the connection and apply suction to start flow.

Once flow is established, reconnect the tubing on the SUPPLY connection. The pump is now purged and the unit is ready for operation.

Section IV Operation

Start Up

Before starting the unit, check all electrical and plumbing connections and make sure the circulating system has been properly filled with cooling fluid.

To start the unit, place the POWER ON/OFF switch in the ON position and momentarily press and hold the PUSH TO START button. The recirculation pump will start.

If the unit does not continue to run when the PUSH TO START button is released, check the reservoir fluid level. The float switch in the reservoir prevents the unit from operating if the fluid level is below the operating level. If the fluid level is low, “top off” the reservoir and restart the unit.

Once the System I continues to circulate cooling fluid through the instrument being cooled, replace the reservoir plug. Tighten the plug “hand tight”; excessive pressure can damage the PVC reservoir.

Temperature Adjustment

A control valve, located in the COOLING WATER INLET 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 is discontinued when the unit is shut off.

To adjust the temperature of the cooling fluid, turn the calibrated TEMPERATURE dial and position the desired temperature as close as possible to the reference line.

The RECIRCULATING TEMPERATURE gauge on the front of the unit indicates the temperature of the fluid in the reservoir.

The temperature controller opens and closes the control valve in the COOLING WATER INLET to maintain the desired temperature. The green and amber lights on the control panel indicate the status of the valve. When the green light is on, the valve is open and heat is being removed from the cooling fluid. When the amber light is on, no cooling is occurring.

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.

When tap water is used as a cooling water source, a slight “bucking” may occur as the valve opens and closes. The amount of “bucking” depends on the pressure differential between the COOLING WATER INLET and the COOLING WATER OUTLET/DRAIN. By lowering the pressure differential to 12 psi, the amount of “bucking” can be minimized. The “bucking” is not harmful to the System I.

Section V Special Features

Low Fluid Level Monitor

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

In the event of a low fluid level fault, the unit will shut down, the red HIGH TEMP/LOW LEVEL lamp will light, and the EXTERNAL INTERLOCK contacts will open. The cause of the fault must be identified and corrected before the unit can be restarted.

High Temperature Monitor

The high temperature monitor (HTC) is connected to a sensor that monitors the cooling fluid temperature as it exits the heat exchanger. The monitor protects the system from exposure to excessively hot cooling fluid. A temperature fault occurs when the cooling fluid temperature exceeds the set temperature limit.

In the event of a high temperature fault, the unit will shut down, the red HIGH TEMP/LOW LEVEL lamp will light, and the EXTERNAL INTERLOCK contacts will open. The cause of the fault must be identified and corrected before the unit can be restarted.

The monitor is located on the rear of the unit. It is factory preset at 38°C (100°F).



The maximum setting should not exceed +60°C (140°F).

A slotted adjustment screw is located in the center of the monitor. A temperature range scale is located next to the adjustment screw. The temperature scale is in °F, a temperature conversion chart is located on the monitor's cover.

To adjust the monitor, turn the adjustment screw until the pointer on the temperature scale corresponds to the desired limit. A temperature limit 5°F higher than the operating temperature is recommended.

EXTERNAL INTERLOCK Contacts

A set of relay contacts is connected to a receptacle on the front panel labelled EXTERNAL INTERLOCK. The contacts are rated for 15A/250V. This is not a power inlet or outlet. The receptacle is isolated from the circuitry. Its ground pin is connected to the chassis. The contacts are normally open: they are closed during normal operation and open when the unit is turned off or when a fault occurs.

Section VI Maintenance and Service



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).

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).

Cleaning

Periodically inspect the reservoir. If cleaning is necessary, flush the reservoir with a cleaning fluid compatible with the circulating system and the cooling fluid.

Algae

To restrict the growth of algae in the reservoir, it is recommended that the reservoir cover 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.

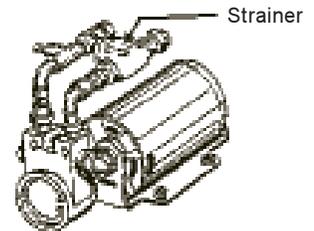
Pump Strainer

A wire mesh screen (under hex nut) is located in the pump suction line. If debris is drawn into the system, the strainer will prevent the material from being sucked into the pump and damaging the pump vanes.

After initial installation, the strainer may become clogged with debris and scale. Therefore, the strainer must be cleaned after the first week of installation. After this first cleaning, a monthly visual inspection is recommended. After several months, the cleaning frequency will be established. Before cleaning the strainer, disconnect the line cord from the power source and drain the reservoir.

PD-2 pumps have a wire mesh screen located under the large hex nut on the pump suction line.

Remove the appropriate nut. Remove the strainer from the unit and rinse it with water. When the screen is clean, replace it in the strainer cavity, tighten the hex nut and replace the panel. Refer to Section III, Filling Requirements for instructions on replacing the cooling fluid.



Pressure Relief Valve Adjustment

The adjustable pressure 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 operating pressure of the system is determined by the back pressure of the connected equipment and the setting of the flow control.

If adjustment is necessary, contact our Service Department.

For applications requiring maximum pressure less than 55 psi, an External Pressure Reducer (EPR) is available. An EPR allows an operating pressure of 10 to 50 psi. Contact our Sales Department for more information (see Preface, After-sale Support). Before calling please obtain the following information:

BOM number

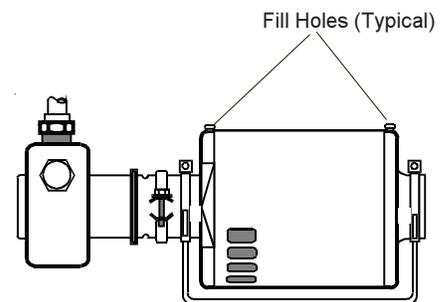
Serial number

Pump Motor Lubrication

Some units with PD pumps may require pump motor lubrication. Refer to the name plate label on the rear of the unit for the specific pump in your unit.

Motors used to drive the pump are manufactured by several companies.

These motors use sleeve type bearings with large oil reservoirs. Oiling instructions are generally posted on each motor. In the absence of legible lubrication instructions, add approximately 30 to 35 drops of SAE 20 (142 CS viscosity) non-detergent oil (i.e. 3-IN-ONE® Tool Oil) to each bearing on the following schedule:



Duty Cycle	Oiling Frequency
Continuous	Yearly
Intermittent	Every 2 years
Occasional	Every 5 years

Section VII Troubleshooting

Checklist

Unit will not run (POWER ON/OFF switch is in ON position, HIGH TEMP/LOW LEVEL light is not lit).

Make sure the voltage of the power source meets the specified voltage, $\pm 10\%$. Refer to the serial number on the rear of the unit for the specific electrical requirements of your unit.

Unit runs when PUSH TO START button is pressed, but stops when button is released.

Press and hold PUSH TO START button for longer period of time.

Check for proper reservoir level. The float switch in the reservoir prevents the unit from operating if the fluid level in the reservoir is below the operating level. If the fluid level is low, "top off" the reservoir and restart the unit.

Make sure the high temperature monitor is set higher than the temperature of the cooling fluid.

Unit runs for a short period, then stops (HIGH TEMP/LOW LEVEL light is lit).

Check the fluid level in the reservoir. If it is low, check the system for leaks.

Make sure the TEMPERATURE dial is set for a temperature lower than the high temperature limit setting (see Section V, High Temperature Monitor).

Make sure the heat load is not greater than the cooling capacity of the unit (see Section II, Cooling Capacity).

Make sure the cooling water supply meets the requirements outlined in Section III, Facility Water Requirements.

A possible power interruption has occurred, causing the "latch" relay to unlatch. Attempt to restart.

Service Assistance

If, after following these troubleshooting steps, your unit 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

Temperature at which the problem occurs

Temperature, pressure, and flow rate of cooling water supply

Technical Support

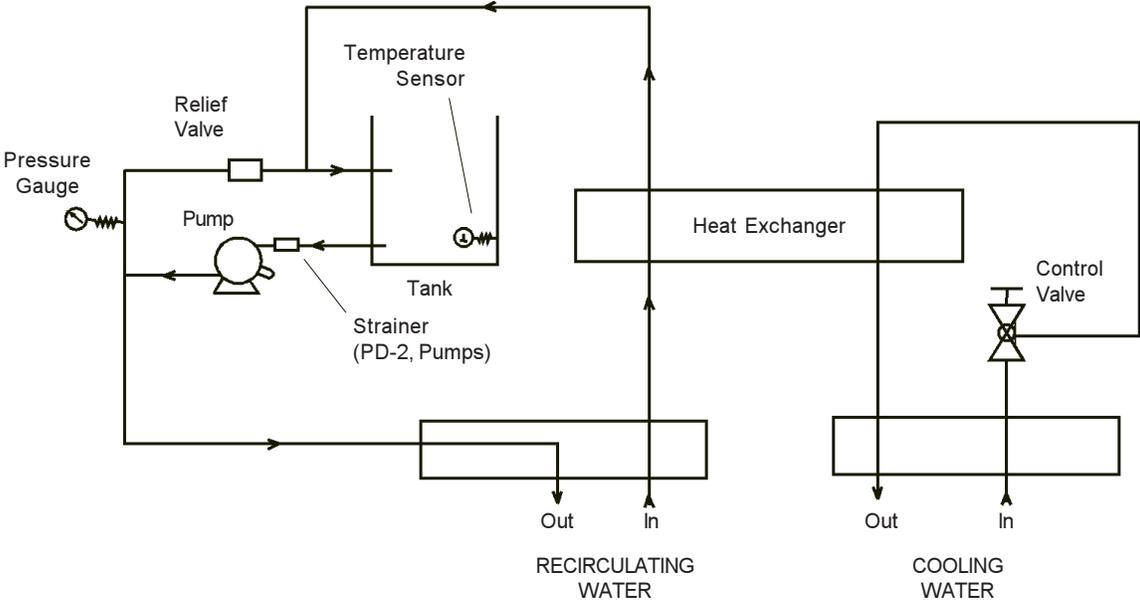
Our Service Department can provide you with a wiring diagram and a complete list of spare parts for your unit (see Preface, After-sale Support). Before calling, *please* obtain the following information:

Part number

Serial number

Section VIII Diagrams

Flow Diagram



WARRANTY

Thermo Electron Corporation warrants for 12 months from date of shipment any Thermo unit according to the following terms.

Any part of the unit manufactured or supplied by Thermo and found in the reasonable judgment of Thermo to be defective in material or workmanship will be repaired at an authorized Thermo Repair Depot without charge for parts or labor. The unit, including any defective part must be returned to an authorized Thermo Repair Depot within the warranty period. The expense of returning the unit to the authorized Thermo Repair Depot for warranty service will be paid for by the buyer. Thermo's responsibility in respect to warranty claims is limited to performing the required repairs or replacements, and no claim of breach of warranty shall be cause for cancellation or rescission of the contract of sales of any unit. With respect to units that qualify for field service repairs, Thermo's responsibility is limited to the component parts necessary for the repair and the labor that is required on site to perform the repair. Any travel labor or mileage charges are the financial responsibility of the buyer.

The buyer shall be responsible for any evaluation or warranty service call (including labor charges) if no defects are found with the Thermo product.

This warranty does not cover any unit that has been subject to misuse, neglect, or accident. This warranty does not apply to any damage to the unit that is the result of improper installation or maintenance, or to any unit that has been operated or maintained in any way contrary to the operating or maintenance instructions specified in Thermo's Instruction and Operation Manual. This warranty does not cover any unit that has been altered or modified so as to change its intended use.

In addition, this warranty does not extend to repairs made by the use of parts, accessories, or fluids which are either incompatible with the unit or adversely affect its operation, performance, or durability.

Thermo reserves the right to change or improve the design of any unit without assuming any obligation to modify any unit previously manufactured.

THE FOREGOING EXPRESS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Thermo's OBLIGATION UNDER THIS WARRANTY IS STRICTLY AND EXCLUSIVELY LIMITED TO THE REPAIR OR REPLACEMENT OF DEFECTIVE COMPONENT PARTS AND Thermo DOES NOT ASSUME OR AUTHORIZE ANYONE TO ASSUME FOR IT ANY OTHER OBLIGATION.

Thermo ASSUMES NO RESPONSIBILITY FOR INCIDENTAL, CONSEQUENTIAL, OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED TO LOSS OR DAMAGE TO PROPERTY, LOSS OF PROFITS OR REVENUE, LOSS OF THE UNIT, LOSS OF TIME, OR INCONVENIENCE.

This warranty applies to units sold in the United States. Any units sold elsewhere are warranted by the affiliated marketing company of Thermo. This warranty and all matters arising pursuant to it shall be governed by the law of the State of New Hampshire, United States. All legal actions brought in relation hereto shall be filed in the appropriate state or federal courts in New Hampshire, unless waived by Thermo.