Thermo Scientific NESLAB System III

Heat Exchanger

Thermo Scientific Manual P/N U00678 Rev. 12/07/06

Installation
Operation
Basic Maintenance

Visit our Web site at:

http://www.thermofisher.com/tc

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System III Liquid to Liquid Heat Exchanger Instruction and Operation Manual

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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 Mark on the rear of the unit. The testing has demonstrated compliance with the following directives:

LVD, 73/23/EEC	Complies with IEC/EN61010-1
EMC, 89/336/EEC	IEC/EN61326-1

For any additional information, refer to the Declaration of Conformity that shipped with the unit.

WEEE/RoHS

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Fisher Scientific's compliance with these Directives, the recyclers in your country, and information on Thermo Scientific products which may assist the detection of substances subject to the RoHS Directive are available at:

www.thermo.com/WEEERoHS

After-sale Support

Thermo Fisher Scientific 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, contact our Customer Service Department. Before calling, *please* obtain the following information:

- *BOM number*
- *Serial number*
- *Software version*

The BOM and serial number are on a label on the rear of the unit. To display the software version see page 17.

Unpacking

Retain all cartons and packing material until the unit has been 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.

Out of Box Failure

An out of box failure is defined as any product that fails to operate in conformance with the seller's published specifications at initial power up. The unit must be installed in accordance with manufacturer's recommended operating conditions within 30 days of shipment from the seller.

Any product meeting the definition of an out of box failure must be packed and shipped back in the original packaging to Thermo Fisher Scientific for replacement with a new unit. The seller pays all shipping costs. The customer must obtain a Return Material Authorization (RMA) from Thermo Fisher prior to shipping the unit.

Warranty

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

Feedback

We appreciate any feedback you can give us on this manual. Please e-mail us at neslabmanuals@thermofisher.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.

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.

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.

Never operate without fluid.

Refer service and repairs to a qualified technician.

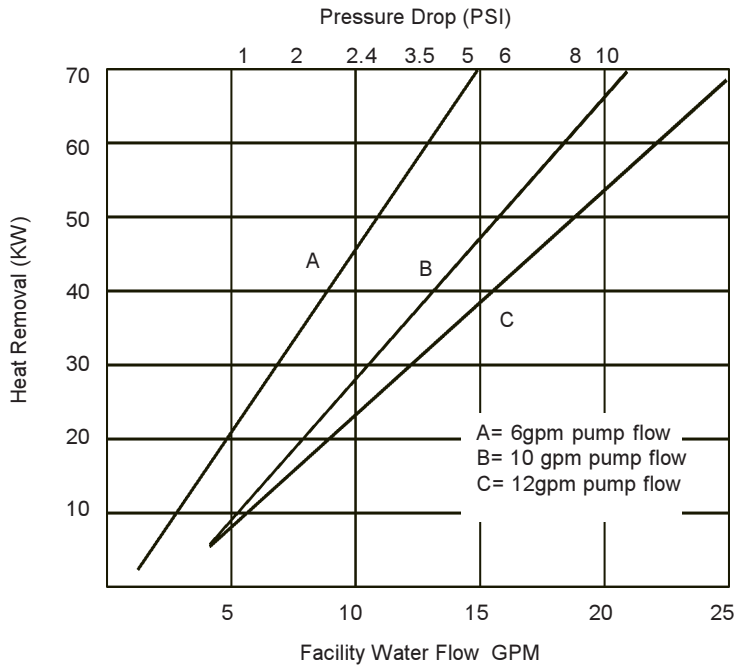
In addition to the safety warnings listed above, warnings are posted throughout the manual. These warnings are designated by an exclamation mark inside an equilateral triangle with text highlighted in bold print. Read and follow these important instructions. Failure to observe these instructions can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

Section II General Information

Description

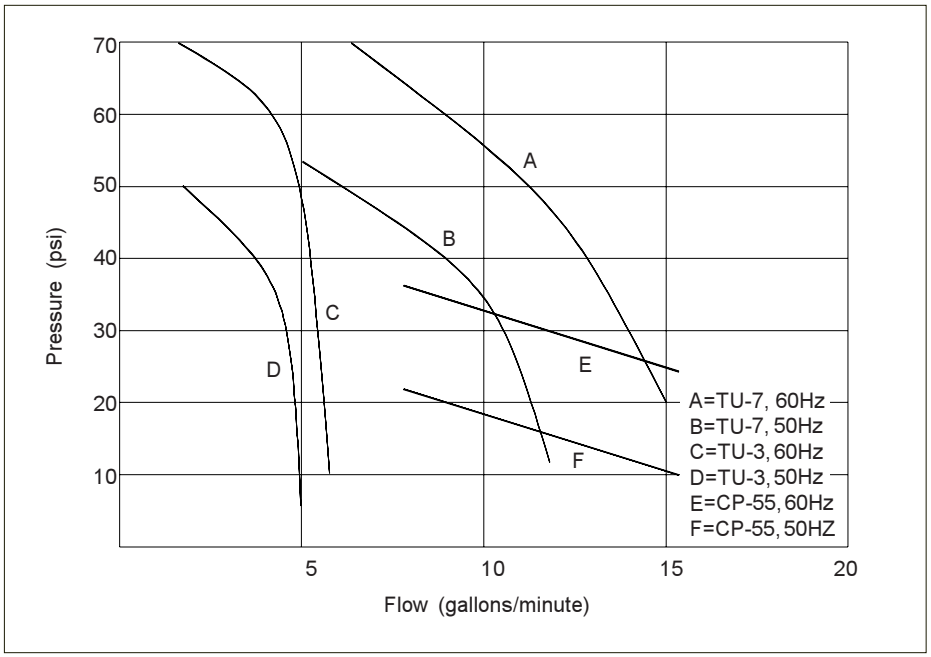
The NESLAB System III Liquid to Liquid Heat Exchanger is designed to remove heat from water-cooled instruments. The unit consists of a heat exchanger, recirculation pump, PVC reservoir, and a microprocessor controller.

Specifications

Temperature Range	+5°C to +40°C
Temperature Stability	±1.0°C
Cooling Capacity[1]	
Reservoir Volume[2] *Gallons* *Liters*	1.25 4.7
Dimensions[3] *(H x W x D)* *Inches* *Centimeters*	20¾ x 17⅜ x 27 52.7 x 44.1 x 68.6
Shipping Weight[4] *Pounds* *Kilograms*	206 93.4

1. Cooling capacity is based in a 10°C difference between the temperature of the cooling water supply and the cooling fluid flowing from the System III to the instrument being cooled (see Section III, Facility Water Requirements). Pressure drop obtained with the System III modulating valve fully open.
2. Larger volume reservoir units are available.
3. Units with CP-55 and TU-3 pumps. Other larger volume units measure 33¾ x 23 x 27¼ (85.7 x 58.4 x 69.2). For complete dimensions see pages 22-23.
4. Approximate. Larger volume units weigh approximately 355 pounds (161 kilograms).

Pump Capacity[5,6]



5.TU-7, TU-8, and TU-9 pumps require 3Ø power.
6.TU-5 pumps are rated 9 gpm @ 50 psi, TU-6 pumps are 12 gpm @ 50 psi, TU-8 pumps are 20 gpm @ 50 psi, and TU-9 pumps 23 gpm @ 50 psi.

Section III Installation

Site

The unit should be located in a laboratory or clean industrial environment with easy access to a facility cooling water supply and a drain. Never place the unit in a location where excessive heat, moisture, or corrosive materials are present.

Refer to the pump label on the rear of the unit to identify the specific type of pump in your unit. Units with a TU-7, TU-8 or TU-9 pump are equipped with a pump motor fan. The fan is used to cool the pump motor and prevent the motor from overheating. Air is drawn through the front of the unit and is discharged through the rear of the unit. A minimum clearance of 6 inches (0.15 meters) at the front and rear of the unit is necessary for ventilation.

Facility Water Requirements

Limit the facility water inlet pressure to less than 150 psi (10,2 Bar) and limit the facility water inlet pressure to outlet pressure differential across the System III to less than 35 psid (2,4 Bar).

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 be derated. The chart is based on a difference between the temperature of the cooling water supply (House Water) and the cooling fluid flowing from the System III to the instrument being cooled.

As the heat load increases, the required flow rate of the cooling water supply increases. For example, on a System III with a 6 gpm pump flow, if the heat load is 12 kilowatts, approximately 3 gpm of cooling water flow is required to remove the heat. However, if the heat load is increased to 36 kilowatts, about 8 gpm of cooling water flow is required.

The flow meter on the front of the unit does not measure the flow rate of the cooling water supply. The flow meter measures the flow rate of the cooling fluid returning to the instrument being cooled.

Electrical Requirements

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.

Refer to the serial number label 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, ±10%.

Voltage Selection

If the unit is to be operated from a 220 to 240V source, a voltage range selector switch inside the unit must be reset. See Maintenance and Service section for instructions on changing the voltage selector.

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 FACILITY WATER and RECIRCULATING CLEAN FLUID. The top fittings are outlets and the bottom fittings are inlets.

These connections are 1 inch FPT.

A basket strainer is supplied with the unit to protect the heat exchanger from becoming clogged by dirty cooling water. Install this strainer on the FACILITY WATER inlet. A clogged strainer can adversely affect cooling capacity. See Section V, Facility Water Strainer for cleaning instructions.

Connect the FACILITY WATER connections to the cooling water supply and the drain.Connect the RECIRCULATING CLEAN FLUID 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 +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 the loss of cooling capacity.

Tubing and insulation are available from Thermo Fisher. 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.

Fluids

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

We recommend using distilled/deionized water with a 0.05 to 0.1 MOhmcm reading.

Highly distilled/deionized water, above the 3 MOhmcm region, may become aggressive and is not recommended for use with units with wetted parts other than stainless steel. Distilled/deionized water in the 15 MOhmcm region is definitely aggressive and should not be used. Units operating in these regions should be closely monitored. See Water Quality Standards and Recommendations in the Appendix.

If you do not have access to distilled/deionized water we recommend using filtered tap water. Thermo Fisher cannot recommend any custom fluids, these fluids are too dependent on your particular application.

Below +8°C, a non-freezing solution is required. The selected cooling fluid must have a viscosity of 50 centistokes or less. A 50/50 mixture, by volume, of distilled/deionized water and laboratory grade ethylene glycol is suggested.

Filling Requirements

Remove the reservoir cover. Fill the reservoir with clean cooling fluid to within 1 inch of the top of the reservoir. Have extra cooling fluid on hand and follow the steps described in Section IV, Start Up.

Automatic Refill Device (Optional)

The automatic refill device maintains the correct level of cooling fluid in the reservoir. The device consists of a float switch in the reservoir and a solenoid valve at the rear of the unit. If the cooling fluid level falls, the float switch will drop, opening the solenoid valve and allowing make-up fluid to fill the reservoir. Once the cooling fluid reaches the proper level, the float switch will rise and the solenoid valve will close.

NOTE: For the solenoid valve to close properly, the minimum supply flow rate should be 2.2 gallons per minute.

Connect the $^{3}/_{8}$ inch OD stainless steel barbed fitting on the solenoid valve to the make-up fluid source using $^{5}/_{16}$ or $^{3}/_{8}$ inch ID flexible tubing.

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

Flow Control

The RECIRCULATING FLOW CONTROL handle is connected to a three-way valve that controls the flow of the cooling fluid to the instrument being cooled. The handle is located on the front of the unit.

When the handle is in the “+” position, the valve is open and all available cooling fluid is supplied to the instrument being cooled. When the handle is in the “0” position, the valve is closed and no cooling fluid is supplied to the instrument being cooled. When the handle is between these two positions, the flow rate of the cooling fluid is between full flow and no flow. Use the flow meter to adjust the desired flow rate.

The gauge next to the flow control handle indicates the operating pressure.

Auto Restart

Units are equipped with an auto restart feature. If power is lost, the unit will automatically restart when power is restored. This feature is enabled/disabled using the controller's Setup Loop, see page 14.

Section IV Operation

Start Up

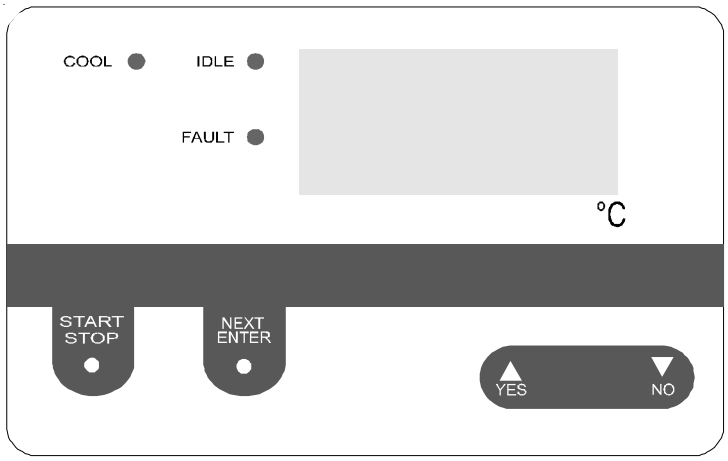
Before starting the unit, double check all electrical and plumbing connections and make sure the circulating system (the System III, your application, and the tubing that connects them) has been properly filled with cooling fluid.

Turn the RECIRCULATING FLOW CONTROL to "0". Press START/STOP. The pump starts and the controller displays the reservoir fluid temperature.

The low fluid level monitor in the reservoir prevents the unit from operating if the fluid level in the reservoir is below the safe operating level. By slightly, and/or intermittently opening the RECIRCULATING FLOW CONTROL (toward "+") and using extra cooling fluid to keep the reservoir 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 it. When the system is full, the reservoir level will no longer drop when the RECIRCULATING FLOW CONTROL valve is opened (toward "+").

A control valve, located in the FACILITY 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 stops automatically when the unit is shut off.



Temperature Controller

To turn the unit off, press START/STOP. The recirculation pump will stop.

The IDLE and COOL lights indicate the control valve's 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 IDLE light is on. As the control valve moves between these extremes, the two lights flash with varying on-time to indicate the approximate position of the control valve.

Temperature Controller

The microprocessor controller controls temperature using a PID (Proportional-Integral- Derivative) algorithm. It is designed with self-diagnostic features and easy to use operator interface.

NEXT ENTER
Use this key to accept and save changes.

YES, ▲
This key is used to increase numerical values.

NO, ▼
This key is used to decrease numerical values.

When the controller is powered it displays the reservoir fluid temperature. Press the **NEXT ENTER** key to view the setpoint. The display flashes between **SP** and the actual setpoint number. If desired, use the **YES** and **NO** keys to change the setpoint. The display flashes as soon as either key is depressed. Once the desired setpoint is displayed, press **NEXT ENTER**.

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 temperature control system actuates a control valve in the FACILITY WATER line. The control valve adjusts the flow of the cooling water supply to produce the desired operating temperature.

NOTE: The controller does not use the new value until the **NEXT ENTER** key is depressed and the display stops flashing. The controller will not allow you to enter a value above the maximum or below the minimum value, or any illegal value. If you try to enter an illegal value the display will revert to its original value when the last digit was entered.

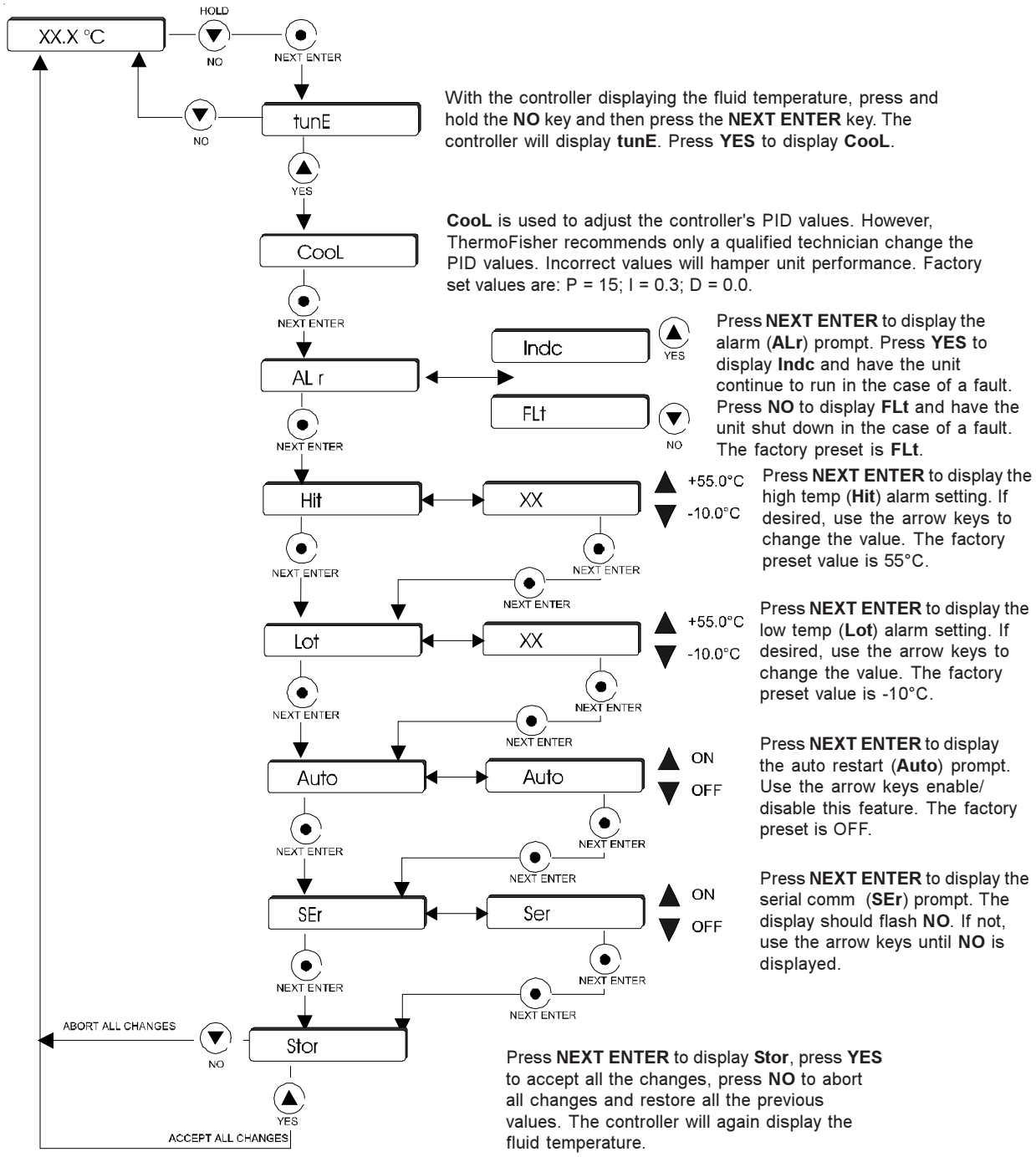
If the **NEXT ENTER** key is not depressed within one minute, the controller will time out and the new value will not be accepted. The controller will revert to the previous value.

NOTE: Error codes are addressed in Section V, Maintenance and Service.

SetupLoop

The controller is used to tune the COOL PID values; configure the unit to continue to run (Indc) or shut down (FLt) in the event of a fault; set the high (Hit) and low (Lot) temperature limits; and enable/disable auto restart (Auto). If a temperature limit is exceeded the controller will display an error code, see Section VI.

NOTE: Serial Communication (SEr) is not operational. Ensure the display indicates OFF.



With the controller displaying the fluid temperature, press and hold the **NO** key and then press the **NEXT ENTER** key. The controller will display **tunE**. Press **YES** to display **CooL**.

CooL is used to adjust the controller's PID values. However, ThermoFisher recommends only a qualified technician change the PID values. Incorrect values will hamper unit performance. Factory set values are: P = 15; I = 0.3; D = 0.0.

Press **NEXT ENTER** to display the alarm (**ALr**) prompt. Press **YES** to display **Indc** and have the unit continue to run in the case of a fault. Press **NO** to display **FLt** and have the unit shut down in the case of a fault. The factory preset is **FLt**.

Press **NEXT ENTER** to display the high temp (**Hit**) alarm setting. If desired, use the arrow keys to change the value. The factory preset value is 55°C.

Press **NEXT ENTER** to display the low temp (**Lot**) alarm setting. If desired, use the arrow keys to change the value. The factory preset value is -10°C.

Press **NEXT ENTER** to display the auto restart (**Auto**) prompt. Use the arrow keys enable/ disable this feature. The factory preset is OFF.

Press **NEXT ENTER** to display the serial comm (**SEr**) prompt. The display should flash **NO**. If not, use the arrow keys until **NO** is displayed.

Press **NEXT ENTER** to display **Stor**, press **YES** to accept all the changes, press **NO** to abort all changes and restore all the previous values. The controller will again display the fluid temperature.

Setup Loop

Section V Maintenance & 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).

Service Contracts

Thermo Fisher Scientific 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

Units with TU pumps have a wire mesh pump strainer is located at the bottom of the reservoir. If debris is drawn into the reservoir, 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 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. We recommend a visual inspection of the reservoir be made monthly after the initial cleaning. After several months, the frequency of cleaning 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.

Cover the strainer with a plastic bag to help trap any particles which may become dislodged, and then 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.

Facility Water Strainer

The facility water strainer is the user-installed basket strainer on the FACILITY WATER inlet. **NOTE:** The strainer is designed to be used only with water. Clean the strainer when it becomes visibly clogged or dirty.

Disconnect the power cord from the power source and turn off the facility cooling water.

Place a container under the strainer to collect any water that spills out of the basket when it is removed.

Unscrew the clear plastic basket. Remove the screen and rinse it with water. Replace the screen and the basket.

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 3.7 liters.

Configuration

The unit top is secured to the cabinet by four ball stud retainers; one at each corner. Remove cabinet top by prying upward gently (cover pops off) in order to perform the following adjustments.

In some cases, the side access panels may need to be removed. The access panels are secured using screws installed through the bottom of the cabinet. **NOTE**: Some models have a one piece cover rather than separate top and side panels. This type of cover is secured by five screws on each side of the case.

Voltage Selection

Remove the top cover from the cabinet.

The VOLTAGE SELECT toggle switch is located on the right side of the control box. Two ranges are available: 200-208V and 220-240V. Set the switch for the appropriate range.

Replace the top cover.

Pressure Relief Valve

Units with TU pumps have 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 to 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.

If adjustment is necessary, consult our Service Department for assistance (see Preface, After-sale Support).

Fault Interlock Contact

A set of contacts is connected to a receptacle on the control panel. The contacts are rated 10A/240V. 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 closed during normal operation and open when the unit is turned off or when a fault is detected.

Fuses

Three-phase units have fuses. Refer to the serial number label on the rear of the unit for the specific electrical requirements of your unit.

Remove the top cover, the right access panel and the control box cover. The fuses are located inside the control box.

Phase Rotation

Three phase units with three phase pump motors are equipped with a phase rotation interlock. If the phasing is wrong, the controller will display **PHEr** 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 **PHEr** display should be off and the unit should start.

Pump Motor Overload Protector

Three phase units with three phase pump motors have 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 controller will display **OL** and the unit will shut down. The overload protector will automatically reset after about two minutes. The unit must be manually restarted.

Displaying Software Version

This procedure will display the software version number on the unit's display. In the event the unit is not operational, the software version (and the checksum) can also be read from the label which is on the microprocessor chip itself.

The following chart uses an example of software version 000507.84A

begin at the reservoir temperature display	**20.3**°C
Press and hold NO for at least 10 seconds.	**0507**
displays software version digits to **left** of decimal. Note the two leading zeros do not display.	
Press NEXT	**84**
displays software version digits to **right** of decimal.	
Press NEXT	**1**
displays software version revision letter (as its equivalent number - display cannot show letters. A=1, B=2, etc.)	
Press NEXT	**0000**
displays checksum - this can be disregarded	
Press NEXT	**20.3**°C
returns to reservoir temperature display	

Section VI Troubleshooting

Error Codes

The controller also has the capability to display error codes.

Power up Errors

Power up errors are displays until any controller key is pressed. If the error message persists the problem is likely a keypad or controller board failure.

Display	Indication
Er 00	ROM checksum
Er 01	RAM check
Er 02	Keypad failure
Er 03	NOVRAM checksum error

Operating Errors

Operating errors are displays once and then clear after three seconds or when any controller key is pressed. If error messages Er04 - Er14 persist, the problem is likely controller board failure. If Er15 is displayed, ensure serial communications is turned off in the Setup Loop. If Er16 is displayed the unit needs calibration, contact Thermo Scientific for assistance.

Display	Indication
Er 04 - 13	Interrupt error
Er 14	Synchronous error
Er 15	Asynchronous error
Er 16	Bad calibration

Latching Errors

In order to restart the unit when a latching error is displayed, the controller's START/STOP button must be pressed after the condition is cleared.

Display	Indication
Lo t	Fluid temperature lower than low temp alarm setting.
Hi t	Fluid temperature higher than high temp alarm setting.
Er 22	Fluid temperature higher than the high overrange point. This is a fixed value, factory set at 55°C.
Er 25	RDT1 input shorted.
Er 26	RTD1 input open.
LLF	Low level fault switch open for at least three seconds.
PHEr	Improper phasing.
OL	Pump motor overload.

If any other code appears contact Thermo Fisher customer service, see Preface.

Poor Temperature Stability

The System III is designed to maximize heat removal with minimal facility cooling water requirements. Under conditions of excessive cooling capacity, instability may result. The condition may be aggravated by :
High temperature setpoint

Low facility water temperature

Small heat load

High facility water pressure

The situation can be remedied by limiting the available facility cooling water. Facility water pressure can be reduced with a pressure regulator before the System III. However, excessive restriction of facility water will reduce the System III's capacity.

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:

BOM 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

Software Version

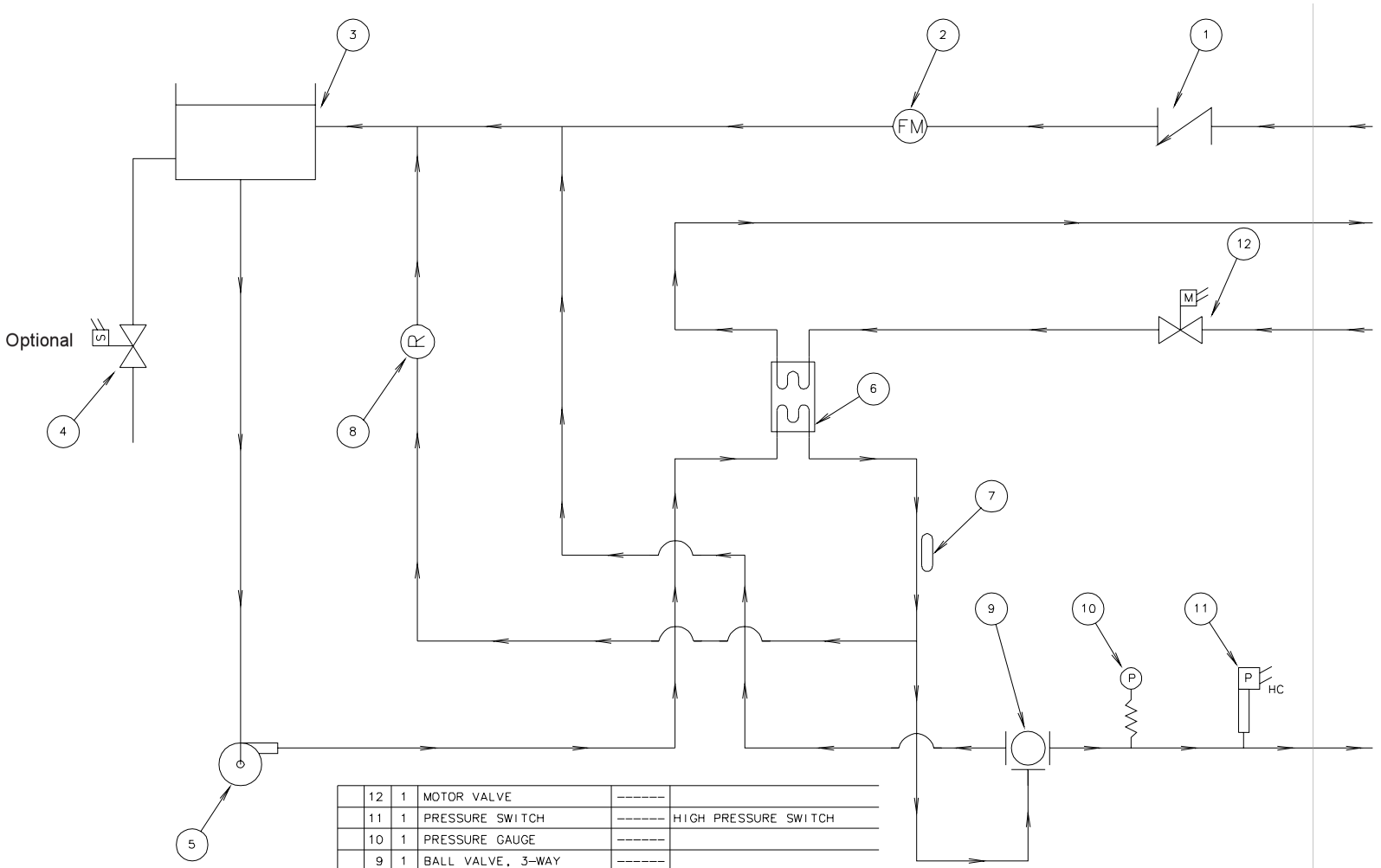
Parts List

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:

BOM number

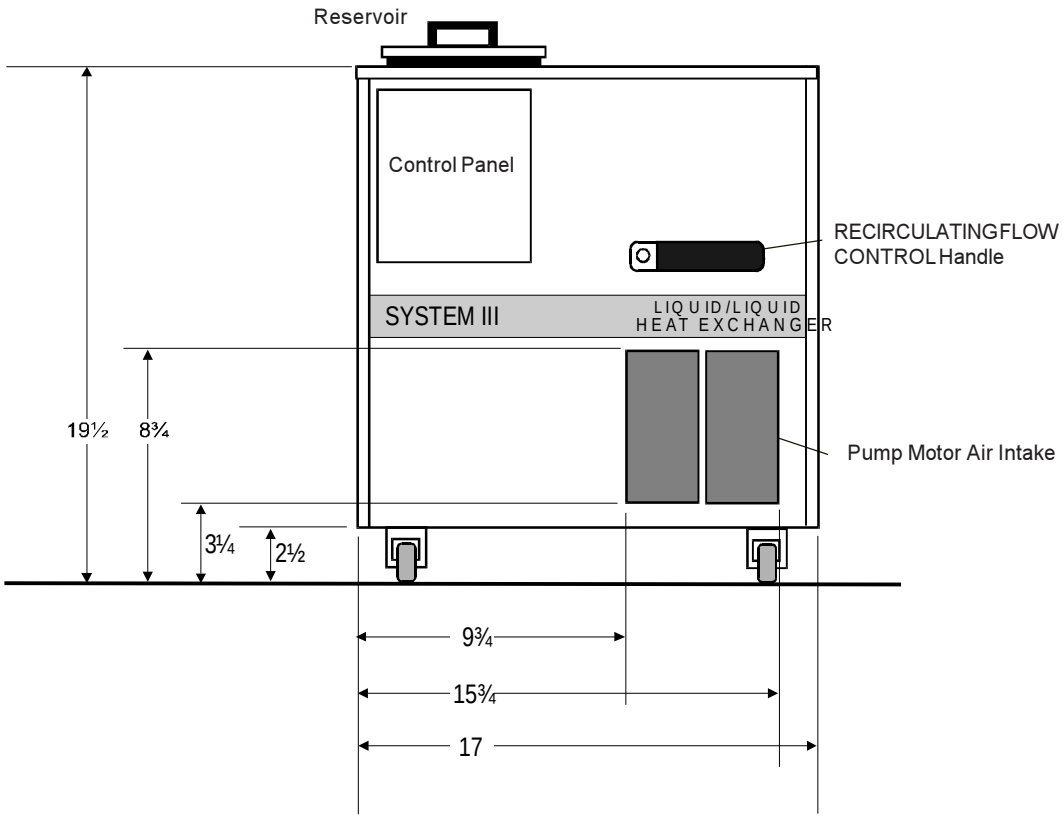
Serial number

TU Pump Flow Diagram

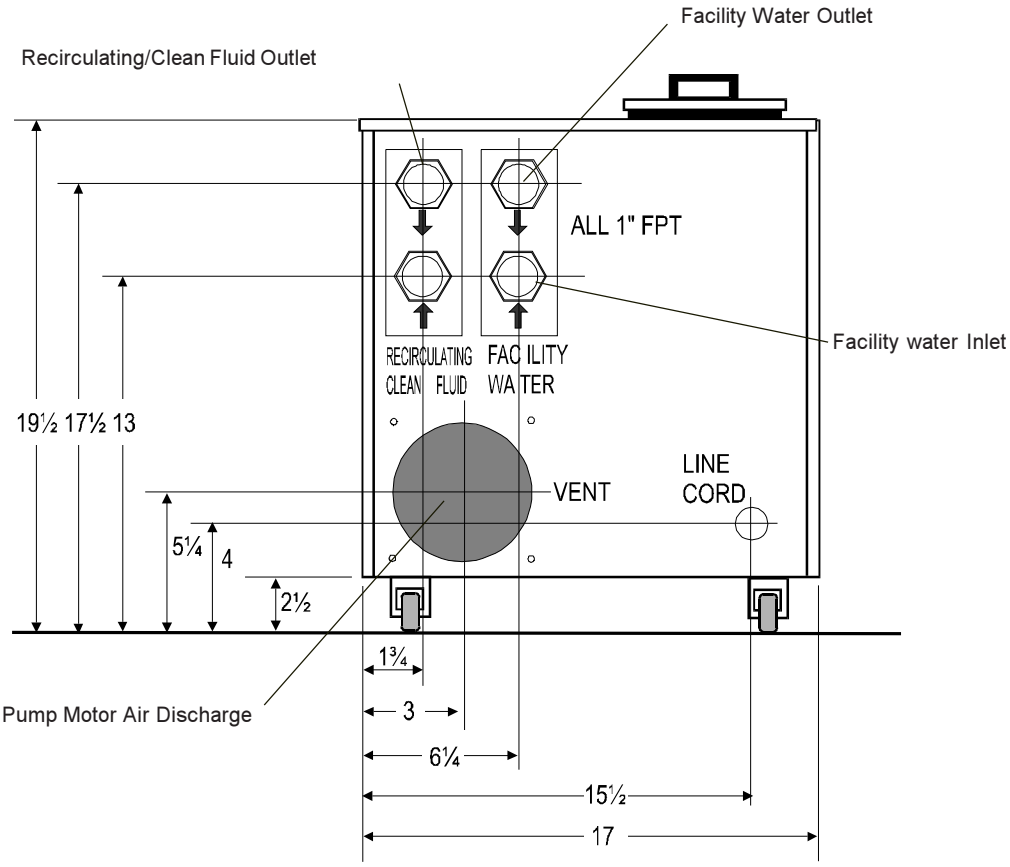


	12	1	MOTOR VALVE	------	
	11	1	PRESSURE SWITCH	------	HIGH PRESSURE SWITCH
	10	1	PRESSURE GAUGE	------	
	9	1	BALL VALVE, 3-WAY	------	
	8	1	RELIEF VALVE	------	
	7	1	TEMPERATURE SENSOR	------	
	6	1	PLATE EXCHANGER ASSY	------	
	5	1	PUMP	------	
	4	1	SOLENOID, AUTO-REFILL	------	4SOL
	3	1	TANK ASSEMBLY	------	
	2	1	FLOW METER	------	TU-8 and TU-9 only
	1	1	CHECK VALVE	------	

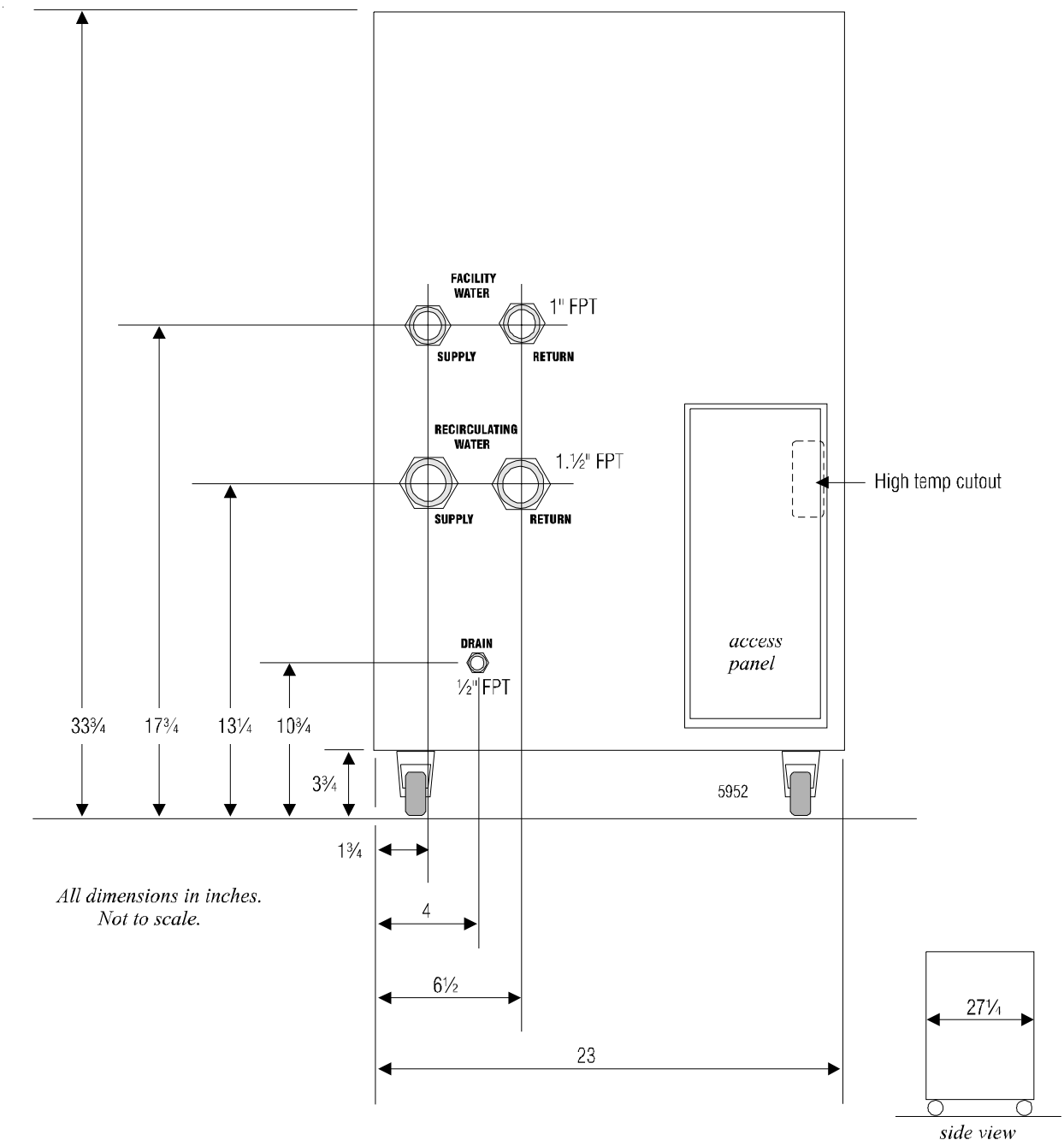
Front View



Rear View



Large Volume Units



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Appendix

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*

* MOhmcm (Compensated to 25°C)

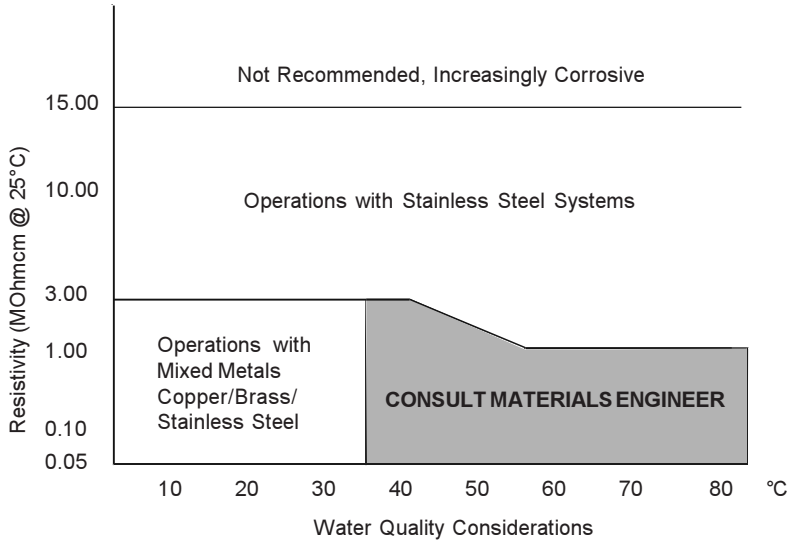
Unfavorably high total ionized solids (TIS) can accelerate the rate of galvanic corrosion. These contaminants can function as electrolytes which increase the potential for galvanic cell corrosion and lead to localized corrosion such as pitting. Eventually, the pitting could become so extensive that leaking 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 MOhmcm (compensated to 25°C) by using a purification system. Although the initial fill may be as high as 10 MOhmcm (compensated to 25°C), the desired level for long time usage is 1 to 3 MOhmcm (compensated to 25°C).

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



WARRANTY

Thermo Fisher Scientific warrants for 12 months from date of shipment any Thermo Scientific product according to the following terms.

Any part of the unit manufactured or supplied by Thermo Fisher and found in the reasonable judgment of Thermo Fisher to be defective in material or workmanship will be repaired at an authorized Thermo Scientific Product Repair Depot without charge for parts or labor. The unit, including any defective part must be returned to an authorized Thermo Scientific Product Repair Depot within the warranty period. The expense of returning the unit to the authorized Thermo Scientific Product Repair Depot for warranty service will be paid for by the buyer. Our 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 recision of the contract of sales of any unit. With respect to units that qualify for field service repairs, Thermo Fisher Scientific'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.

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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.

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