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Thermo Scientific
NESLAB HX Series
Recirculating Chiller

Thermo Scientific Manual P/N U00744 Rev. 03/26/08

Installation
Operation
Basic Maintenance

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Product Service Information, Applications Notes, MSDS Forms, e-mail.

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HX Series Recirculating Chiller
Table of Contents

PREFACE

Compliance 3
WEEE/RoHS 3
After-sale Support 4
Warranty 4
Unpacking 5
Feedback 5

SECTION I
Safety

Warnings 6

SECTION II
General Information

Description 7
Quick Reference Guide 9
Specifications 11
Cooling Capacity 12
Pump Capacity 13

SECTION III
Installation

Site (Air-cooled Units) 15
Site (Water-cooled Units) 17
Electrical Requirements 19
Plumbing Requirements 20
Fluids 22
Filling Requirements 23

SECTION IV
Temperature Controller

Controller Keypad 25
Status Indicators 26
SYS FAULT Display 27
Controller Displays 28
Changing a Value 28

SECTION V
Operation

Flow Control 33
Start Up 33
Pressure Gauge 34
INTERFACE Connector 35

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SECTION VI
Optional Features

Automatic Refill Device 37
Heater Package 38
SENSOR Connector 40
COMM Connector 40
Remote Box 41
External Pressure Regulator 42
Particulate Filters 43

SECTION VII
Maintenance & Service

Service Contracts 45
Condenser Cleaning 45
Hoses 45
Algae 46
Configuration 46
Reservoir Cleaning 47
Pump Strainer 48
Pump Motor Lubrication 49
Phase Rotation 49
High/Low Pressure Cutouts 50
Pressure Relief Valve 50
Pump Motor Overload Protector (3Ø Units) 51
Displaying Software Version 51
Refrigeration Data 51

SECTION VIII
Troubleshooting

Checklist 53
Service Assistance 54

SECTION IX
Diagrams

Refrigeration Flow (HX 75 and HX 150) 55
Refrigeration Flow (HX 300 through HX 750) 55
Pump Flow (CP Pumps) 56
Pump Flow (PD and TU Pumps) 56
Dimensions 57

SECTION X
Wetted Materials

APPENDIX A **Water Quality and Standards/Fluid Risk Assessment**

APPENDIX B **External Probe Calibration**

APPENDIX C **Programming Software**

APPENDIX D **RS-232 Serial Communications Protocol**

APPENDIX E **RS-485 Serial Communications Protocol**

Warranty

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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

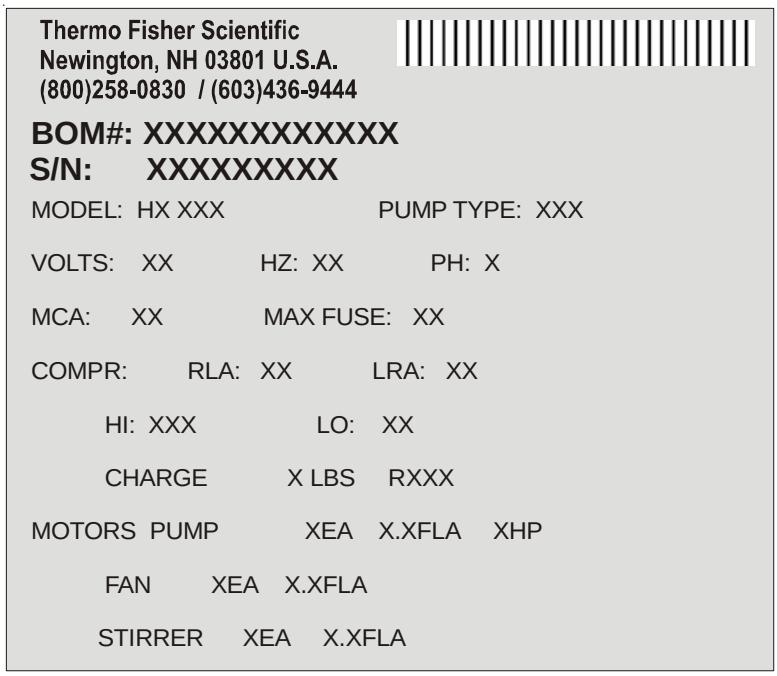
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After-sale Support

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. See inside front cover for contact information. 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 or side of the unit. To display the software version see page 51.



Label (typical)

Warranty

Thermo Scientific NESLAB HX units have a warranty against defective parts and workmanship for one full year from date of shipment. See back page for more details.

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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.

On units with a remote control box, the box is packed in a separate carton. Be sure to locate this separate carton; do not dispose of it by mistake.

Out of Box Failure

An Out of Box Failure is defined as any product that fails to operate in conformance with sellers 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.

Except for HX 300s, HX 500s, and HX 750s, any Temperature Control 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; Seller to pay the cost of shipping. Customer must receive a Return Material Authorization (RMA) from Thermo Fisher prior to shipping the unit.

Out of Box Failures for HX 300s, HX 500s, and HX 750s will be repaired at the customer's site; all component parts and labor necessary to perform the repair, as well as travel labor and travel expenses, are the responsibility of the Seller.

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.

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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 for assistance, see back cover.

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

Transport the unit with care. Sudden jolts or drops can damage the unit's components.

Do not attempt to defeat any of the interlock switches or safety features built into the unit.

Observe all warning labels.

Never remove warning label.

Never operate damaged or leaking equipment.

Never operate the unit without cooling fluid in the fluid reservoir.

Make sure the unit is off before connecting or disconnecting the power cord or other cables.

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

Always empty the fluid reservoir before moving the unit.

Never operate equipment with damaged power cords.

Refer service and repairs to a qualified Thermo Fisher 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. 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.



The lightning flash with arrow symbol, within an equilateral triangle, is intended to alert the user to the presence of non-insulated "dangerous voltage" within the unit's enclosure. The voltage may be of significant magnitude to constitute a risk of electrical shock.

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Section II General Information

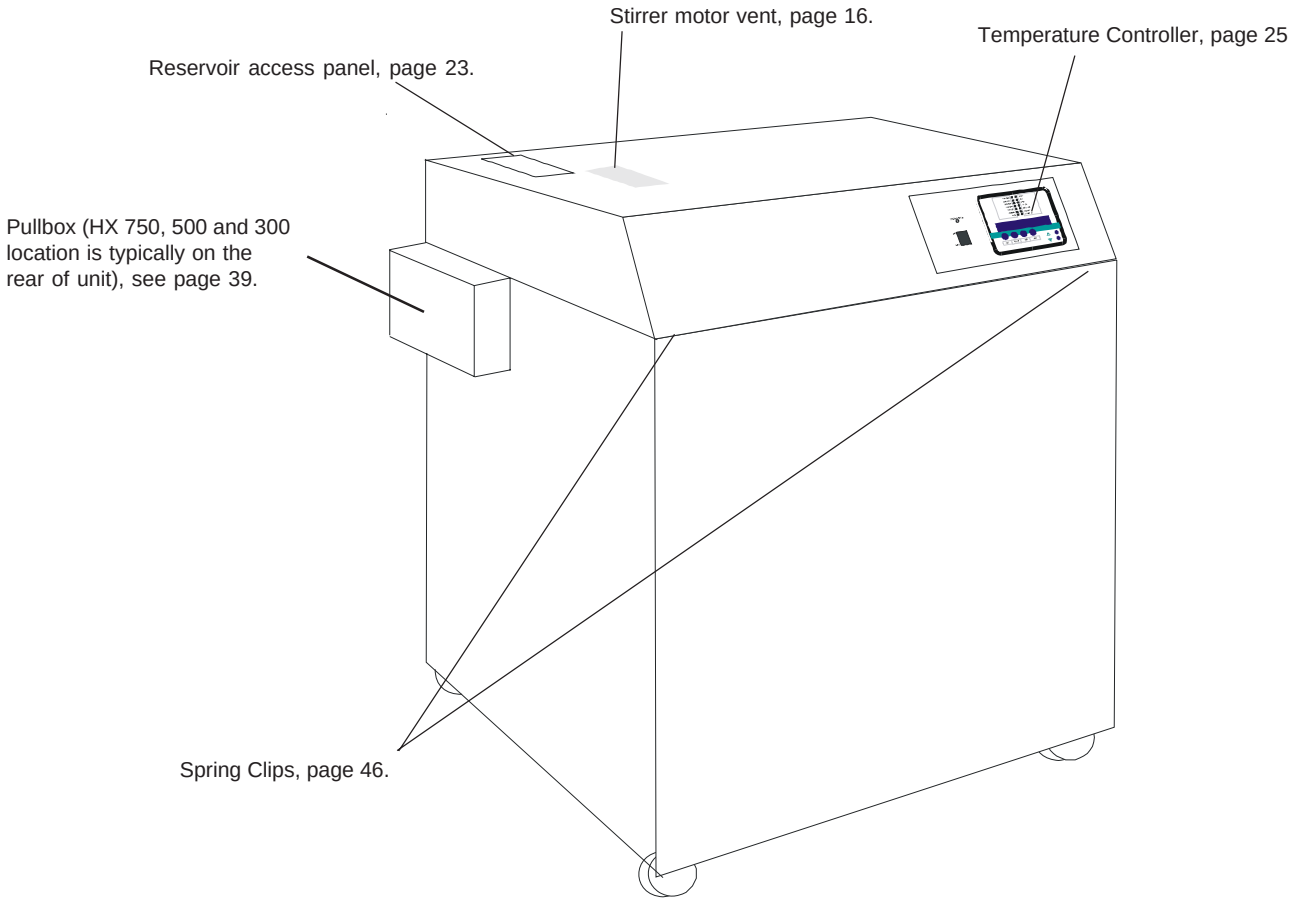
Description

The Thermo Scientific NESLAB HX Series Recirculating Chiller is designed to provide a continuous flow of cooling fluid at a constant temperature and volume.

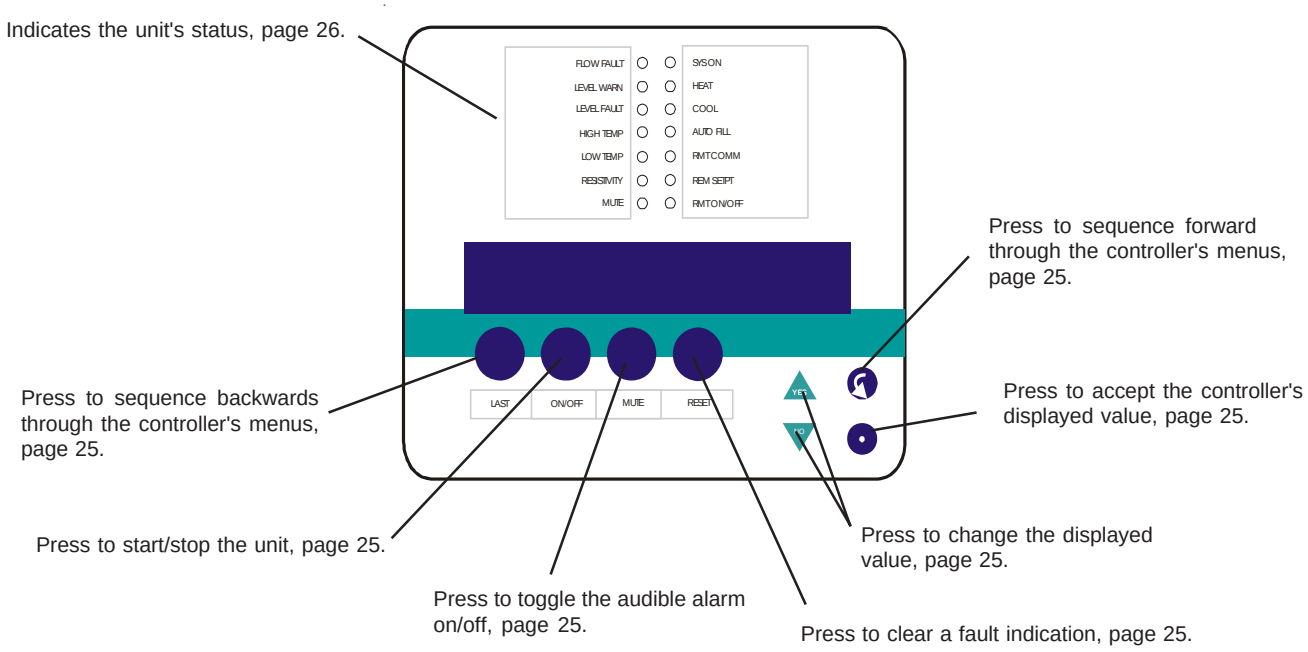
The unit consists of an air-cooled or water-cooled refrigeration system, a fluid reservoir, a fluid recirculation pump, and a temperature controller. Optional remote temperature controllers and remote probes are also available.

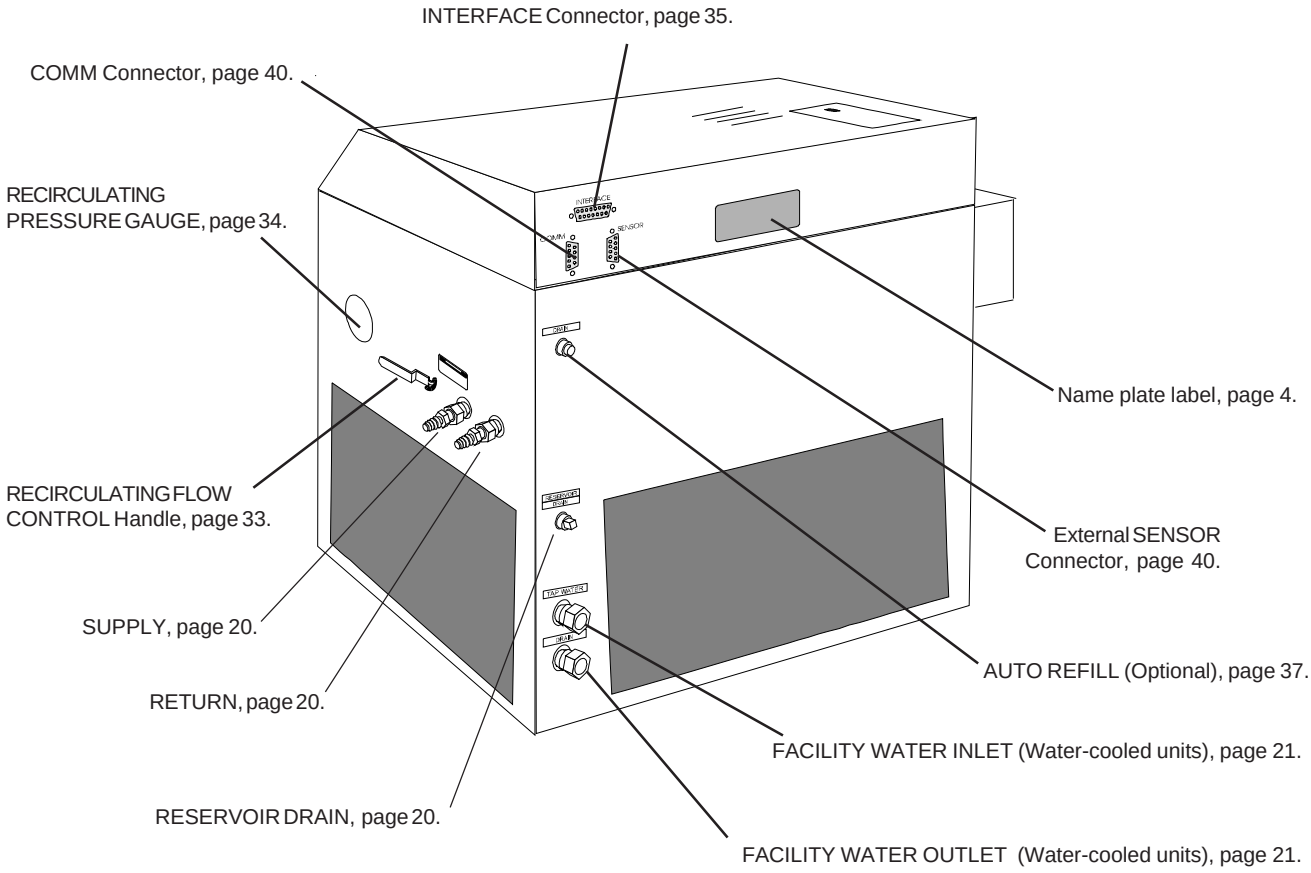
HX units are available with a large number of options. This manual explains how to install, operate, and maintain a “standard” HX unit. This manual also explains some of the available options. Supplemental manuals are supplied with units equipped with options not covered in this manual.

Throughout the manual, you will be asked to consult the unit’s name plate label for specific information. The label is located on the rear or side of the case top, see illustration on the bottom of the next page.



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Quick Start Procedures (Air-Cooled Models)

Installation

Position the unit so the intake and discharge are not impeded. Inadequate ventilation will cause a reduction in cooling capacity and, in extreme cases, compressor failure.

Avoid excessively dusty areas and institute a periodic cleaning schedule. For proper operation, the unit needs to pull substantial amounts of air through a condenser. A build up of dust or debris on the fins of the condenser will lead to a loss of cooling capacity.

The unit will retain its full rated capacity in ambient temperatures up to approximately +24°C.

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

The plumbing connections are located on the right side of the unit and are labelled SUPPLY and RETURN. These connections are ¾ inch FPT, 1 inch FPT for units with a CP 75 or TU 9 pump. Remove the plastic protective plugs from both plumbing connections. Connect the SUPPLY fitting to the inlet of your application. Connect the RETURN fitting to the outlet of your application.

To fill the reservoir open the access panel on the left rear corner of the case top and remove the reservoir cover by unscrewing the thumbscrews. Fill the reservoir to within one inch of the top. If the fluid capacity of your application and recirculation lines is significant, have extra fluid on hand.

We recommend using distilled/deionized water with a 0.05 to 0.1 MOhmcm reading. If you do not have access to distilled/deionized water we recommend using filtered facility water.

Operation

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

On models HX 300 through HX 750, the unit must be connected to the power source for at least 12 hours to allow the compressor oil to heat and separated from the refrigerant.

To start the unit first connect it to main power. On units equipped with a circuit protector, place it to the on position. The MAIN POWER LED will illuminate. Place the ON/OFF switch to the ON position. The COOL and HEAT LEDs on the front panel indicate the status of the refrigeration system. COOL is on when the unit is removing heat from the cooling fluid, HEAT is on when heat is being added to the fluid reservoir. As the operating temperature approaches the setpoint, the LEDs cycle.

When the unit is shut off, wait five minutes before restarting to allow time for the refrigeration pressures to equalize. If the pressures are not allowed to equalize, the compressor will short-cycle and no cooling will occur.

Temperature Adjustment

To display the temperature setpoint, while displaying the reservoir temperature press the NEXT key. To adjust the temperature setpoint use the YES/NO keys as described in this manual.

Flow Control

The RECIRCULATING FLOW CONTROL handle controls the flow rate to your application. In the full vertical position you receive full flow, the full horizontal position is no flow.

Periodic Maintenance

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

The cooling fluid should be replaced periodically. When operating at low temperatures, the concentration of water in the cooling fluid will increase over time, leading to a loss of cooling capacity.

Periodic vacuuming of the condenser fins is necessary. The frequency of cleaning depends on the operating environment. We recommend making a monthly visual inspection of the condenser after initial installation. After several months, the cleaning frequency will be established.

Units with PD and TU pumps have a strainer. If debris is in 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. 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 frequency of cleaning will be established.

Before cleaning the strainer, disconnect the power cord from the power source and drain the reservoir.

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Quick Start Procedures (Water-Cooled Models)

Installation

Position the unit in a clean environment with easy access to facility cooling water and a drain. The facility water requirements must meet those specified in the instruction or unit performance will be reduced.

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

The plumbing connections are located on the rear and right side of the unit and are labelled FACILITY WATER INLET, FACILITY WATER OUTLET, SUPPLY and RETURN. Remove the plastic protective plugs from all the plumbing connections. Connect the FACILITY INLET fitting to the facility cooling water and the OUTLET fitting to a drain. Connect the SUPPLY fitting to the inlet of your application and the RETURN fitting to the outlet of your application. On HX 75s through HX 300s, the FACILITY WATER fittings are ½ inch FPT. On HX 500s and HX 750s, these fittings are 1 inch FPT. The SUPPLY and RETURN connections are ¾ inch FPT, 1 inch FPT for units with a CP 75 or TU 9 pump.

To fill the reservoir open the access panel on the left rear corner of the case top and remove the reservoir cover by unscrewing the thumbscrews. Fill the reservoir to within one inch of the top. If the fluid capacity of your application and recirculation lines is significant, have extra fluid on hand.

We recommend using distilled/deionized water with a 0.05 to 0.1 MOhmcm reading. If you do not have access to distilled/deionized water we recommend using filtered filtered water.

Operation

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

Ensure the facility water is turned on.

On models HX 300 through HX 750, the unit must be connected to the power source for at least 12 hours to allow the compressor oil to heat and separated from the refrigerant.

To start the unit first connect it to main power. On units equipped with a circuit protector, place it to the on position. The MAIN POWER LED will illuminate. Place the ON/OFF switch to the ON position. The COOL and HEAT LEDs on the front panel indicate the status of the refrigeration system. COOL is on when the unit is removing heat from the cooling fluid, HEAT is on when heat is being added to the fluid reservoir. As the operating temperature approaches the setpoint, the LEDs cycle.

When the unit is shut off, wait five minutes before restarting to allow time for the refrigeration pressures to equalize. If the pressures are not allowed to equalize, the compressor will short-cycle and no cooling will occur.

Temperature Adjustment

To display the temperature setpoint, while displaying the reservoir temperature press the NEXT key. To adjust the temperature setpoint use the YES/NO keys as described in this manual.

Flow Control

The RECIRCULATING FLOW CONTROL handle controls the flow rate to your application. In the full vertical position you receive full flow, the full horizontal position is no flow.

Periodic Maintenance

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

The cooling fluid should be replaced periodically. When operating at low temperatures, the concentration of water in the cooling fluid will increase over time, leading to a loss of cooling capacity.

Units with PD and TU pumps have a strainer. If debris is in 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. 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 frequency of cleaning will be established.

Before cleaning the strainer, disconnect the power cord from the power source and drain the reservoir.

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Specifications

	HX 75	HX 150	HX 300
Process Fluid Temperature Range[1]	+5°C to +35°C		
Temperature Stability	±0.1°C		
Unit Dimensions (H x W x D)			
Inches	36¾ x 23¼ x 18¾	40⅝ x 26¼ x 21⅛	46⅞ x 33¾ x 25¼
Centimeters	93.3 x 59.0 x 47.6	103.2 x 66.7 x 53.6	119.1 x 85.7 x 64.1
Reservoir Volume			
Gallons	5.0	8.0	15.0
Liters	18.9	30.3	56.8
Refrigerant			
60 Hz	R22	R22	R22
50 Hz	R134A	R134A	R134A
Shipping Weight			
Pounds	363	383	477
Kilograms	165	173	216

	HX 500	HX 750
Process Fluid Temperature Range[1]	+5°C to +35°C	
Temperature Stability	±0.1°C	
Unit Dimensions[2] (H x W x D)		
Inches	51⅝ x 46 x 28¾	64¾ x 46 x 29
Centimeters	131.1 x 116.8 x 73.0	163.2 x 116.8 x 73.7
Reservoir Volume		
Gallons	28.0	40.0
Liters	106.0	151.4
Refrigerant		
60 Hz	R22	R404A
50 Hz	R22	R404A
Shipping Weight		
Pounds	1085	1085
Kilograms	492	492

1. For safety reasons, the unit is designed to shut down if the reservoir fluid temperature exceeds 7°C of either temperature limit.
2. Modified temperature ranges from -15°C to +90°C are available.
3. Model HX 750 with a water-cooled refrigeration system has the same dimensions as the HX 500. For additional dimensions see page 57.
4. Thermo Fisher Scientific reserves the right to change specifications without notice.

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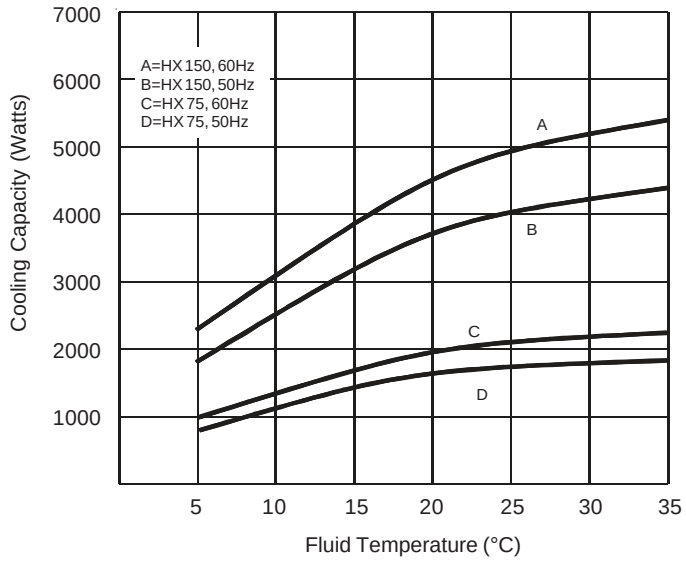
Cooling Capacity

Cooling capacity will vary depending on fluid temperature, ambient temperature, and cooling fluid.

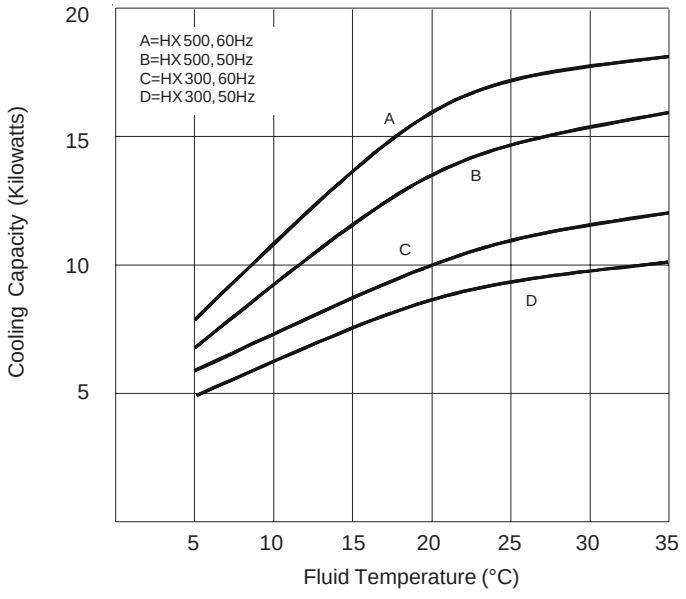
Cooling capacities were obtained under the following conditions:

1. *air-cooled unit operating at +20°C (+68°F) ambient temperature.*
2. *cooling fluid with specific heat of 1.0 was used for fluid temperatures from +5°C to +35°C.*

HX 75 & HX 150

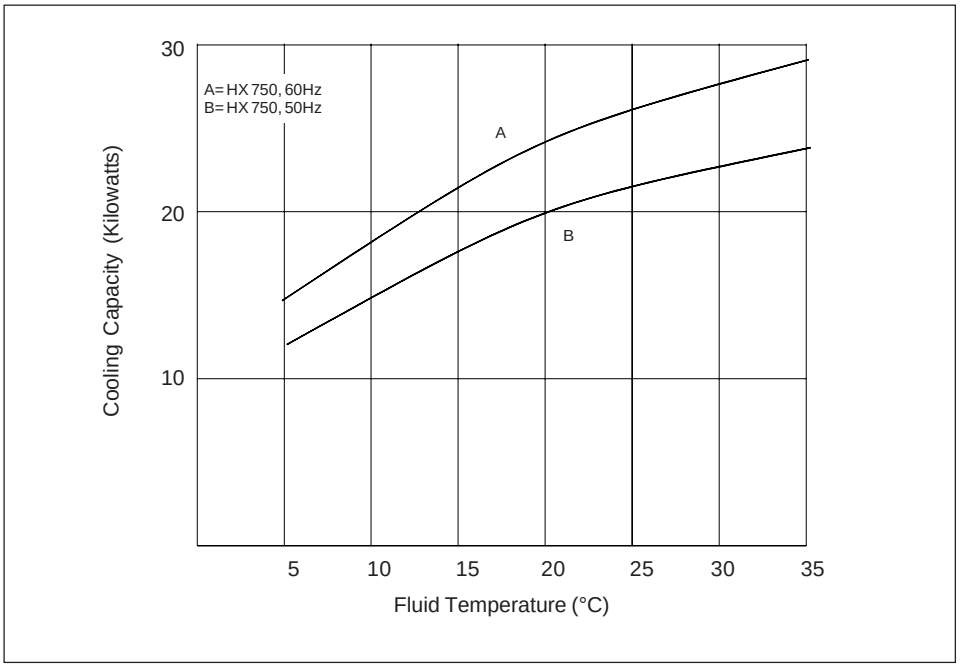


HX 300 & HX 500



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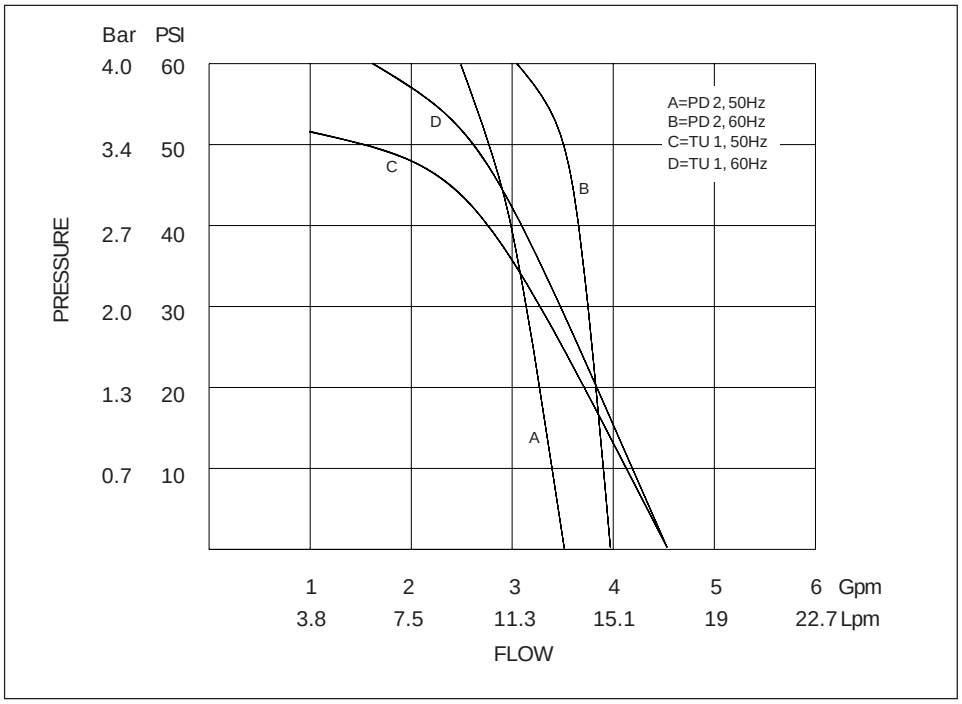
HX 750



Pump Capacity

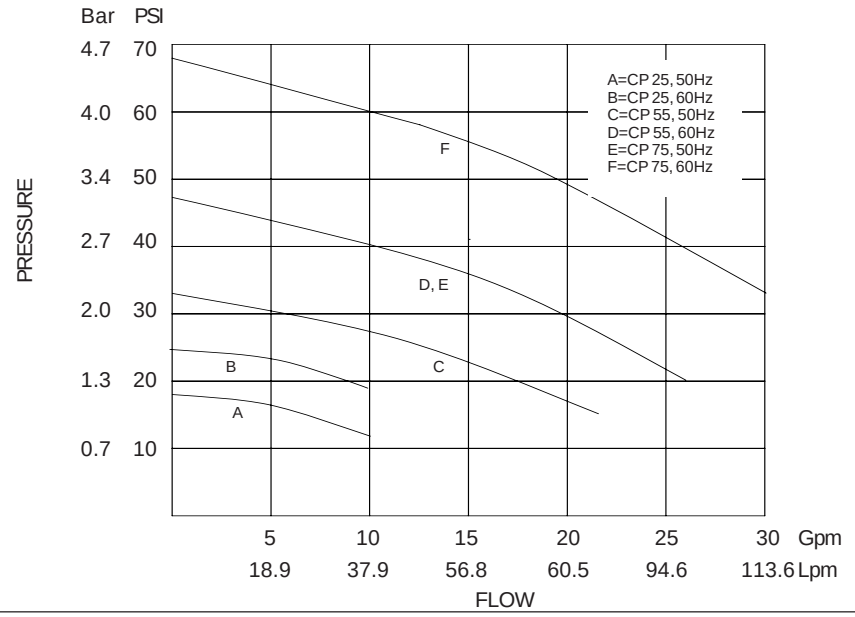
HX units are available with one of three standard pump types: positive displacement (PD), centrifugal (CP), and turbine (TU). Refer to the name plate label on the rear of the case top to identify the specific pump in your unit.

PD 2 & TU 1

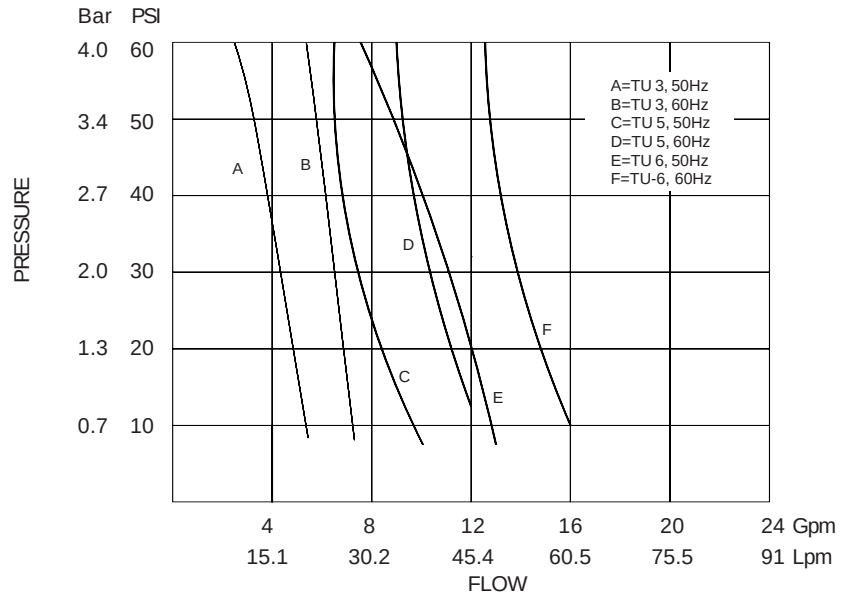


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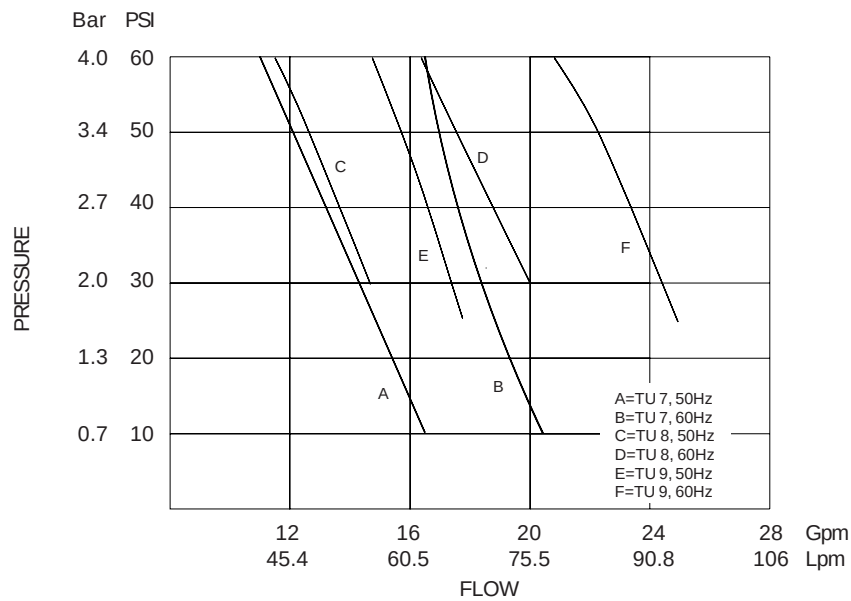
CP



TU 3, 5 & 6



TU 7, 8 & 9



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Section III Installation

Site (Air-cooled Units)

The unit should be located in a laboratory or clean industrial environment.

Ambient Temperature Range	+55°F to +95°F (+13°C to +35°C)
Overvoltage Category	II
Pollution Degree	2

The unit will retain its full rated capacity in ambient temperatures to approximately +75°F (+24°C). Reduce the cooling capacity 1% for every 1°F above +75°F, to a maximum ambient temperature of +95°F. In °C, reduce the cooling capacity 1% for every 0.5°C above +24°C, to a maximum ambient temperature of +35°C.



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

The unit has an air-cooled refrigeration system. It must be positioned so the air intake and discharge are not impeded.

On models HX 75 and HX 150, air is drawn through the left side of the unit and discharged through the right and rear. A minimum clearance of 2 feet (0.6 meter) on these three sides is necessary for adequate ventilation.

On models HX 300 through HX 750, air is drawn through the front of the unit and discharged through the side and rear panels. A minimum of 5 feet (1.5 meters) on all four sides of the unit is necessary for ventilation.

On models with a three-phase condenser fan motor, it is possible to connect the main power and have the motor turn in the wrong direction resulting in incorrect airflow over the condenser. Proper airflow is achieved by exchanging any two main power connectors so air is drawn into the fan. See page 39.

In some applications where space is at a premium, the minimum ventilation clearance can be compromised. However, consult our Sales Department before positioning the unit in a location with less minimum clearance than listed above. Inadequate ventilation will cause a reduction in cooling capacity and, in extreme cases, compressor failure.



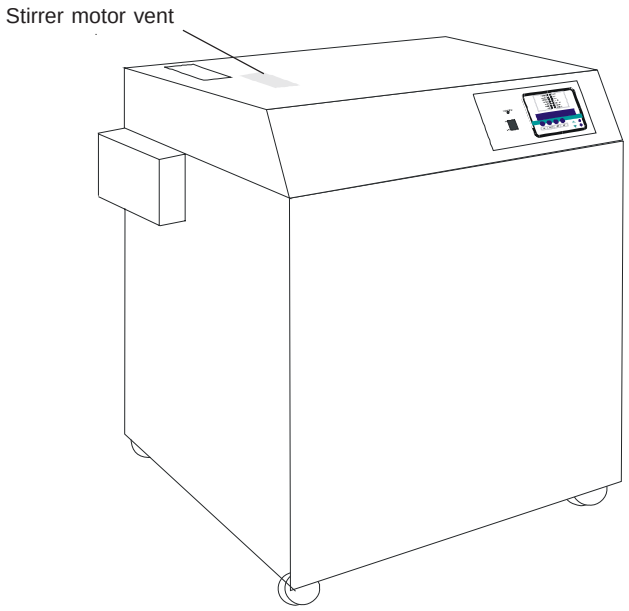
Avoid excessively dusty areas and institute a periodic cleaning schedule (see Section VII, Condenser Cleaning). If the compressor is allowed to overheat the unit's High Pressure Cutout (HPC) will cycle the unit on and off until cleaning is done and proper airflow is restored. This cycling will eventually damage the unit's compressor.

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On models HX 150 through HX 750 a stirrer motor is located under the case top. (Models HX 500 and HX 750 have two stirrer motors.) Heat generated by the stirrer motor is discharged through vents in the case top. Do not block the vents. A minimum clearance of 2 inches (5 centimeters) is necessary for adequate ventilation.

NOTE: HX 75s and units with plate heat exchangers do not have stirrer motors.

Models HX 300 through HX 750 are equipped with a compressor crankcase heater. The crankcase heater warms the oil in the compressor and prevents refrigerant from mixing with the oil. Before start up, connect the unit to its power source for at least 12 hours. This allows time for the oil to heat and separate from the refrigerant.



Refer to the table below to determine the approximate amount of air intake required for the unit to retain its full rated capacity. If the air intake does not meet these standards, cooling capacity will be reduced.

	HX 75	HX 150	HX 300
Air Intake			
Cubic feet per minute	600	1050	1900
Liters per minute	17000	29730	53800

	HX 500	HX 750
Air Intake		
Cubic feet per minute	5000	5600
Liters per minute	141750	158800

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Site (Water-cooled units)

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

All units are equipped with castors for easy movement. This allows the unit to be placed in a small area, as long as there is ample space to move the unit for access on all four sides. We recommend a minimum access clearance of 3 feet (1 meter) on two adjacent sides.

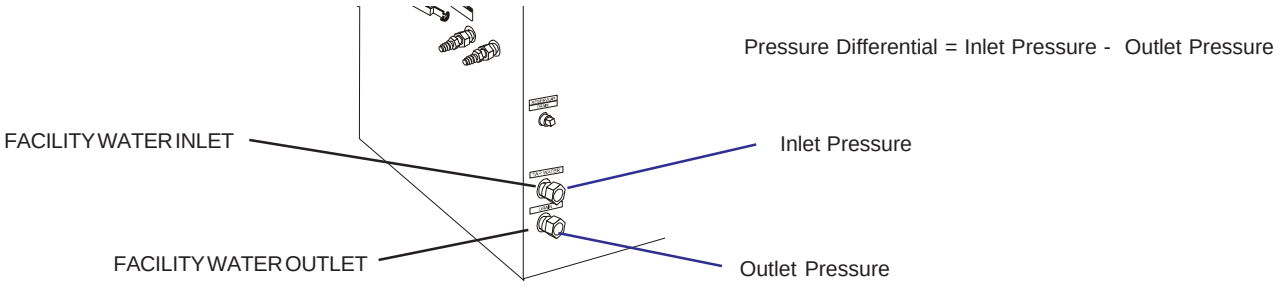
The facility cooling water supply must meet or exceed the requirements listed in the table shown on the next page for the unit to operate at its full rated capacity. As the temperature of the cooling water supply increases, the required flow rate and pressure of the cooling water supply increases.If the facility cooling water does not meet these standards, the cooling capacity will be reduced.

If the unit is being used with a building water supply, the back pressure of the drain must be less than the supply pressure.

To prevent damage to the unit's inlet and outlet valves, maximum static facility water pressure should not exceed 150 psig and available supply-to-return differential pressure must not exceed 35 psid across the rated flow range.

Facility Water Maximum Inlet Pressure must not exceed 150 PSIG.

Facility Water Maximum Pressure Differential must not exceed 35 PSID under any condition.



A water-regulating 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.

On models HX 150 through HX 750 a stirrer motor is located under the case top. (Models HX 500 and HX 750 have two stirrer motors.) Heat generated by the stirrer motor is discharged through vents in the case top. Do not block the vents. A minimum clearance of 2 inches (5 centimeters) is necessary for adequate ventilation. See illustration on previous page. **NOTE:** HX 75s and units with plate heat exchangers do not have stirrer motors.

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	Temperature of cooling water supply			
	+55°F (+13°C)	+65°F (+18°C)	+75°F (+24°C)	+85°F (+29°C)
HX 75				
Minimum Flow Rate				
Gallons per minute	0.75*	1.0	1.5	3.0
Liters per minute	2.8*	3.7	5.7	11.4
Minimum Pressure D				
Minimum PSID	1.5*	2.0	3.5	8.0
Minimum Bar	0.10*	0.13	0.24	0.55
HX 150				
Minimum Flow Rate				
Gallons per minute	1.0*	1.5	2.0	3.5
Liters per minute	3.8*	5.7	7.6	13.2
Minimum Pressure D				
Minimum PSID	2.0*	3.5	5.0	10.0
Minimum Bar	0.13*	0.24	0.34	0.69
HX 300				
Minimum Flow Rate				
Gallons per minute	2.5*	4.0	6.5	11.0
Liters per minute	9.5*	15.1	24.6	41.6
Minimum Pressure D				
Minimum PSID	6.0*	8.0	13.5	25.0
Minimum Bar	0.41*	0.55	0.93	1.72
HX 500				
Minimum Flow Rate				
Gallons per minute	3.5	5.0	8.0	16.0
Liters per minute	13.2	18.9	30.3	60.6
Minimum Pressure D				
Minimum PSID	13.0	17.0	23.0	57.0**
Minimum Bar	0.89	1.17	1.58	3.93
HX 750				
Minimum Flow Rate				
Gallons per minute	6.0	8.0	12.5	16.6
Liters per minute	22.7	30.3	47.3	62.8
Minimum Pressure D				
Minimum PSID	14.0	20.0	28.5	40.0**
Minimum Bar	0.96	1.38	1.96	2.76

At 20°C ambient.
*Estimated Value
** Operating at these pressures may lead to valve "chatter" under some operating conditions.

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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 your responsibility to assure a proper ground connection is provided.

The user is responsible to ensure that the power cord provided meets local electrical codes. If not, contact qualified installation personnel.

The unit is intended for use on a dedicated outlet. The HX has an internal circuit protection that is equivalent (approx.) to the branch circuit rating. This is to protect the HX, and is not intended as a substitute for branch circuit protection.

Refer to the table below to determine the unit's electrical requirements. Verify the requirements by reviewing the ratings listed on the name plate label on the rear of the case top.

	HX 75 & HX 150	HX 300
Volts	208-230 220-240	208-230 200-220 380-420
Hertz	60 50	60 50 50
Phase	1 1	3 3 3
Plug	NEMA L6-30P or L6-20P	NEMA L15-30P or L16-20P

	HX 500 & HX 750
Volts	208-230 380-420
Hertz	60 50
Phase	3 3

Make sure the voltage of the power source agrees with the unit's voltage and frequency rating. The unit is designed to tolerate deviations of ±10% from the rated line voltage.

Models HX 75 through HX 300 rated 24 Amps or less have an 8 foot (2.4 meter) power cord installed on the unit at the time of shipment.

HX 500s and HX 750s and some units equipped with heaters do not have a power cable. Installation of the cable is your responsibility. Wire the unit in conformance to local, state and federal electrical codes. Double check all wiring to make sure it is properly connected and protected from the elements. See the instructions and illustration on page 39.

Models HX 300 through HX 750 are equipped with a compressor crankcase heater. The crankcase heater warms the oil in the compressor and prevents refrigerant from mixing with the oil. Before start up, connect the unit to its power source for at least 12 hours. This allows time for the oil to heat and separate from the refrigerant.

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Plumbing Requirements

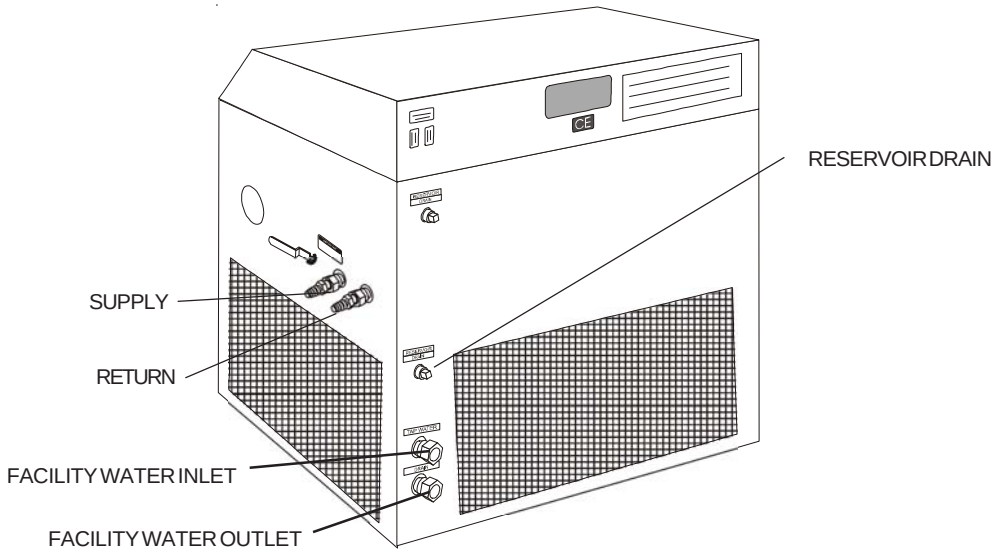
Air-cooled and water-cooled unit

Before installing the unit to an instrument that previously used facility water as a cooling fluid, flush the instrument several times to remove any rust or scale that has built up. Consult the manufacturer of the instrument for a cleaning fluid recommendation.

The plumbing fittings used to connect the HX to the instrument being cooled are located on the right side of the unit (labelled SUPPLY and RETURN). These connections are ¾ inch NPT, unless otherwise specified. **NOTE:** Units with CP 75 or TU 9 pumps have 1 inch NPT connections.

Remove the protective plugs from the SUPPLY and RETURN connections. Connect the SUPPLY fitting to the inlet of your application. Connect the RETURN fitting to the outlet of your application.

The RESERVOIR DRAIN connection, located on the rear of the unit, is a ½ inch FPT fitting connected internally to the unit's fluid reservoir. This fitting is for draining the reservoir. The unit is shipped with a ½ inch MPT plug installed in this fitting. Remove the plug to drain the reservoir.



Two plumbing adapters (¾ inch MPT x 5/8 inch hose) are included with the unit. If the unit is being plumbed to the instrument being cooled using flexible tubing, install the adapters in the SUPPLY and RETURN plumbing ports. To prevent leaking, wrap the threads of the adapters with Teflon® sealing tape before installing them in the plumbing ports. The adapters will accept ½ or 5/8 inch ID flexible tubing.

Flexible tubing, if used, should be heavy wall or reinforced construction. All tubing should be rated to withstand 110 psi at the unit's highest possible operating temperature. Make sure all tubing connections are securely

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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 Fisher. Contact our Sales Department for more information. See Preface, After-sale Support.

If the unit is "hard plumbed" to the instrument being cooled or to the cooling water supply, damage can occur if the unit is bumped or jolted from its site. Provisions should be made to prevent the unit from being moved after installation. Once the unit is plumbed, secure the locking castors on the unit's base. If the unit is located in a heavy traffic area where the possibility of collision is imminent, it may be necessary to secure the unit to the site using blocks or mounting brackets.

It is important to keep the distance between the unit and your application 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 your application, not at the HX.

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

Water-cooled units

The plumbing connections used to connect the water-cooled condenser in the HX to the facility cooling water supply are located at the rear of the unit (labelled FACILITY WATER INLET and FACILITY WATER OUTLET). On HX 75s through HX 300s, these fittings are ½ inch FPT. On HX 500s and HX 750s, these fittings are 1 inch FPT.

Remove the plastic protective plugs from the FACILITY WATER connections. Connect the FACILITY WATER INLET fitting to the facility cooling water supply. Connect the FACILITY WATER OUTLET fitting to a drain.

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Fluids



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

Thermo Fisher recommends using distilled/deionized water with a 0.05 to 0.1 MOhmcm reading. For units with extended temperature ranges above +35°C, we recommend distilled/deionized water up to +80°C. Above +80°C, you are responsible for the fluid(s) used.



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.

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



If your unit is equipped with a plate heat exchanger do not use 100% water as a recirculating fluid. Due to the physical nature of a plate heat exchanger, and its response to temperature changes, using 100% water may cause the plate heat exchanger to rupture.

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

NOTE: When using the remote sensor for low-temperature operation the unit itself may, depending on your application and setup, have to maintain an even lower temperature. Should the unit's fluid reservoir temperature exceed the low-end temperature range by 7°C, the unit will shut down.



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



When using EG/water top-off with EG/water. Do not top-off with plain water. Topping-off with plain water can severely affect the freezing point and boiling point of the fluid. This may result in system failure.



Do not use a Deionization (DI) filter with Inhibited EG. A DI filter will remove inhibitors from the solution rendering the fluid ineffective against corrosion protection. Also, inhibitors increase fluid conductivity.

See Appendix A for additional information.

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Filling Requirements

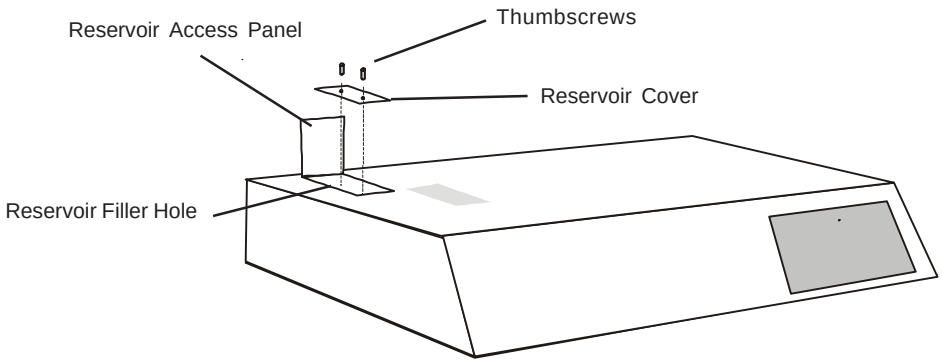
The reservoir access panel is located at the left rear corner of the case top. To open the access panel, slide the latch back (towards the rear of the unit) and lift.

The reservoir cover is located below the access panel. Loosen the thumbscrews and remove the reservoir cover.

Fill the fluid reservoir with cooling fluid to within 1 inch of the top.

The fluid capacity of the instrument being cooled and the recirculation lines may be significant. To prevent the lowering of the fluid level in the reservoir below the operating level, have extra cooling fluid on hand to keep the reservoir filled to within 1 inch of the top.

When the recirculating system is full replace the reservoir cover and thumbscrews. Close the access panel.

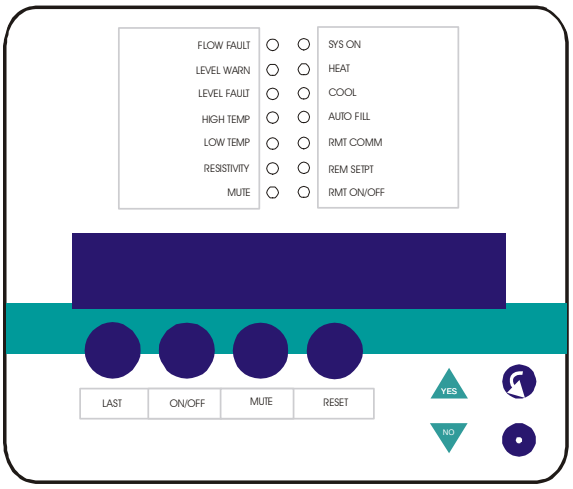


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Section IV Temperature Controller



Controller Keypad

The front panel mounted unit/temperature controller allows the operator to start, control, and monitor many features of the unit.

LAST The **LAST** key scrolls backward through the controller menu displays.

ON/OFF The **ON/OFF** key starts/stops the unit.

MUTE The **MUTE** key toggles the audible alarm silence function for the current alarm. When alarm is silenced, the MUTE LED lights.

RESET Alarm LEDs will remain lit after the problem is eliminated to provide indication of problem cause to the operator. The **RESET** key clears these indicators after fault condition is corrected.



The **YES** key answers yes to displayed yes/no questions, or increments numerical values.



The **NO** key answers no to displayed yes/no questions, or decrements numerical values.



The **NEXT** key scrolls forward through the controller menu displays.



The **ENTER** key confirms entry of numeric values.

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Status Indicators

Units are configured in one of two ways. They are configured either to shut down in the case of a fault, Cutout Option (CUTOUT), or, for those customers willing to take the risk of damage to their unit in order to continue providing all available cooling to their application, a Switch Option (WARN). See Setup Loop on page 30. Contact our Service Department for more information.

If the Switch Option is chosen, LEVEL FAULT, HTC FAULT, and FLOW FAULT ***do not*** shut down the unit but they are serious conditions and require immediate attention. Once the cause of the fault is identified and corrected, push the controller's RESET button to clear the indication. Cycle the MASTER POWER ON OFF switch to clear the flashing HTC FAULT indication, see page 38.

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

FLOW FAULT indicates the unit flow is below the low-flow setpoint. The unit will shut down in the Cutout Option, but will continue to operate in the Switch Option. **NOTE:** You can disable the low-flow monitor by setting the low-flow setpoint to 0, see page 30. The indicator flashes if the setpoint is set to 0.

LEVEL WARN indicator flashes if the reservoir level is below the top float switch mounted in the reservoir. The unit will continue to run.

LEVEL FAULT indicates the reservoir level is below the bottom float switch and is too low for safe operation. The unit will shut down.

HIGH TEMP indicates that the reservoir temperature is above the high temperature limit setpoint.

If the reservoir temperature is started above the high limit setpoint the unit will continue to run and the HIGH TEMP indicator will continue to flash until the reservoir temperature is below the high limit setpoint. Should the reservoir temperature go above the high limit setpoint the unit continues to run in the Switch Option, but shuts down in the Cutout Option.

LOW TEMP indicates that the reservoir temperature is below the low temperature limit setpoint.

If a unit is started with the reservoir temperature below the temperature limit setpoint, the unit will run and the LOW TEMP status indicator will continue to flash until the reservoir temperature is above the low limit setpoint. Should the reservoir temperature subsequently go below the low limit setpoint the unit continues to run in the Switch Option, but shuts down in the Cutout Option.

RESISTIVITY (optional) indicator flashes if the measured resistivity is below the resistivity setpoint.

MUTE indicates the buzzer has been turned off.

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SYS ON indicates unit is running.

HEAT indicates heat is being added to the reservoir system to maintain constant temperature. The indicator flashes when the optional heater is inside the proportional band.

COOL indicates the refrigeration system is removing heat from the reservoir system to maintain constant temperature.

As the fluid temperature approaches the temperature setpoint, the COOL indicator cycles on and off to indicate the duty cycle of the system. The unit can be in COOL or HEAT mode, but never both at the same time. A balance between COOL and HEAT controls the temperature.

AUTO FILL (optional) indicates the reservoir fluid level is below the top float switch and the auto refill device is activated, see page 37.

RMT COMM (optional) indicates the unit is configured to receive communication via an optional COMM connector located on the rear of the unit, see page 40.

REM SETPT indicates the temperature setpoint is being remotely controlled by the analog input (pin 15) on the INTERFACE on the rear of the unit, see page 35.

RMT ON/OFF indicates the unit is configured to receive a remote on/off input signal from pin 14 on the INTERFACE on the rear of the unit, see page 35.

SYS FAULT Display

A SYS FAULT display indicates a critical error that will always shut down all, or part of, the unit. A phase error, high or low refrigeration pressure, or a pump motor overload will illuminate the message. See pages 49 and 50 for additional information.

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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.

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. Use the key combination shown in Figure 1 on the next page to scroll through the loop.

The Setup Loop allow you to display and/or alter different parameters of the controller. The Setup Loop can be accessed from the Operator's Loop temperature display by pressing and holding the key combinations shown on Figure 2 on the next page.

Changing a Value

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

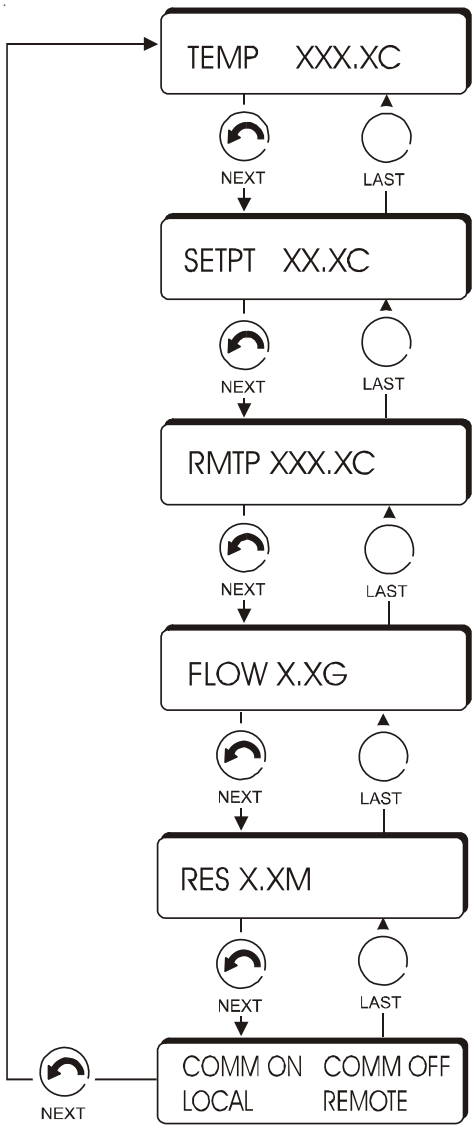
The display will flash as soon as either key is depressed, and will continue to flash until the **ENTER** key is pressed to accept the new value. The new value will not be used by the controller until the **ENTER** key is depressed and the display stops flashing.

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 depressed again.

For large values you can change the display 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 digits are entered will abort the procedure and return the display to the original value.

The controller will not allow you to enter a value below the minimum or above the maximum (typically +5°C and +35°C, these values change for units with extended temperature ranges). If you try to enter an illegal value outside the operating range, the display will revert to its original value.

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TEMPERATURE xxx.xC
This displays the temperature of coolant leaving the chiller.

SETPT xx.xC
This displays the setpoint for temperature control. The chiller's temperature controller causes the fluid temperature to equal this temperature. If needed, use the **YES/NO** keys to change the value then press **ENTER** to accept the new value.

RMTP xxx.xC
For units using the optional external probe, this feature displays the probe's sensed temperature. The probe's temperature control cannot exceed the unit's operational temperature range ±7°C or the unit will shut down. Ensure the probe is connected to the unit . See SENSOR on page 40. Select the external probe using the Setup Loop discussed on the next page.

FLOW x.xG
This displays the flow rate at the RETURN port in gallons or liters per minute. Select GPM or LPM using the Setup Loop discussed on the next page.

RES x.xM
This displays the uncompensated fluid resistivity.

COMM OFF COMM ON LOCAL REMOTE
This displays one of the four possible communication configurations created in the Setup Loop. See next page.

Figure 1 Operator's Loop

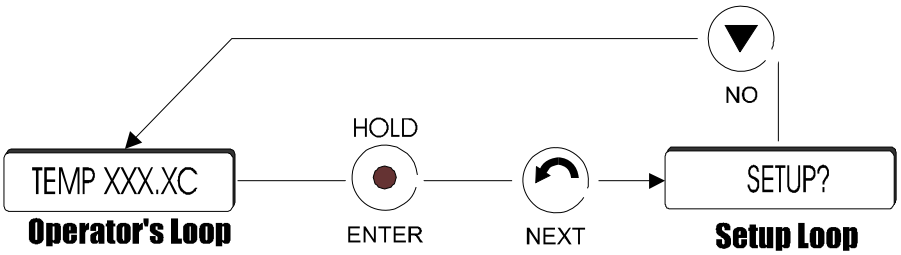


Figure 2 Changing Loops

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Setup Loop

The Setup Loop allows the operator to change limits; to configure how the unit will react to a fault: shutdown (CUTOUT) or continue to run (WARN); to display the flow rate in GPM or LPM; and to include or exclude the optional external probe display in the Operator's Loop. It is also used to select the beeper; to change the temperature controller's tuning constants; to select optional external communication; to select the auto restart feature; and to configure the temperature display to a tenth of a degree. Optional displays are highlighted.

NOTE: If the unit is configured for the remote operation option, the temperature limits are for the external probe. For safety reasons, if the unit's fluid reservoir temperature exceeds 7°C of either end of the unit's temperature range, **the unit will shut down.**

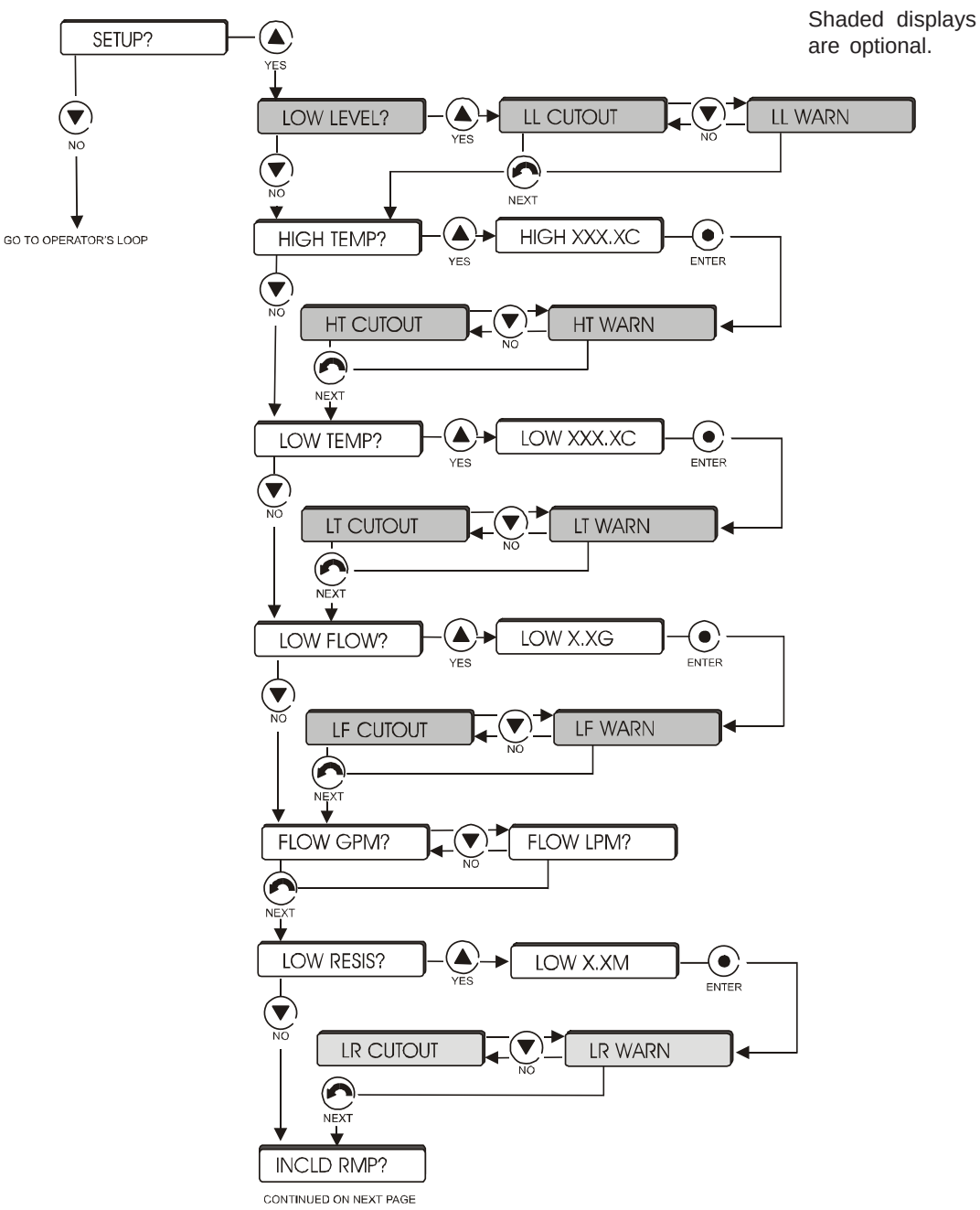


Figure 3 Setup Loop (1 of 2)

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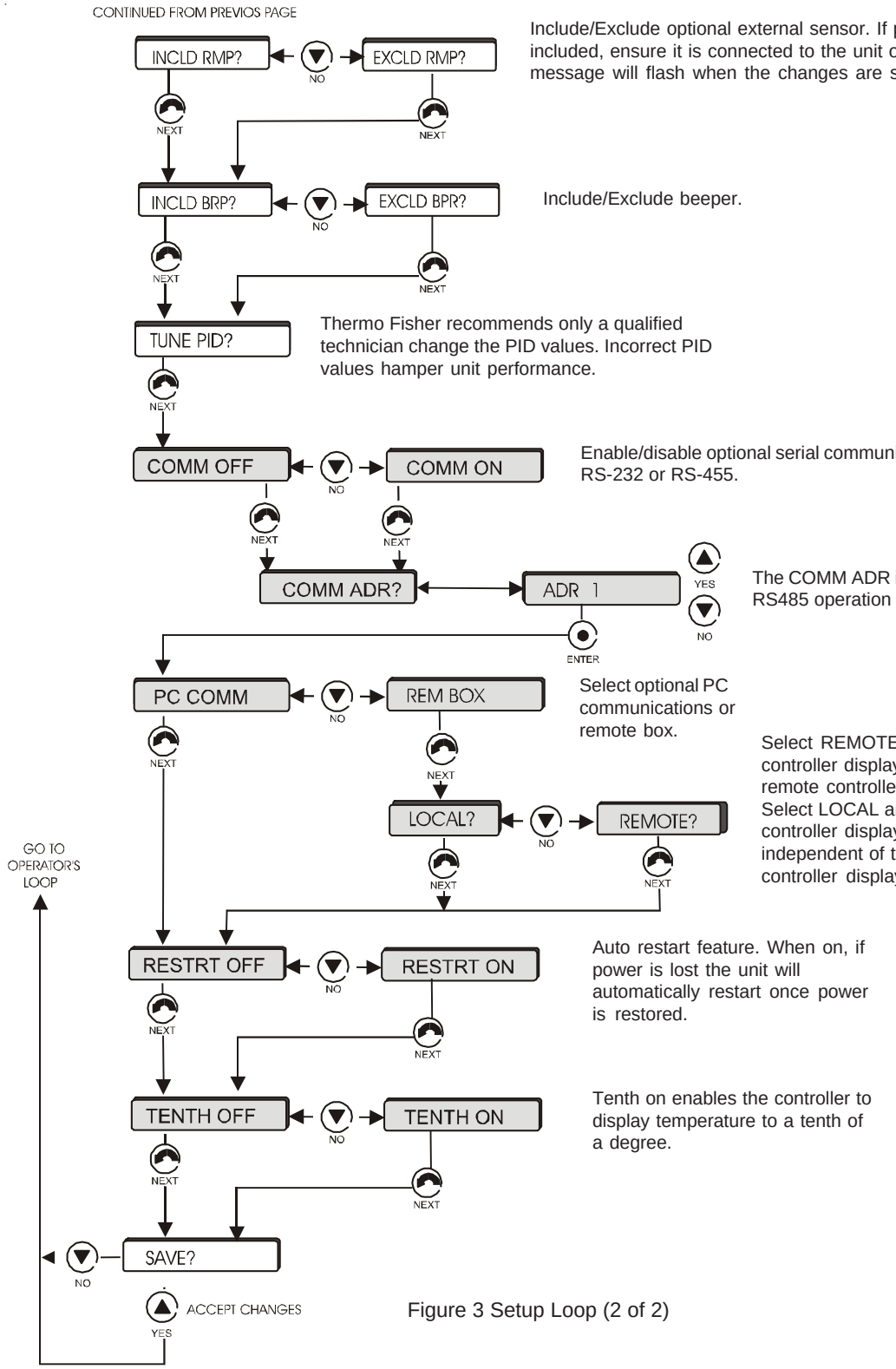


Figure 3 Setup Loop (2 of 2)

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

NOTE: If serial communications, PC COMM, or Remote operation is selected, it is enabled only when the changes are saved. When using the remote box option, the fastest way to return from remote to local is to press and hold the **ENTER** key and then press the **NEXT** key *on the local controller.*

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Section V Operation

Flow Control

The RECIRCULATING FLOW CONTROL handle, located on the right-hand side of your unit, is connected to a valve that controls the flow rate of the cooling fluid to your application.

When the handle is in the full vertical position, the valve is open and all possible cooling fluid is supplied to your application. When the handle is in the full horizontal position, the valve is closed and no cooling fluid is supplied to your application. When the handle is between these two positions, the flow rate of the cooling fluid is between full flow and no flow. Use a flow meter on the SUPPLY line to adjust the desired flow rate.

The flow control valve must be opened slightly to allow fluid to circulate through the flow switch that monitors the flow rate. For small pumps, a flow rate of more than 0.3 gpm (1.0 lpm) is necessary. For large pumps, a 1.0 gpm (3.8 lpm) is needed. Pump flow for normal operation is pump dependent and is factory preset

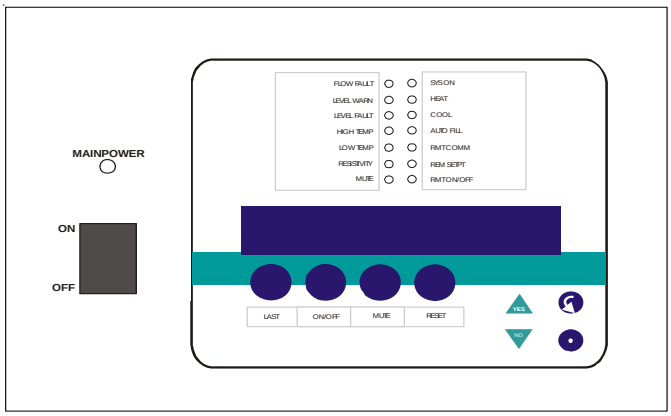
Never quickly turn the valve wide open from the closed or slightly open position.

Start Up

On water-cooled units, ensure the facility water is on and make sure the cooling water supply is connected to the FACILITY WATER INLET connection, not the OUTLET connection.

Apply power to the unit. For CE Mark units, place the circuit protector on the bonnet to the on position. The MAINPOWER indicator will illuminate.

Models HX 300 through HX 750 are equipped with a compressor crankcase heater. The crankcase heater warms the oil in the compressor and prevents refrigerant from mixing with the oil. Before start up, connect the unit to its power source for at least 12 hours. This allows time for the oil to heat and separate from the refrigerant.



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Place the MAIN POWER ON OFF switch ON. The controller will go through a short self-test and then display the reservoir fluid temperature.

LOCAL Start Up

Depress the ON/OFF key on the temperature controller. The unit will start and the SYS ON LED will illuminate.

To stop the unit, depress the ON/OFF key on the temperature controller.

When the unit is shut off, wait approximately five minutes before restarting. This allows time for the refrigeration pressures to equalize. If the pressures are not allowed to equalize, the compressor will short-cycle (clicking sound) and no cooling will occur.

REMOTE Start Up

Locate the J100 INTERFACE on the rear of the unit. Connect pin 1 to pin 12. The RMT ON/OFF indicator will illuminate. Connect pin 1 to pin 14 and the unit will start. See next page for additional information.

To stop the unit, disconnect pin 1 from pin 14.

When the unit is shut off, wait approximately five minutes before restarting. This allows time for the refrigeration pressures to equalize. If the pressures are not allowed to equalize, the compressor will short-cycle (clicking sound) and no cooling will occur.

Pressure Gauge

The RECIRCULATING PRESSURE gauge is located next to the flow control handle. The gauge indicates the operating pressure of the system.

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INTERFACE Connector 15-pin Dsub Female

PIN	NAME	NOTES	DEFINITION
1	12VDC COMMON		Common for digital inputs (pins 13 and 14)
2	RESISTIVITY OUT		0-10VDC Analog Voltage Output: Reference to pin 6. This voltage output is proportional to the resistivity of the reservoir fluid: 0.5VDC / M-cm. (Ex: 9.0V = 18Mohm-cm) (Max Load @ 10V = 5mA)
3	LOW LEVEL	Note 1	Dry Relay Contact: Reference to pin 11. Closes if either level switch is in the “low” position for more than 1 second.
4	TEMP/SENSOR	Note 1	Dry Relay Contact: Reference to pin 11. Closes immediately when any of the following occur: 1. High Temp Fault, 2. High Temp Warn, 3. Low Temp Fault, 4. Low Temp Warn, 5. RTD1 Fault/Warn, 6. RTD2 Fault/Warn, or 7. Resistivity Warn.
5	PUMP ON	Note 1	Dry Relay Contact: Reference to pin 11. Closes immediately when pump is turned on. Opens immediately when pump is turned off.
6	ANALOG GROUND		Common for analog signals (pins 2, 7 and 15)
7	RESERVOIR TEMP OUT **OR** EXTERNAL SENSOR TEMPERATURE IF EXTERNAL SENSOR ENABLED		0-10VDC Analog Voltage Output: Reference to pin 6. This voltage output is proportional to the reservoir fluid temperature: Scale = 10mV / ^{O}C. (Ex: 200mV = 20°C) (Max Load @ 10V = 5mA) * Optional Range = 0 – 10V (where: 0V = Low Temp Span, 10V = Hi Temp Span.) Contact Factory for details.
8	LOW FLOW	Note 1	Dry Relay Contact: Reference to pin 11. Closes immediately when a low flow occurs while the pump is on. Note: To allow the pump to get up to speed at startup, the pump is allowed to run for 3 seconds before the low flow sensor is read.
9	FAULT NO	Note 1	Dry Relay Contact: Reference to pin 11. Closes after power up and no-faults present. Opens immediately when any of the following faults occur: 1. Low Flow, 2. Low Level, 3. Temp/Sensor, 4. High Pressure Fault, or 5. Heater High Temp Cutout.
10	FAULT NC	Note 1	Dry Relay Contact: Reference to pin 11. Compliment of pin 9 (open when pin 9 is closed).
11	RELAY COMMON		Common for all relay contacts (pins 3, 4, 5, 8, 9, 10).
12	REMOTE ON/OFF ENABLE		Digital Input: Reference to pin 1. Connect to pin 1 to allow unit to be remotely turned on/off through pin 14 REMOTE ON/OFF.
13	REMOTE SETPOINT ENABLE		Digital Input: Reference to pin 1. Connect to pin 1 to allow the setpoint to be changed remotely through pin 15 REMOTE SETPOINT IN.
14	REMOTE ON/OFF		Digital Input: Reference to pin 1. Connect to pin 1 to turn unit on. Disconnect to turn unit off. Note: Pins 1 and 12 must be connected to allow operation from this pin.
15	REMOTE SETPOINT IN		Analog Voltage Input: Reference to pin 6. Apply a DC voltage to this pin to adjust the unit’s setpoint: Range = 10mV/ ^{O}C. (Ex: 200mV = 20°C) (Max Input Voltage = 10VDC, Input Impedance > 600K). * Optional Range = 0 – 10V (where: 0V = Low Temp Span, 10V = Hi Temp Span) Contact Factory for details.

Note 1:
All relay contacts (except for Pin 10) are normally OPEN when power is off. Pin 10 contacts are normally CLOSED when power is off. All relay contacts are rated: 24V AC/DC, 2A, <= .08 Ohm.

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Section VI Optional Features

Automatic Refill Device

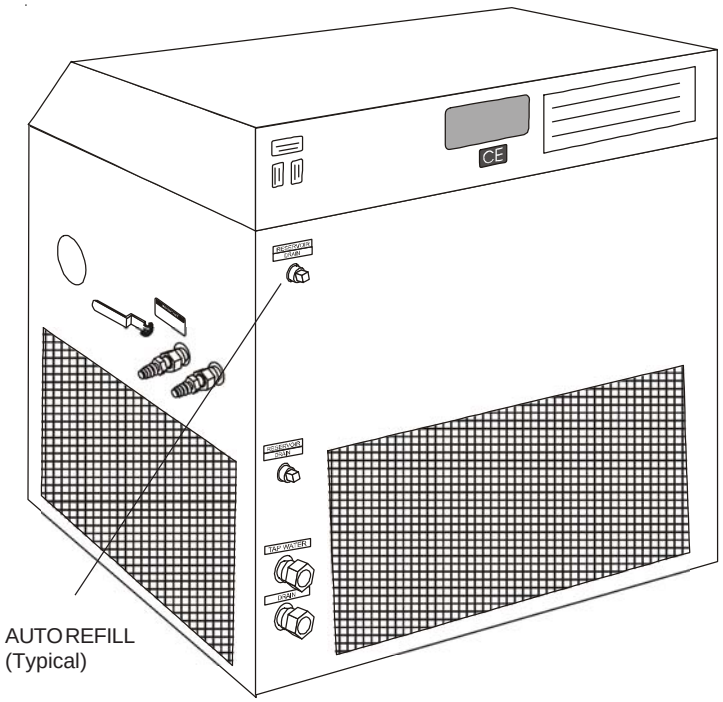
The automatic refill device is designed to maintain the correct level of cooling fluid in the reservoir. The device consists of a solenoid valve and a reservoir float switch. If the cooling fluid level falls, the float switch drops, opening the solenoid valve and allows makeup fluid to fill the reservoir. Once the cooling fluid level reaches the proper level, the float switch rises and the valve closes.

NOTE: Refill times depends on the facility water pressure.

The plumbing connection for the refill device is located at the left rear corner of the unit and is labelled AUTO REFILL. This connection is a $^{3}/_{8}$ inch OD stainless steel barbed fitting.

Connect this fitting to a makeup fluid source using $^{5}/_{16}$ or $^{3}/_{8}$ inch ID flexible tubing. Make sure all tubing connections are securely clamped.

Tubing is available from Thermo Fisher. Contact our Sales Department for more information, see Preface.



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Heater Package

The heater package option consists of an immersion heater in the unit's fluid reservoir, a high temperature limit device, a low-level switch, and a solid state zero-crossing relay. A HTC FAULT message on the controller will light if the high temperature limit device is tripped. The low-level switch will disconnect power to the heater if the heater surface is exposed to air.

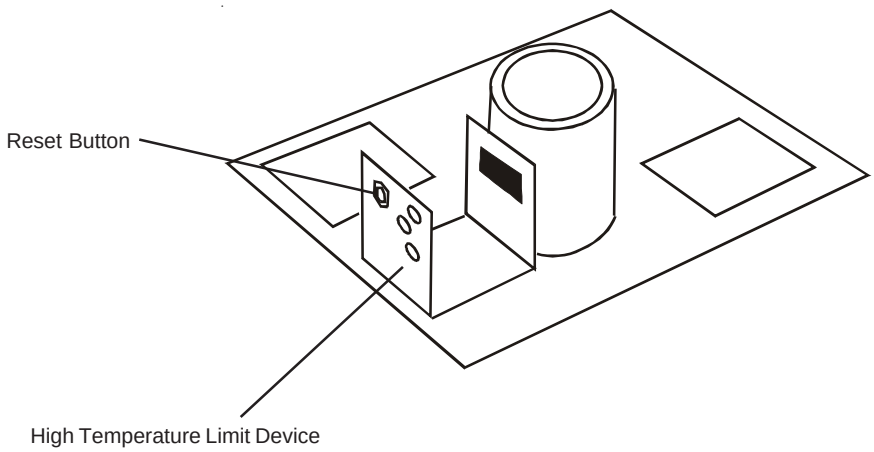
The heater surface temperature may operate several degrees higher than the reservoir fluid. The limit device is factory set to a temperature above the upper limit of the temperature controller's range.

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

To reset a tripped temperature limit device, lift and open the case top. The case top is secured to the unit base by a hinge between the case top and the base (along the rear of the unit), and by two spring clips located at the front corners, see illustration on page 7. To gain access to the temperature limit device, disengage the spring clips with a flat bladed screw driver and lift the front of the case top and tilt it back. A support brace, located on the right side of the inner case, will stop and support the case top.

You must identify and correct the fault before restarting the unit. The protection device and the heater power connections are located on top of the fluid reservoir. The protection device has a small, black reset button. Press the reset button to restore heater operation and clear the HTC fault. Cycle the MASTER POWER ON OFF switch to clear the flashing HTC FAULT indication.

Some units equipped with heaters do not have a power cable. Installation of the cable is your responsibility. Wire the unit in conformance to local, state and federal electrical codes. Double check all wiring to make sure it is properly connected and protected from the elements.



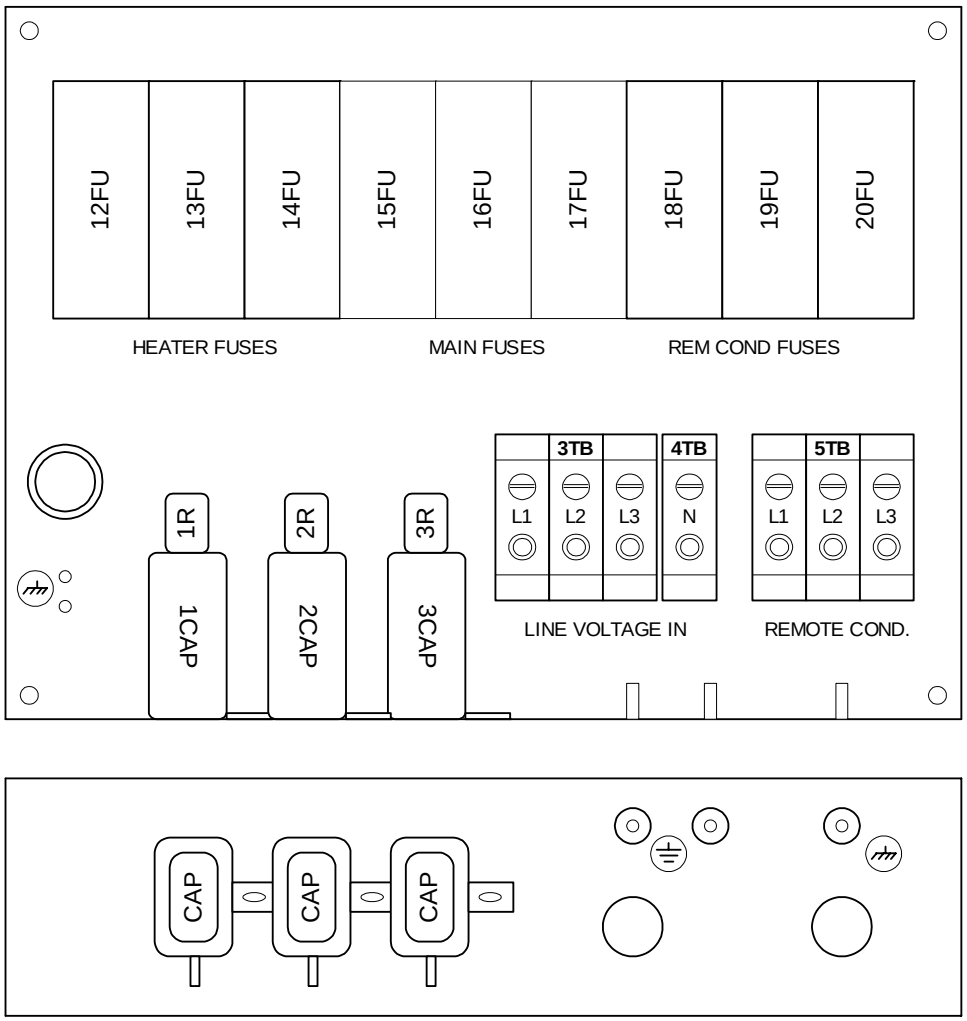
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The unit construction provides protection against the risk of electric shock by grounding appropriate metal parts. The protection may not function unless the power cord is connected to a properly grounded outlet. It is your responsibility to assure a proper ground connection is provided. For personal safety and equipment reliability, only a qualified technician should perform the following procedure.

To access the connections open the pullbox.

- Insert your cable through the conduit.
- Locate 3TB and 4TB and connect your cable.
- Close the pullbox.

Note: Pullbox shown with heater and remote condenser options.



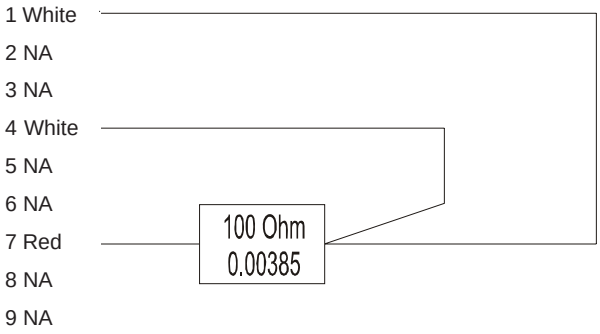
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SENSOR Connector

The unit can be configured to have its temperature controlled from an external location. Temperature is read on the controller's RTMP display. In the Operator's Loop, RTMP is the sensed temperature, TEMP indicates the HX's tank temperature. See page 29.

The external probe is connected to a 9-pin male "D-sub" located on the rear of the unit. Ensure your external application does not cause the HX to exceed its temperature range. For safety reasons the HX will shut down if either limit is exceeded by 7°C.

This is a 3-wire RTD probe. It must be calibrated before initial use, see Appendix B.



COMM Connector

COMM is a 9-pin female "D-sub" located on the rear of the unit used for remote operation. The unit can be configured to operate from a PC comm or remote box option. See pages 30 to 31. For NEScom software information, see Appendix C. For serial communications protocol see Appendix D for RS 232 or Appendix E for RS 485.

When using the remote box option, the fastest way to return from remote to local is to press and hold the ENTER key and then press the NEXT key on the local controller.

Going from local to remote is not available at the remote box.

The pin out information for either configuration is:

RS-232 (NC com)		**RS-485 (Remote Box)**	
1	Not used	1	Ground
2	TX	2 -7	Not used
3	RX	8	T+
4	Not used	9	T-
5	Ground		
6-9	Not used		

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Remote Box

The remote box operates by sending and receiving RS485 serial communication. It is attached to the unit by an RS485 cable with 9-pin D subminiature connectors on the rear of the remote box and the 9-pin COMM port on the rear of the unit. See previous page for pin out information. The cable is available in 25, 50, 75, 100 and 200 foot lengths.

Power up the local unit and then the remote box. The unit is put in remote mode by entering the local controller's Setup Loop and enabling and then saving the REM BOX? selection, see pages 30 - 31. *For safety reasons, the unit cannot be put in the remote mode by using the remote box.*

After the Setup Loop is saved, the remote box will momentarily display CONNECTING and then the display will show the current reservoir temperature. CONNECTING indicates that communication is not yet established between the local unit and the remote box. If the CONNECTING display does not extinguish check the cable connections and then toggle the power to the unit. Run the Operator's Loop, it should display REMOTE. If not, rerun the Setup Loop and ensure changes are saved. Check to see that the unit is in the remote mode by observing that the REMOTE ENABLE light on the remote controller is lit.

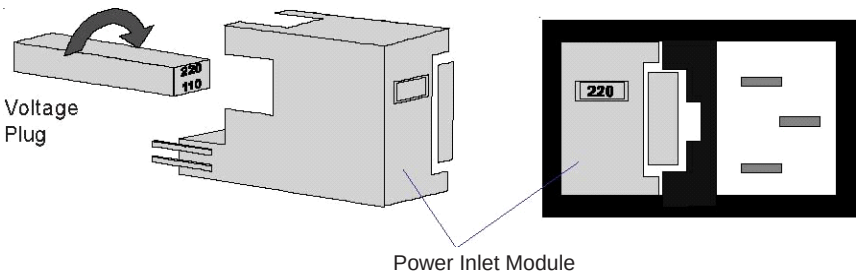
When the unit is in the remote mode the remote box controls all unit functions, including the pump. The local controller does not operate in the remote mode.

In the remote mode the local controller display is determined by the Setup Loop's LOCAL? REMOTE? selection. With REMOTE? selected the local controller mirrors the remote controller's displays. With LOCAL? selected the local controller continually displays the reservoir fluid temperature.

The remote box controls the unit until the unit is returned to the local mode. Use either controller to return to the local mode. Press and hold the controller's enter key and then press the next key. The REMOTE light will turn off.

The remote box also has a 15-pin connector for standard 10mV/°C temperature output (between pin 7 and referenced to pin 6). It can be used for a chart recorder or other recording device. An optional 0 - 10VDC signal is available.

The remote box can be configured for 110V or 220V operation. The voltage is displayed on the power inlet module located on the rear of the remote box. To change the voltage pry the module out from the power connection. Remove the voltage plug from the module and rotate it 180°. Reinstall the plug. The desired voltage should be displayed. Reinstall the inlet module.

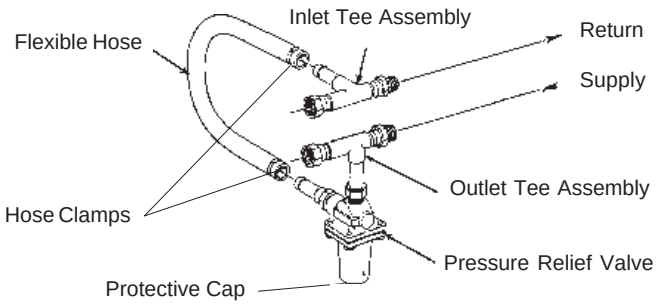


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External Pressure Regulator

For applications requiring a maximum pressure less than 55 psi, an External Pressure Reducer (EPR) is available. An EPR allows an adjustable operating pressure of 10 to 50 psi. If the pressure of the fluid leaving the unit exceeds the valve setting the relief valve will bypass the fluid back into the unit to relieve the pressure. The back pressure of the connected equipment and the flow rate of the recirculating fluid to your application determine the pressure of the system.

Connect the EPR assembly as shown below. Tighten the hose clamps tight enough to prevent leakage. Do not overtighten or the clamps will “bite” into the flexible tubing and can cause excessive wear.



Connect the outlet tee assembly to the inlet of your application. Connect the inlet tee assembly to the outlet of your application.

Adjustment

When adjusting the relief valve some leaking may occur, place a container under the valve during adjustment.

Remove the protective cap and locate a threaded fitting with a slot for a large screwdriver. Hold the threaded fitting in place and loosen the lock nut on the valve body until it is almost flush with the threaded fitting. Unscrew the threaded fitting three to four turns. (If the threaded fitting unscrews completely from the valve housing, screw it back in two to three turns.)

To simulate blockage, close (or pinch off) the hose between the EPR outlet tee assembly and your application. Monitor the operating pressure of the HX unit. Turn the threaded fitting until the desired relief pressure is set (the EPR valve cannot be set lower than the total back pressure of your instrument, or flow will not be received).

Tighten the locknut to secure the position of the threaded fitting. Open the hose between the EPR outlet tee assembly and your application.

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Nitrogen Purge

Units equipped with nitrogen purge valves are designed to accept a constant flow of dry nitrogen into the reservoir. The nitrogen blankets the cooling fluid reducing fluid evaporation.

Remove the reservoir cover by removing the screws. Fill the reservoir with fluid. Replace the reservoir cover and screws. Connect the nitrogen line to the valve on the reservoir cover.

A pressure regulator, set to 0.5 psig (0.35 kg/cm^3) or lower, should be used to prevent fluid overflow.

Particulate Filters

Particulate filter assemblies attach to the supply side of the recirculation water. Refer to the separate manual attached to the filter assembly.

The frequency for cleaning/changing the filter depends on your usage. Should the unit's performance be degraded, check the filter.

Filters are available from Thermo Fisher. contact our Customer Service Center. Before calling refer to the name plate label on the rear of the unit to obtain the following information:

-BOM number
-Serial number

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Section VII Maintenance & Service

Service Contracts

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



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

Condenser Cleaning (Air-cooled units only)

For proper operation, the unit needs to pull substantial amounts of air through a finned condenser. A build up of dust or debris on the fins of the condenser will lead to a loss of cooling capacity.



Eventually the compressor will overheat and the High-Pressure Cutout (HPC) will activate and temporarily shut down the unit. The HPC will cycle the unit on and off until the condenser is cleaned. After a period of time, this cycling will damage the unit's compressor.

The frequency of cleaning depends on the operating environment. We recommend making a monthly visual inspection of the condenser after initial installation. After several months, the frequency of cleaning will be established.

For "standard" air-cooled units, periodic vacuuming of the fins on the condenser is necessary. For units with the optional remote air-cooled condenser, remove any debris from around the condenser site. If a visible accumulation of dust or dirt is found on the condenser fins, the condenser should be cleaned with a condenser cleaning solvent and rinsed with water.



Exercise caution not to damage the condenser fins or coil. Condenser fin or coil damage can result in a loss of performance and, in extreme cases, refrigeration system failure.

Hoses

The unit's internal and external hoses and clamps should be inspected and tightened on at least a semiannual basis.

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Algae

To restrict the growth of algae in the fluid reservoir, we recommend the reservoir cover be kept in place and that all recirculation 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 3.5 liters. Other algicides can be harmful to the unit's internal components. Contact us for additional information.

Configuration

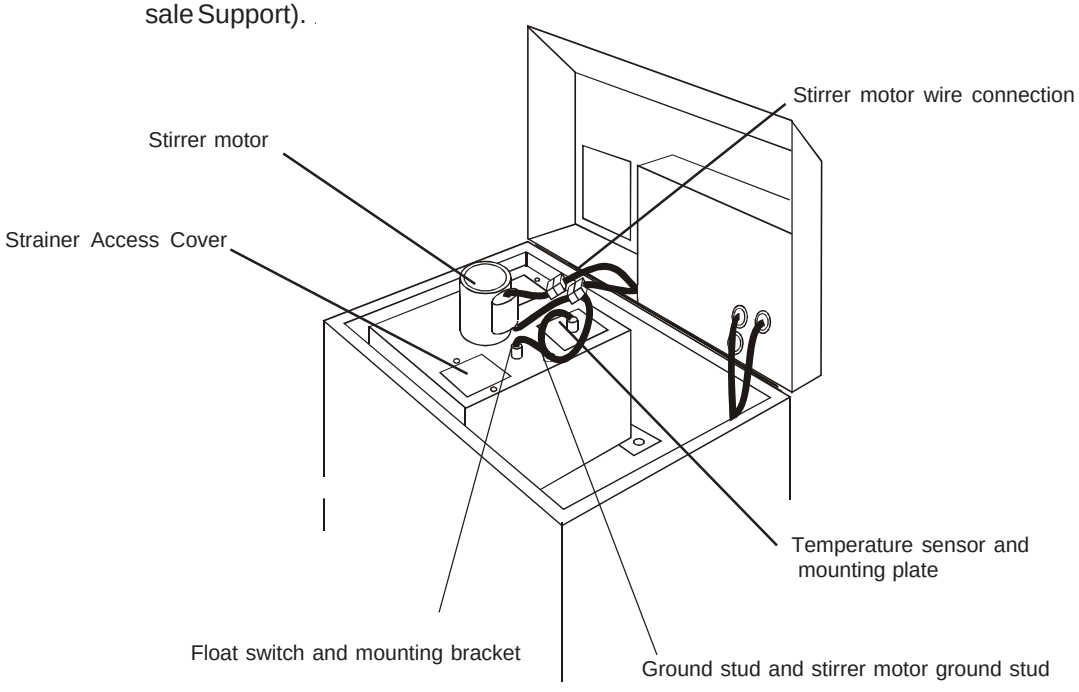
Case Top

The unit has a hinged case top to allow service access. The case top is secured to the top of the unit base by a hinge between the case top and base (along the rear of the unit), and by two spring clips located at the front corners, see illustration on page 7. To gain access to the pump assembly or the reservoir area, disengage the spring clips with a flat bladed screw driver and lift the front of the top cover and tilt it back. A support brace, located on the right side of the inner base, will stop and support the case top. Ensure the spring clips engage when the top is lowered back into position.

Reservoir Cover

Disconnect the unit from its power source before removing the cover.

Access to the inside of the fluid reservoir is necessary to clean the reservoir. The figure below illustrates a typical layout of the components mounted on top of the reservoir cover. The component layout varies depending on the unit size. If you are unable to identify the components on your unit's reservoir cover, contact our Customer Service Department for assistance (see Preface, After-sale Support).



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Locate the reservoir stirrer motor (units with plate heat exchangers and HX 75s do not have a stirrer motor; HX 500s and HX 750s have two stirrer motors). Disconnect the motor wires at the plug located on the side of the electrical box cover. Also disconnect the green ground wire that connects the ground stud on the reservoir cover to the unit's grounding bar.

Locate the float switch mounting bracket. Remove the two stainless steel screws that secure the bracket to the reservoir cover. Carefully remove the mounting bracket and place the assembly in an area adjacent to the reservoir. Make sure not to strain the connecting wires.

Locate the temperature sensor mounting plate. Remove the two stainless screws that secure the bracket to the reservoir. Carefully remove the sensor mounting plate with the sensor(s) attached and place the assembly in a protected area adjacent to the reservoir. Make sure not to damage the sensor(s) or strain the connecting wires.

Remove the stainless steel screws that secure the reservoir cover to the reservoir. Remove the cover and place it to one side in a manner that protects the stirrer motor blades from being bent.

Service Access Panels



Disconnect the unit from its power source before removing any of the access panels.

Service access panels on your unit allow easy access to the pump and refrigeration assemblies. Panel location varies with the size and type of unit. The panels are designed to allow removal without disconnecting the HX from the instrument being cooled.

Reservoir Cleaning

Periodic reservoir cleaning is necessary. We recommend making a monthly visual inspection of the reservoir after initial installation. After several months, the frequency of cleaning will be established.



Disconnect the unit from its power source and drain the reservoir before cleaning the reservoir.

Lift the top cover to access the reservoir. Remove the reservoir cover as described in Configuration on previous page. Clean the reservoir with a cleaning fluid compatible with the recirculating system and the cooling fluid.



Do not use steel wool or other abrasive materials. They can scratch the stainless steel surface and initiate rusting.

When the reservoir is clean, reassemble the cover assembly and close the case top. Refer to Section III, Filling Requirements for instructions on replacing the cooling fluid.

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Pump Strainer

Units with PD and TU pumps have pump strainers that require cleaning. Refer to the name plate label on the rear of the case top to identify the specific pump in your unit. If debris is drawn into the recirculating system, the pump strainer will prevent the material from being drawn into the pump and damaging the pump vanes.

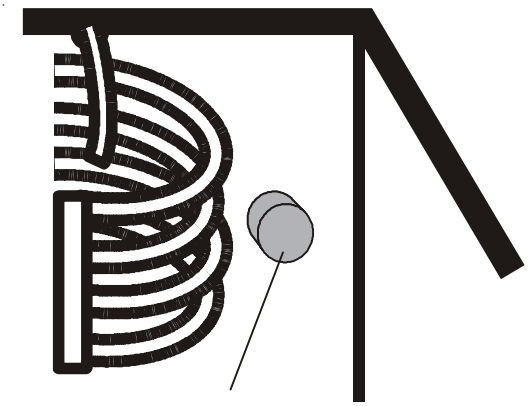
After initial installation, the strainer may become clogged with debris and scale. Clean the strainer after the first week of installation. After this first cleaning, a monthly visual inspection is recommended. After several months, the cleaning frequency will be established.

Disconnect the power cord from the power source and drain the fluid reservoir before cleaning the strainer. Do not operate the unit with any strainer removed.

The wire mesh pump strainer is located in the reservoir on the pump suction line. Remove the strainer access panel located on top of the reservoir cover to access the strainer, see illustration on page 46.

Cover the strainer with a plastic bag to help catch any debris that may become dislodged during removal.

Unscrew the strainer and rinse it with water. Replace the strainer. Refer to Section III, Filling Requirements for instructions on replacing the cooling fluid.



Pump Strainer

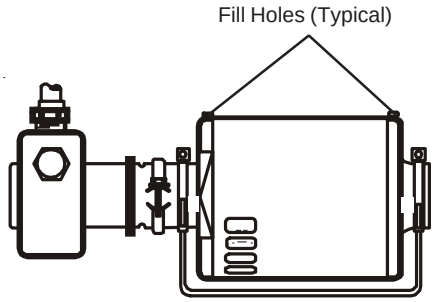
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Pump Motor Lubrication

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

Several companies manufacture motors used to drive the pump. These motors use sleeve type bearings with large oil reservoirs. Oiling instructions are generally posted on each motor. In the absence of instructions, add approximately 30 to 35 drops of SAE 20 non-detergent oil in each fill hole on the following schedule (SAE 20 = 142 CS viscosity):

Duty Cycle	Oiling Frequency
Continuous	Once every year
Intermittent	Once every 2 years
Occasional	Once every 5 years



Phase Rotation

Three-phase units with three-phase pump motors are equipped with a phase rotation interlock. Refer to the name plate label on the rear of the case top for the specific electrical requirements of your unit. The interlock prevents the unit from starting if the phase rotation is wrong and causes a system fault. If the unit will not start, see Section VIII, Checklist. If the options in the checklist are not applicable, the problem may be phase rotation.

If phase rotation is the problem, disconnect the unit from its power source, remove the pullbox cover. Reverse any two line conductors on the line side of the relay. See page 39.

Never remove the green ground wire.

Replace the pullbox cover. Reconnect the unit to its power source. If the unit will not start, contact our Customer Service Department.

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High/Low Pressure Cutouts

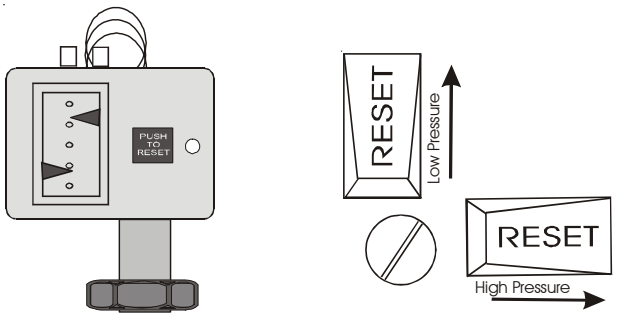
Should the unit's refrigeration discharge pressure become too high the high-pressure cutout will activate and shut down the compressor. High pressures can be caused by a lack of cooling water to the compressor or debris in the refrigeration lines. A dirty or blocked condenser can also create high pressure.

Should the unit's refrigeration discharge pressure become too low the low-pressure cutout will activate and shut down the compressor. Low pressures can be caused by a leak in the refrigeration lines.

If a fault occurs, the controller displays a SYS FAULT message and the compressor will shut down. The pump will continue to run.

Once the cause of the problem has been identified and corrected you must manually reset the cutout. Units have a yellow sticker identifying the cutout location. The switch can be accessed through the opening in the service panel

There are two types of switches. Either locate the white switch on the cutout and press in on the switch until a "click" is heard. **(**If the switch does not "click" the cutout was not activated and the unit shut down occurred for another reason.) On the other type move the green switch on top the cutout as shown.



Pressure Relief Valve
(PD and TU Pumps Only)

Units with a PD or TU pump have an adjustable pressure relief valve. Refer to the name plate label on the rear of the case top to identify the specific pump in your unit.

The 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 valve does not determine the actual operating pressure; the back pressure of the connected equipment and the setting of the flow control valve determine the operating pressure of the system. If adjustment seems necessary, consult our Service Department for assistance.

Before calling, refer to the name plate label on the rear of the case top to obtain the following:

- *BOM number*
- *Serial number*

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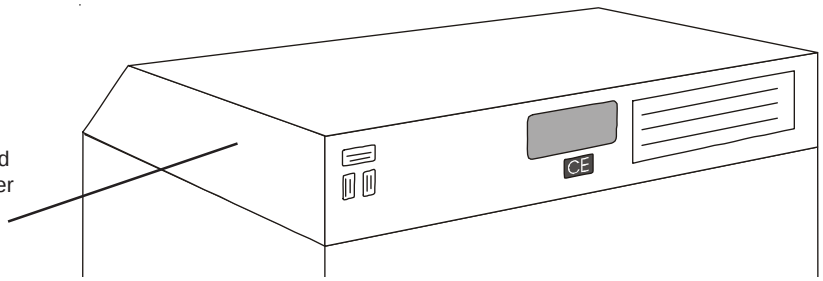
Pump Motor Overload Protector (3Ø Pumps Only)

The overload protector prevents the pump motor from exposure to excessive current. If an overload fault occurs, due, for example, to excessive pressure or flow, or excessive ambient temperature, the overload protector will shut off the pump motor. The overload protector will automatically reset after approximately one to two minutes.

If a fault occurs, the controller displays a SYS FAULT message and the pump, compressor, and heater will shut down. Once the cause of the fault is identified and corrected, press the controller's RESET button to restart the pump.

The overload protector can be adjusted to require manual resetting after an overload fault. Contact our Service Department for adjustment instructions. See Preface, After-sale Support.

The pump motor overload protector is located under the bonnet inside the electrical enclosure.



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 000550.36L. Press **NO** to return to the reservoir fluid temperature display.

Refrigeration Data

Refer to the name plate label on the rear or side of the unit to identify the specific refrigeration data for your unit. For any additional data contact Thermo Fisher.

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Section VIII Troubleshooting

Checklist

Unit will not start or cycles on and off

HX 300s through HX 750s are equipped with a compressor crankcase heater. The crankcase heater warms the oil in the compressor and prevents refrigerant from mixing with the oil. Before start up, the unit must be connected to its power source for at least 12 hours. This allows time for the oil to be heated and separate from the refrigerant.

Check controller for a fault condition.

For CE Mark units, check the circuit protector setting on the bonnet.

For units equipped with an optional Emergency Off (EMO) button, ensure it has not been activated. The EMO location varies, but it is usually located next to the controller.

Check the connections on the rear of the unit.

Check house circuit breaker.

On water-cooled units, ensure the facility water is on and make sure the cooling water supply is connected to the FACILITY WATER INLET connection, not the OUTLET connection. Check the High Pressure Cutout, it may need to be reset (see Section VII, High/Low Pressure Cutouts).

On air-cooled units, ensure the condenser fins are clean and that proper airflow is not restricted.

Check power source for correct voltage output. Refer to the name plate label on the rear of the unit for the specific electrical requirements of your unit. Power source must be specified voltage, ±10%.

On three phase units with three phase pump motors, the phase rotation may be reversed (see Section VII, Phase Rotation).

When using the remote sensor for low-temperature operation the unit itself may, depending on your application and setup, have to maintain an even lower temperature. Should the unit's fluid reservoir temperature exceed the low-end temperature range by 7°C, the unit will shut down.

Unit will not circulate fluid

Check the tubing and any optional filters/cartridges between the unit and your application for obstructions or for cleaning/replacement.

Units with PD and TU type pumps may require pump strainer cleaning. Refer to the name plate label on the rear of the case top to identify the specific pump in your unit. For instructions on cleaning the pump strainer (see Section VII, Pump Strainer).

On units with PD pumps, check the pump and coupling. Make sure the power is off and locate the brass pump and grey motor. A silver clamp ring holds the two together. Remove the clamp and separate the pump and motor. First look to see if the coupling is broken or not, and then check the pump shaft by rotating. If it is seized or sticks then it has failed. Contact Thermo Fisher.

On units with CP type pumps, if the back pressure of the instrument being cooled is greater than the maximum pressure of the pump, adequate flow may not be obtained. Check for obstructions in the tubing.

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Inadequate temperature control
Check/adjust the setpoint in the Operator's Loop.

Ensure the unit is not configured for optional external probe operation.

Make sure the installation of the unit is in compliance with the conditions described in Section III.

Make sure the heat load of the instrument being cooled is not greater than the cooling capacity of the unit.

When the unit is shut off, wait approximately five minutes before restarting. This allows time for the refrigeration pressures to equalize. If the pressures are not allowed to equalize, the compressor will short-cycle (clicking sound) and no cooling will occur.

The controller circuit board may be defective.

No remote box communication
If the CONNECTING display does not extinguish check the cable connections and then toggle the power to the unit. Run the Operator's Loop, it should display REMOTE. If not, rerun the Setup Loop and ensure changes are saved. Check to see that the unit is in the remote mode by observing that the REMOTE ENABLE light on the remote controller is lit.

Returning to local mode
When operating using the remote box, the quickest way to return to the local mode is to press the **NEXT** and **ENTER** keys on the local controller.

No serial communications
All units are tested for serial communications before they leave the factory. Ensure the RMT COMM indicator on the controller is illuminated.

Check all communications commands and settings, they *must be exact*. See Appendix D for RS 232 or Appendix E for RS 485.

Check all wiring for proper connections or possible shorts.

Software to verify serial communication is available from Thermo Fisher.

Service Assistance

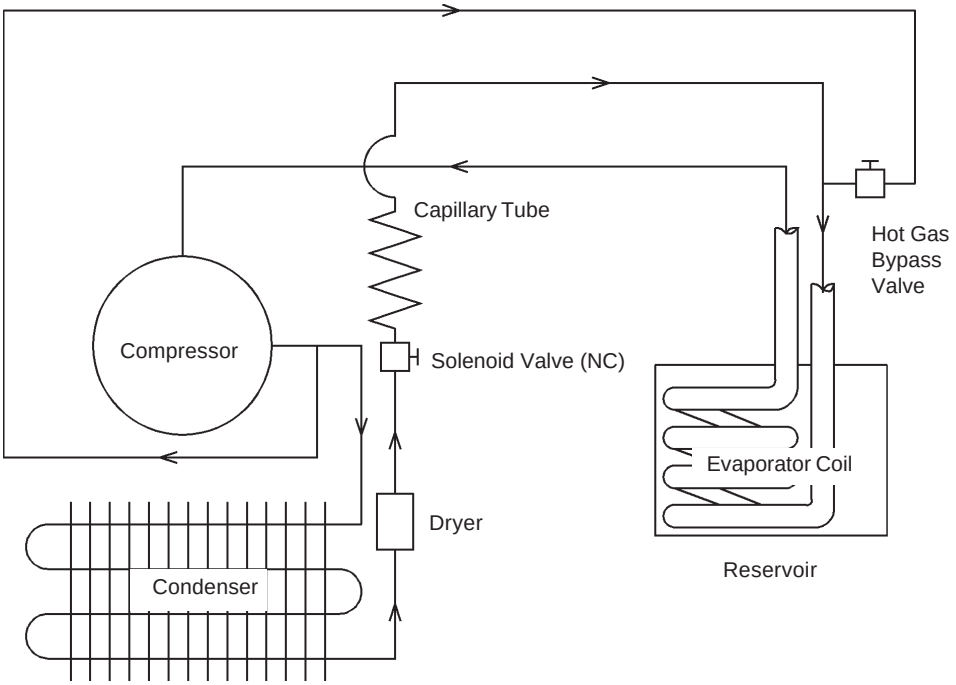
If, after following these troubleshooting steps, your unit fails to operate properly, contact our Service Department for assistance. Before calling, please obtain the following information:

BOM number
Serial number
Voltage of power source
Temperature of facility water
Software version

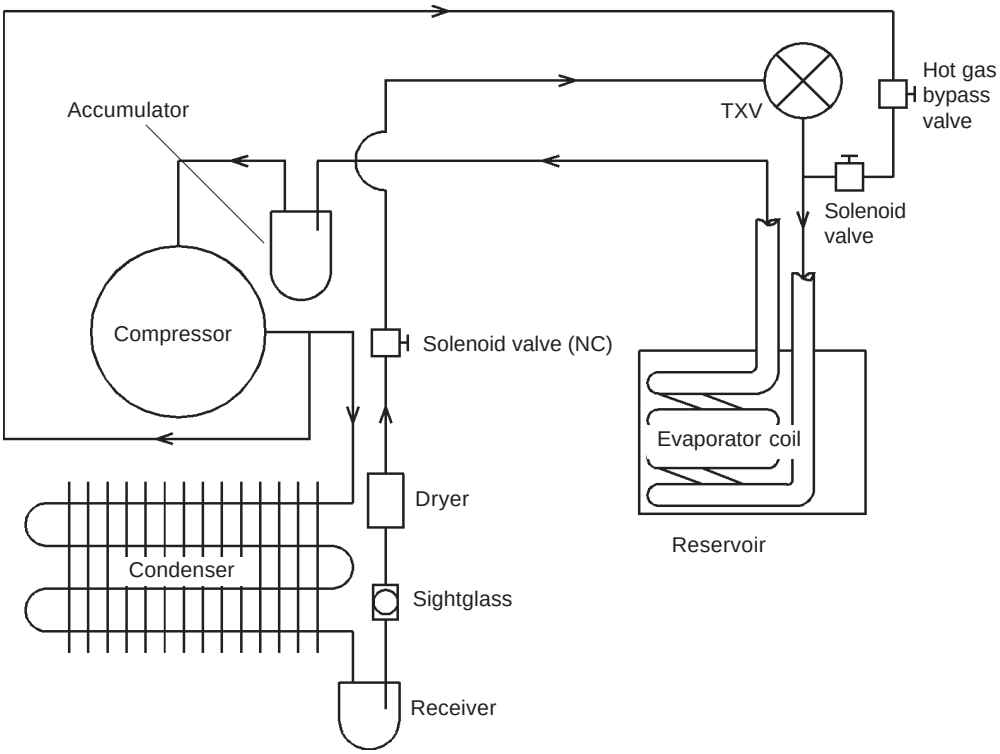
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Section IX Diagrams

Refrigeration Flow Diagram
(HX 75 and HX 150)

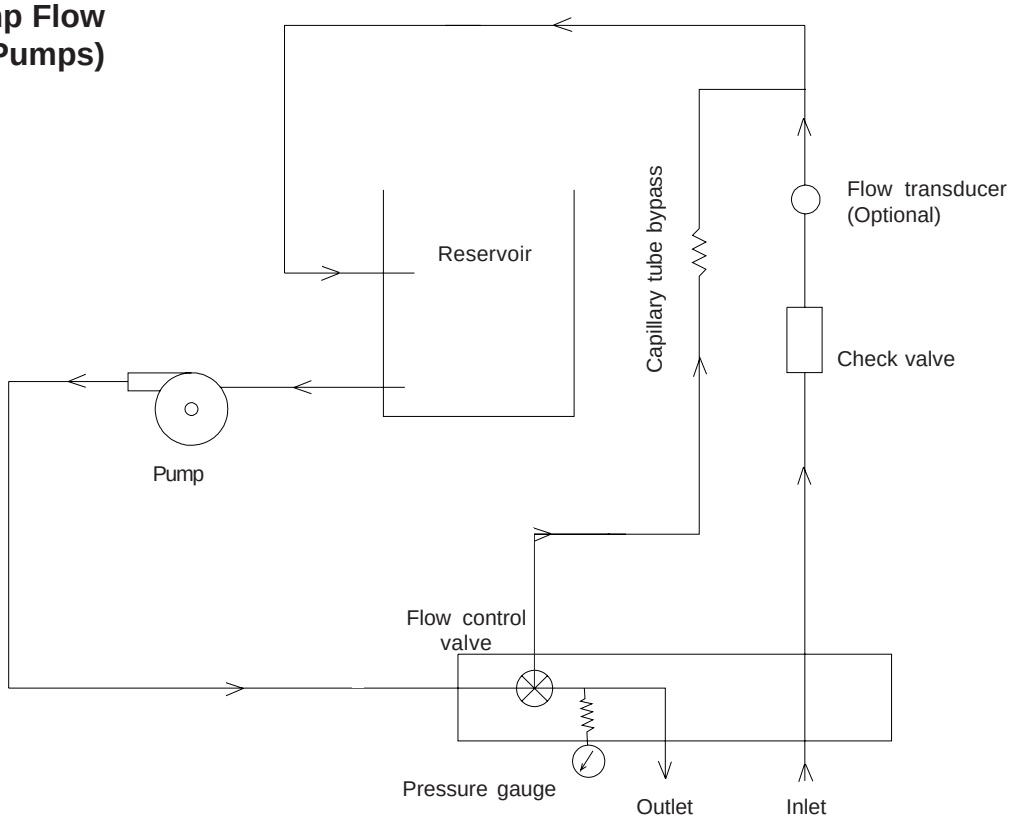


Refrigeration Flow Diagram
(HX 300 through HX 750)

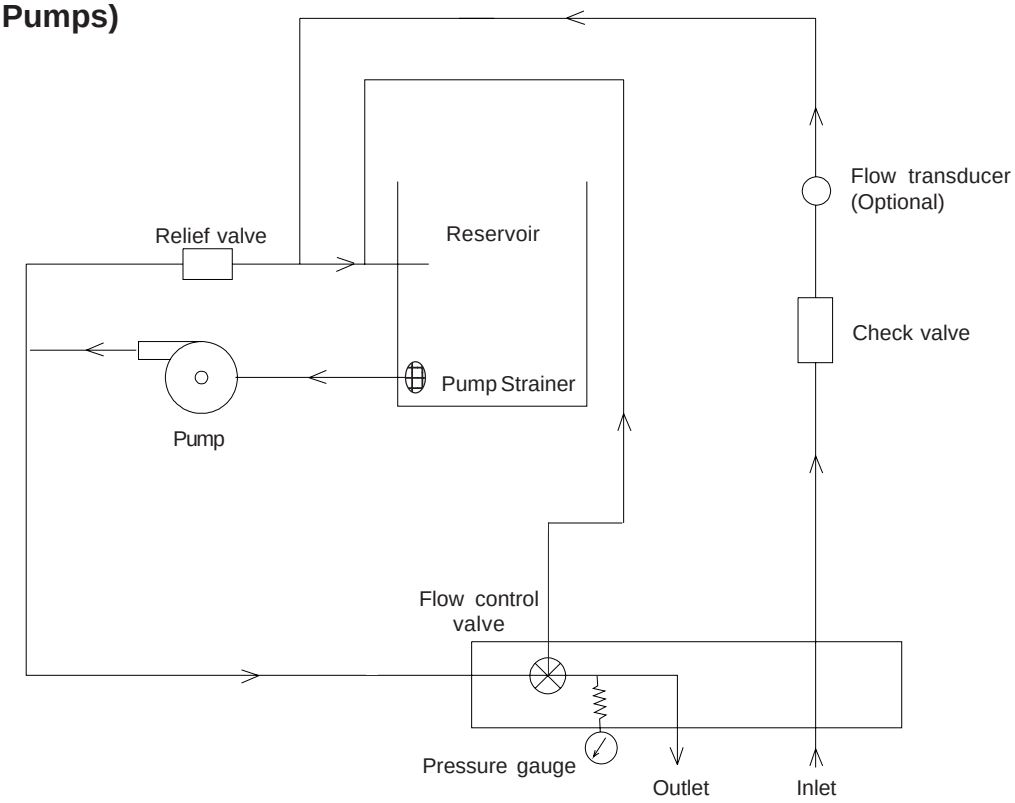


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Pump Flow Diagram (CP Pumps)



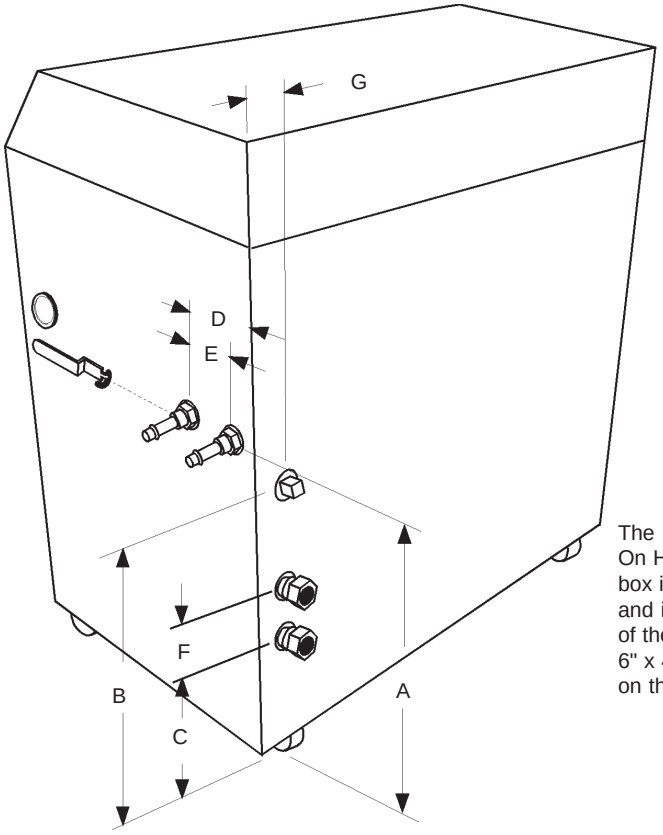
Pump Flow Diagram (PD and TU Pumps)



Diagrams

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Dimensions



The pullbox comes in two sizes. On HX 300s, 500s and 750s the box is 12" x 16" x 4" (H x W x D) and is usually located on the rear of the unit. For all others it is 6" x 6" x 4" (H x W x D) and is located on the left side.

Unit Dimensions	HX75	HX150	HX300	HX500	HX750AC*
Dimension A	16	20	25 3/8	25 1/4	41
Dimension B	15 1/4	19 1/4	23 1/2	21 1/8	33 3/4
Dimension C	8 1/4	9 1/4	8 3/8	5 1/2	NA
Dimension D	7 1/4	7 1/4	7 1/2	9 1/2	9 1/2
Dimension E	3	3	3	3	3
Dimension F	3	3	3	5 1/2	NA
Dimension G	1 3/8	1 3/8	1 1/2	2 1/4	2 1/4
Dimension H	2 1/2	2 1/2	2 3/8	2 1/4	2 1/4
Dimension I	25 7/8	28 1/2	32 1/2	36 1/8	36
Dimension J	48 1/2	54	64 7/8	73 1/2	86 1/4
Crate Dimensions (H x W x D)	32 x 32 x 50	32 x 32 x 50	33 x 45x 51	60 x 45 x 72	60 x 45 x 72

* Air-cooled units. Water-cooled units are the same size as the HX 500 units.

1. Dimensions are given in inches, ±1/8 inch.
2. Model HX 750 with a water-cooled condenser has the same dimensions as an HX-500.
3. Dimension A is the distance from the floor to the center of the SUPPLY and RETURN connections.
4. Dimension B is the distance from the floor to the center of the DRAIN connection.
5. Dimension C is the distance from the floor to the center of the facility water outlet connection.
6. Dimension D is the distance from the center of the SUPPLY connection to the rear of the unit case.
7 Dimension E is the distance between the SUPPLY and RETURN connections
8. Dimension F is the distance between the center of the FACILITY WATER connections (upper inlet and lower outlet).
9. Dimension G is the distance from the edge of the unit case to the center of the three plumbing connections.
10. Dimension H is the distance from the floor to the bottom of the case, height of the castors (not shown).
11. Dimension I is the depth of the unit with the case top open (not shown).
12. Dimension J is the height of the unit with the case top open (not shown).

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Section X Wetted Materials

Fluid Path Plumbing

1 Stainless Steel
2 Brass
3 Copper
4 Nylon
5 Bronz
6 Silver
7 Antimony
8 Nickle
9 EPDM
10 Silicon
11 PVC

CP Pumps

1 Stainless Steel
2 Buna N
3 Graphite
4 Ceramic

TU Pumps

1 Bronze
2 Monel
3 Graphite
4 Buna N

PD-2 Pumps

1 Bronze
2 Stainless Steel
3 Graphite
4. Viton

Appendix A Water Quality Recommendations for Recirculating (Process) Water

	Permissible (PPM)	Desirable (PPM)
Microbiologicals		
(algae, bacteria, fungi)	0	0
Inorganic Chemicals		
Calcium	<25	<0.6
Chloride	<25	<10
Copper	<1.3	<1.0
	0.020 ppm if fluid in contact with aluminum	
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	<25	<1
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)

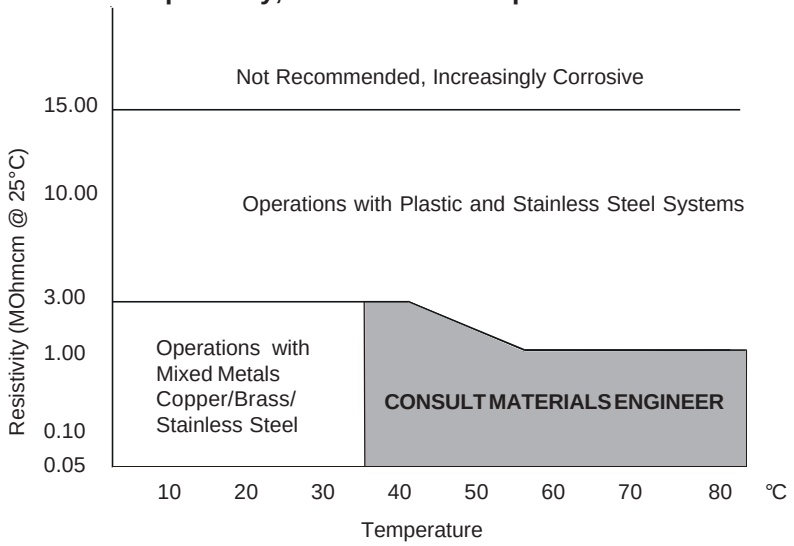
Unfavorably high total ionized solids (TIS) can accelerate the rate of galvanic corrosion. These contaminants can function as electrolytes which increase the potential for galvanic cell corrosion and lead to localized corrosion such as pitting which can be observed at the studs and on the outside surface of cooling coils. Eventually, the pitting will become so extensive that the coil will leak refrigerant into the water reservoir.

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 or deionized water. Do not use untreated tap water as the total ionized solids level may be too high. Although the initial fill may be as high as 10 MOhmcm (compensated to 25°C), the desired level for long time usage for units equipped with a deionization filter 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.

Water Quality/Materials Compatibility, units with in-line partial flow deionization filter



NOTE: For units with an in-line full flow deionization filter mixed metals, including aluminum, can be used up to 40°C and 3 MOhmcm.

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Water Quality Recommendations for Facility Water

	Permissible (PPM)	Desirable (PPM)
Microbiologicals		
(algae, bacteria, fungi)	0	0
Inorganic Chemicals		
Calcium	<40	<0.6
Chloride	<250	<25
Copper	<1.3	<1.0
	0.020 ppm if fluid in contact with aluminum	
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)

NOTE: A corrosion inhibitor is recommended if mixed metals are in the facility water loop.

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Fluid Risk Assessment

Thermo Fisher has determined that uninhibited ethylene glycol can degrade and become corrosive to system materials in as early as three months in certain applications.

This chart shows the fluid preventative maintenance schedule based on application variables that affect the rate of degradation of uninhibited ethylene glycol.

Abiding by this fluid chart will reduce the risk of failure caused by degraded uninhibited ethylene glycol.

Fluid Risk Assessment Chart

Uninhibited Ethylene Glycol

EG operating parameters conductive to *low* degradation rate		**Eg operating parameters conductive to *high* degradation rate**
Flow Rate		
> 4 lpm	3 lpm	< 2 lpm
Resistivity		
> 3 Meg-Ohm	2 MOhmcm	< 2 MOhmcm
Temperature		
< 40°C	40°C - 70°C	> 70°C
Time in Operation		
< 1 Month	2 - 3 Months	> 6 Months

Maintenance Schedule

12 Month - flush and change fluid	6 Month - flush and change fluid	3 Month - flush and change fluid
Low Risk (Monitor Fluid)		**High Risk** (Expect to Change Fluid)

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Appendix B External Probe Calibration

Before using the optional external probe it must be calibrated. To do this you run the unit to its temperature extremes and use the controller's Operator's and Calibration Loops.

Install the external probe into the SENSOR 9-pin "D-sub" located on the rear of the unit.

Use the Operator's Loop to run the unit to its high-end temperature limit. When the setpoint is reached press and hold the **ENTER** key and then press **YES-NO-YES** to display CALIBRATE? Press **YES.**

Press **NEXT** until RMT RTD? is displayed. Press **YES** to display HI CAL? HI xxx.xC will be displayed, use the **YES/NO** keys to reach the desired temperature and the press **ENTER**. Press the **NEXT** key until SAVE? is displayed, press **YES** to return to the Operator's Loop.

Use the Operator's Loop to run the unit to its low-end temperature limit. When the setpoint is reached press and hold the **ENTER** key and then press **YES-NO-YES** to display CALIBRATE? Press **YES**.

Press **NEXT** until RMT RTD? is displayed. Press **YES** to display HI CAL? Press **NO** and LOW CAL? is displayed. Press **YES** and LOWxxx.xC will be displayed, use the **YES/NO** keys to reach the desired temperature and the press **ENTER**. Press the **NEXT** key until SAVE? is displayed, press **YES** to return to the Operator's Loop.

The probe is now calibrated. Re-calibrate as necessary or if the probe is replaced.

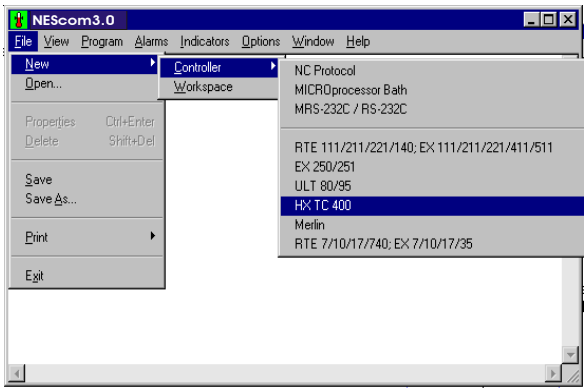
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Appendix C NEScom Programming Software

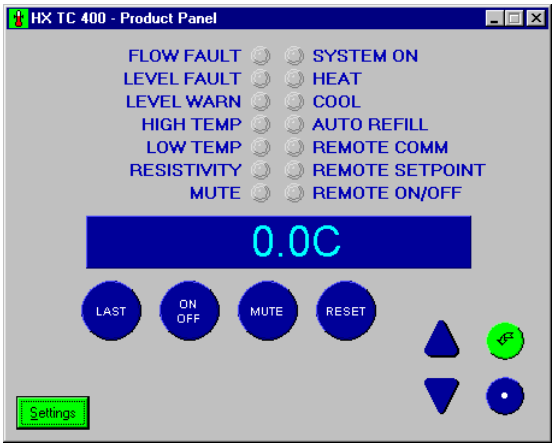
NEScom is a user friendly software that allows you to automate your temperature control process. The software includes a CD, comprehensive Operator's Manual and a toll-free number to a trained technical staff. NEScom Software allows you to write custom temperature programs for our temperature controllers equipped with an RS-232 interface.

Choose upper and lower temperature alarm limits and monitor system status with an alarm. NEScom can also record your results on a user selectable graph. NEScom is PC compatible only.

- For NESLAB units equipped with an RS-232 communications interface
- Select from easy to use product icons
- Create graphs and charts
- Easily configure ramping functions over time
- View pop-up alarm windows which display the error condition
- View a virtual controller screen



Select software functions from the easy to use pulldown menus.



View a virtual controller screen which allows remote monitoring and operation of product control panel.

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Appendix D RS-232 Serial Communications Protocol

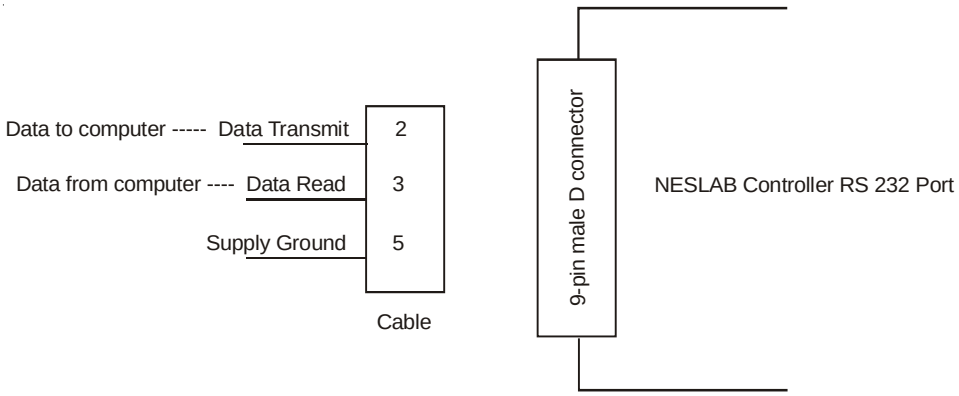
NOTE: This appendix assumes you have a basic understanding of communications protocols.

All data is sent and received in binary form, do not use ASCII. In the following pages the binary data is represented in hexadecimal (hex) format.

The NC Serial Communications Protocol is based on a master-slave model. The master is a host computer, while the slave is the chiller's controller. Only the master can initiate a communications transaction (half-duplex). The slave ends the transaction by responding to the master's query. The protocol uses an RS-232 serial interface with the parameters: 9600 baud,
8 data bits, 1 stop bit, and no parity.

NOTE: Before the unit will communicate, RS232 must be turned on in the controller's Setup Loop.

The unit can be controlled through your computer's serial port by using the unit's standard 9-pin RS-232 connection. Data read of the serial port connects to the data transmit (pin 2) of the unit. Data transmit of the serial port connects to data read (pin 3) of the unit.



Communication cables are available from Thermo Fisher. Contact our sales department for additional information.

All commands must be entered in the exact format shown in the tables on the following pages. The tables on show all commands available, their format and responses. Controller responses are either the requested data or an error message. The controller response *must* be received before the host sends the next command.

The host sends a command embedded in a single communications packet, then waits for the controller's response. If the command is not understood or the checksums do not agree, the controller responds with an error command. Otherwise, the controller responds with the requested data. If the controller fails to respond within 1 second, the host should resend the command.

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NC Serial Communications Protocol

NOTE: All byte values are shown in hex, hex represents the binary values that must be sent to the chiller. **Do not use ASCII.**

The framing of the communications packet in both directions is:

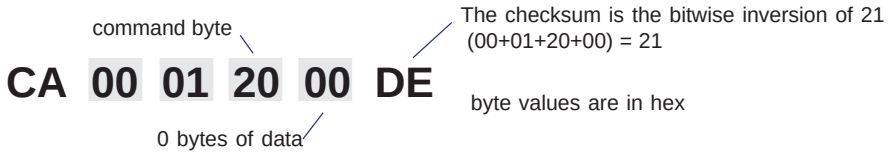
	Checksum region						
Lead char CA	Addr-MSB 00	Addr-LSB 01	Command	n d-bytes	d-byte 1 …	d-byte n	Checksum

Lead char	CA (hex).
	Device address is 1
Addr-msb	Most significant byte of device address is 00 hex.
Addr-lsb	Least significant byte of device address is 01 hex.
Command	Command byte (see Table 1).
n d-bytes	Number of data bytes to follow (00 to 03 hex).
d-byte 1	1st data byte (the qualifier byte is considered a data byte).
…	…
d-byte n	nth data byte.
Checksum	Bitwise inversion of the 1 byte sum of bytes beginning with the most significant address byte and ending with the byte preceding the checksum. (To perform a bitwise inversion, "exclusive OR" the one byte sum with FF hex.)

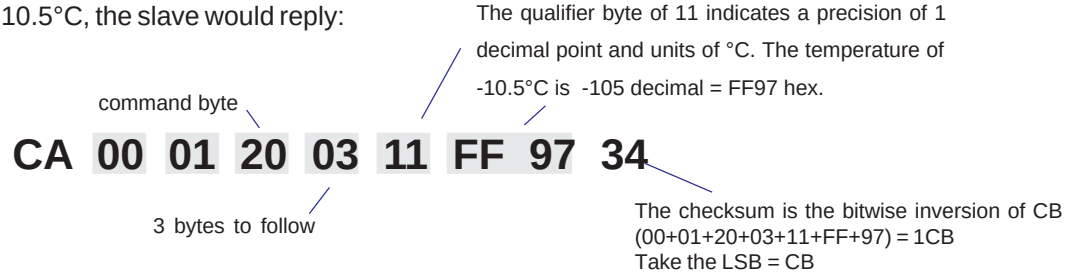
The master requests information by sending one of the Read Functions as shown in Table 1. Since no data is sent to the chiller during a read request, the master uses 00 for the number of data bytes following the command byte.

The chiller will respond to a Read Function by echoing the lead character, address, and command byte, followed by the requested data and checksum. When the chiller sends data, a qualifier byte is sent first, followed by a two byte signed integer (16 bit, MSB sent first). The qualifier byte indicates the precision and units of measure for the requested data as detailed in Table 2.

As an example, the master requests to read internal temperature by sending:



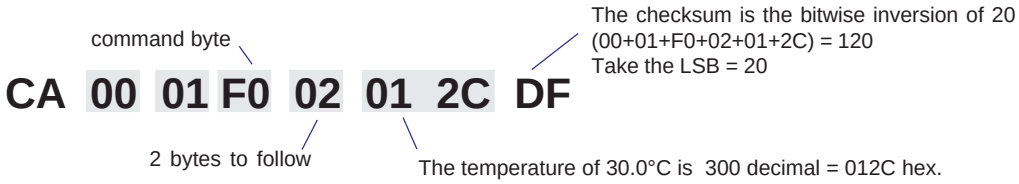
If the temperature is -10.5°C, the slave would reply:



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The master sets parameters in the chiller by sending one of the Set Functions as shown in Table 1. The master does not send a qualifier byte in the data field. The master should be preprogrammed to send the correct precision and units (it could also read the parameter of interest first to decode the correct precision and units needed).

For example, if the master wants to set the setpoint to 30°C, it would send :



The slave responds:

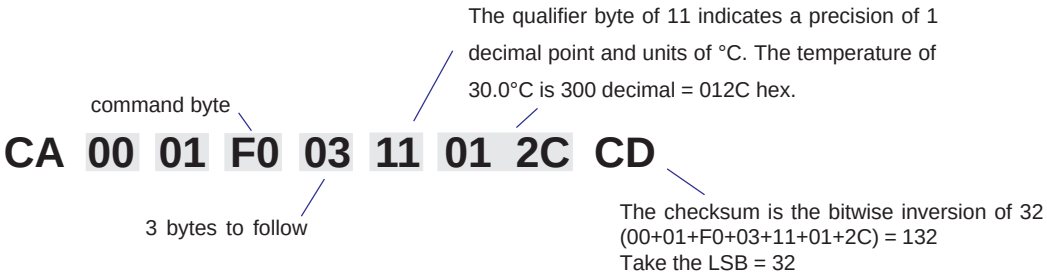


Table 1 Commands (All bytes are in hex)

FUNCTION	MASTER SENDS	UNIT RESPONDS
READ		
Read Internal Temperature	CA 00 01 **20** 00 DE	CA 00 01 **20** 03(qb)(d1)(d2)(cs)
Read External Sensor	CA 00 01 **21** 00 DD	CA 00 01 **21** 03(qb)(d1)(d2)(cs)
Read Setpoint (control point)	CA 00 01 **70** 00 8E	CA 00 01 **70** 03(qb)(d1)(d2)(cs)
Read Low Temperature Limit	CA 00 01 **40** 00 BE	CA 00 01 **40** 03(qb)(d1)(d2)(cs)
Read High Temperature Limit	CA 00 01 **60** 00 9E	CA 00 01 **60** 03(qb)(d1)(d2)(cs)
Read Heat Proportional Band (P)	CA 00 01 **71** 00 8D	CA 00 01 **71** 03(qb)(d1)(d2)(cs)
Read Heat Integral (I)	CA 00 01 **72** 00 8C	CA 00 01 **72** 03(qb)(d1)(d2)(cs)
Read Heat Derivative (D)	CA 00 01 **73** 00 8B	CA 00 01 **73** 03(qb)(d1)(d2)(cs)
Read Cool Proportional Band (P)	CA 00 01 **74** 00 8A	CA 00 01 **74** 03(qb)(d1)(d2)(cs)
Read Cool Integral (I)	CA 00 01 **75** 00 89	CA 00 01 **75** 03(qb)(d1)(d2)(cs)
Read Cool Derivative (D)	CA 00 01 **76** 00 88	CA 00 01 **76** 03(qb)(d1)(d2)(cs)
Read Resistivity Value	CA 00 01 **2C** 00 D2	CA 00 01 **2C** 03(qb)(d1)(d2)(cs)
Read Flow Value	CA 00 01 **10** 00 EE	CA 00 01 **10** 03(qb)(d1)(d2)(cs)
Read Resistivity Setpoint	CA 00 01 **4C** 00 B8	CA 00 01 **4C** 03(qb)(d1)(d2)(cs)
Read Low Flow Setpoint	CA 00 01 **30** 00 CE	CA 00 01 **30** 03(qb)(d1)(d2)(cs)

command bytes shown in **bold**
qb = qualifier byte
d1,d2 = 16 bit signed integer of the value being sent or received
cs = the checksum of the string (see text)
ed = echo back of the command byte as received
v1.v2 = protocol version
* = limited to the range of the chiller
xx = no valid data, include in checksum

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Table 1 Commands (continued) (All bytes are in hex)

FUNCTION	MASTER SENDS	UNIT RESPONDS
SET		
Set Setpoint (control point)*	CA 00 01 **F0** 02(d1)(d2)(cs)	CA 00 01 **F0** 03(qb)(d1)(d2)(cs)
Set Heat Low Temperature Limit*	CA 00 01 **C0** 02(d1)(d2)(cs)	CA 00 01 **C0** 03(qb)(d1)(d2)(cs)
Set Heat High Temperature Limit*	CA 00 01 **E0** 02(d1)(d2)(cs)	CA 00 01 **E0** 03(qb)(d1)(d2)(cs)
Set Low Flow Setpoint	CA 00 01 **B0** 02(d1)(d2)(cs)	CA 00 01 **B0** 03(qb)(d1)(d2)(cs)
Set Resistivity Setpoint	CA 00 01 **CC** 02(d1)(d2)(cs)	CA 00 01 **CC** 03(qb)(d1)(d2)(cs)
Set Heat Proportional Band (P=0.1-99.9)	CA 00 01 **F1** 02(d1)(d2)(cs)	CA 00 01 **F1** 03(qb)(d1)(d2)(cs)
Set Heat Integral (I = 0-9.99)	CA 00 01 **F2** 02(d1)(d2)(cs)	CA 00 01 **F2** 03(qb)(d1)(d2)(cs)
Set Heat Derivative (D= 0-5.0)	CA 00 01 **F3** 02(d1)(d2)(cs)	CA 00 01 **F3** 03(qb)(d1)(d2)(cs)
Set Cool Proportional Band (P=0.1-99.9)	CA 00 01 **F4** 02(d1)(d2)(cs)	CA 00 01 **F4** 03(qb)(d1)(d2)(cs)
Set Cool Integral (I = 0-9.99)	CA 00 01 **F5** 02(d1)(d2)(cs)	CA 00 01 **F5** 03(qb)(d1)(d2)(cs)
Set Cool Derivative (D= 0-5.0)	CA 00 01 **F6** 02(d1)(d2)(cs)	CA 00 01 **F6** 03(qb)(d1)(d2)(cs)
UNIT ERROR RESPONSES		
Bad Command	N/A	CA 00 01 **0F** 02 01(ed)(xx)(cs)
Bad Checksum	N/A	CA 00 01 **0F** 02 03(ed)(xx)(cs)
Bad Data	N/A	CA 00 01 **0F** 02 02(ed)(xx)(cs)
MISCELLANEOUS		
Start Unit	CA 00 01 **81** 01 01 7B	CA 00 01 **81** 01 01 7B
Stop Unit	CA 00 01 **81** 01 00 7C	CA 00 01 **81** 01 00 7C
Request Acknowledge	CA 00 01 **00** 00 FE	CA 00 01 **00** 02(v1)(v2)(cs)
Request Status	CA 00 01 **09** 00 F5	CA 00 01 **09** 04(b1)(b2)(b3)(b4)(cs)

command bytes shown in **bold**
qb = qualifier byte
d1,d2 = 16 bit signed integer of the value being sent or received
cs = the checksum of the string (see text)
ed = echo back of the command byte as received
v1.v2 = protocol version
* = limited to the range of the unit
xx = no valid data, include in checksum

b1, b2, b3, b4 = 4 bytes, each with 4 groups of 2 bits. Each 2 bit group indicates the state of a display LED.
0 = Off, 1 = On, 2 = Undefined, 3 = Flashing

	b1	**b2**	**b3**	**b4**
bit7 bit6	FLOW FAULT	LOW TEMP	HEAT	N/A
bit5 bit4	LEVEL FAULT	RESISTIVITY	COOL	REMOTE SETPOINT
bit3 bit2	LEVEL WARN	MUTE	AUTO REFILL	REMOTE ON/OFF
bit1 bit0	HIGH TEMP	SYSTEM ON	REMOTE COMM	N/A

For example, when byte1 bits 1 and 0 are set to 1, the HIGH TEMP LED is flashing indicating a high temp warn condition. When byte1 bit 0 is set and bit 1 is cleared, the HIGH TEMP LED is on and there is a high temp fault.

Table 2

QUALIFIER BYTE	
00 hex	0 precision, no units of measure
01 hex	0 precision, °C
02 hex	0 precision, °F
10 hex	0.1 precision, no units of measure
11 hex	0.1 precision, °C units
12 hex	0.1 precision, °F units
13 hex	0.1 precision, LPM
14 hex	0.1 precision, GPM
08 hex	0 precision, MOhm-cm
18 hex	0.1 precision, MOhm-cm
20 hex	0.01 precision, no units of measure

Example: The temperature of 45.6°C would be represented by the qualifier 11 hex, followed by the 2 bytes 01 C8 hex (456 decimal).

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Appendix E RS-485 Serial Communications Protocol

NOTE: This appendix assumes you have a basic understanding of communications protocols.

All data is sent and received in binary form, do not use ASCII. In the following pages the binary data is represented in hexadecimal (hex) format.

The NC Serial Communications Protocol is based on a master-slave model. The master is a host computer, while the slave is the bath's controller. Only the master can initiate a communications transaction (half-duplex). The slave ends the transaction by responding to the master's query. The protocol uses an RS-485 serial interface with the default parameters: 9600 baud, 1 start bit, 8 data bits, 1 stop bit, no parity and a selectable address from 1 to 99.

NOTE: Before the unit will communicate, remote operation must be turned on in the controller's Tune/Setup Loop.

The unit can be controlled through your computer's RS-485 serial port by using the unit's 9-pin RS-485 connection. Communication cables are available from Thermo Fisher. Contact our sales department for additional information.

All commands must be entered in the exact format shown in the tables on the following pages. The Tables on the last page of this Appendix show all commands available, their format and responses. Controller responses are either the requested data or an error message. The controller response *must* be received before the host sends the next command.

The host sends a command embedded in a single communications packet, then waits for the controller's response. If the command is not understood or the checksums do not agree, the controller responds with an error command. Otherwise, the controller responds with the requested data. If the controller fails to respond within 1 second, the host should resend the command.

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NC Serial Communications Protocol

NOTE: All byte values are shown in hex, hex represents the binary values that must be sent to the bath. **Do not use ASCII.**

The framing of the communications packet in both directions is:

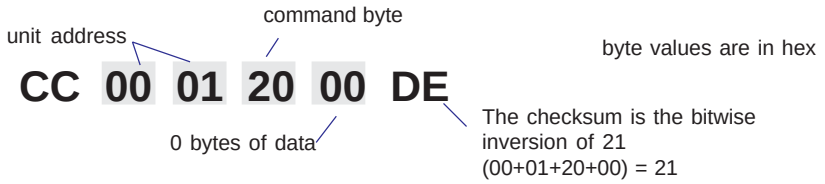
	Checksum region						
Lead char CC	Addr-MSB	Addr-LSB	Command	n d-bytes	d-byte 1 …	d-byte n	Checksum

Lead char	CC (hex).
Addr-msb	Most significant byte of device address is 00 hex.
Addr-lsb	Least significant byte of device address in hex (01 to 63 hex).
Command	Command byte (see Table 1).
n d-bytes	Number of data bytes to follow (00 to 03 hex).
d-byte 1	1st data byte (the qualifier byte is considered a data byte).
…	…
d-byte n	nth data byte.
Checksum	Bitwise inversion of the 1 byte sum of bytes beginning with the most significant address byte and ending with the byte preceding the checksum. (To perform a bitwise inversion, "exclusive OR" the one byte sum with FF hex.)

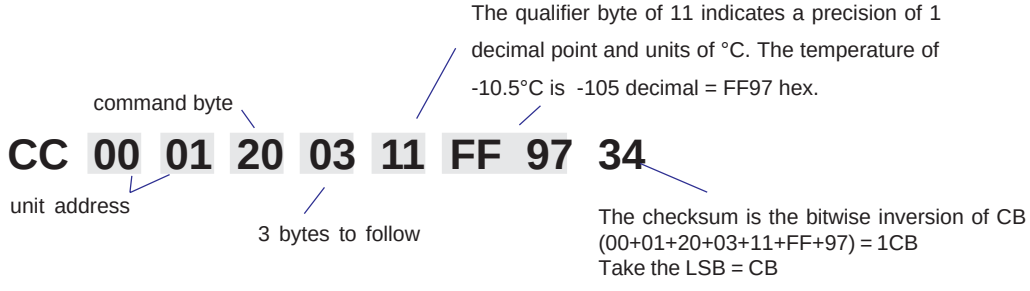
The master requests information by sending one of the Read Functions as shown in Table 1. Since no data is sent to the bath during a read request, the master uses 00 for the number of data bytes following the command byte.

The bath will respond to a Read Function by echoing the lead character, address, and command byte, followed by the requested data and checksum. When the bath sends data, a qualifier byte is sent first, followed by a two byte signed integer (16 bit, MSB sent first). The qualifier byte indicates the precision and units of measure for the requested data as detailed in Table 2.

As an example, the master requests to read internal temperature unit address 01 by sending:



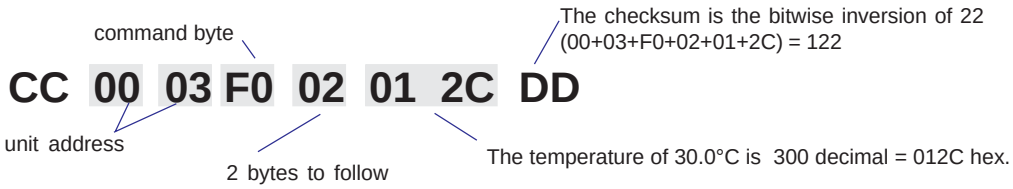
If the temperature is -10.5°C, slave #1 would reply:



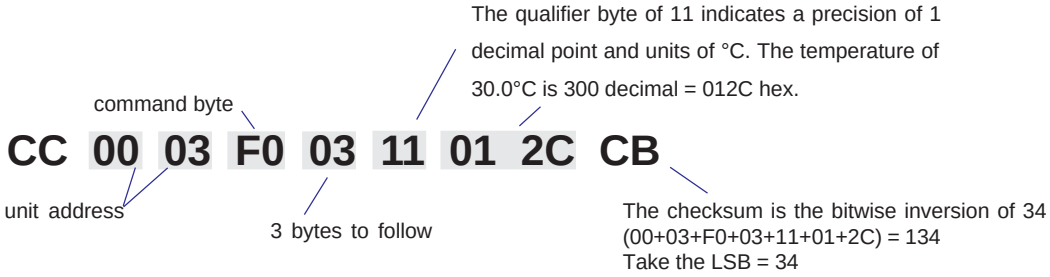
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The master sets parameters in the bath by sending one of the Set Functions as shown in Table 1. The master does not send a qualifier byte in the data field. The master should be preprogrammed to send the correct precision and units (it could also read the parameter of interest first to decode the correct precision and units needed).

For example, if the master wants to set the setpoint to 30°C for unit #3, it would send :



Slave #3 responds:



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Table 1 Typical Commands (All bytes are in hex, all examples use unit address #1)

FUNCTION	MASTER SENDS	UNIT RESPONDS
READ		
Read Internal Temperature	CC 00 01 20 00 DE	CC 00 01 **20** 03(qb)(d1)(d2)(cs)
Read External Sensor	CC 00 01 **21** 00 DD	CC 00 01 **21** 03(qb)(d1)(d2)(cs)
Read Setpoint (control point)	CC 00 01 **70** 00 8E	CC 00 01 **70** 03(qb)(d1)(d2)(cs)
Read Low Temperature Limit	CC 00 01 **40** 00 BE	CC 00 01 **40** 03(qb)(d1)(d2)(cs)
Read High Temperature Limit	CC 00 01 **60** 00 9E	CC 00 01 **60** 03(qb)(d1)(d2)(cs)
Read Proportional Band (P)	CC 00 01 **71** 00 8D	CC 00 01 **71** 03(qb)(d1)(d2)(cs)
Read Integral (I)	CC 00 01 **72** 00 8C	CC 00 01 **72** 03(qb)(d1)(d2)(cs)
Read Derivative (D)	CC 00 01 **73** 00 8B	CC 00 01 **73** 03(qb)(d1)(d2)(cs)
SET		
Set Setpoint (control point)*	CC 00 01 **F0** 02(d1)(d2)(cs)	CC 00 01 **F0** 03(qb)(d1)(d2)(cs)
Set Low Temperature Limit*	CC 00 01 **C0** 02(d1)(d2)(cs)	CC 00 01 **C0** 03(qb)(d1)(d2)(cs)
Set High Temperature Limit*	CC 00 01 **E0** 02(d1)(d2)(cs)	CC 00 01 **E0** 03(qb)(d1)(d2)(cs)
Set Proportional Band (P=1-99.9)	CC 00 01 **F1** 02(d1)(d2)(cs)	CC 00 01 **F1** 03(qb)(d1)(d2)(cs)
Set Integral (I = 0-9.99)	CC 00 01 **F2** 02 d1 d2 cs	CC 00 01 **F2** 03(qb)(d1)(d2)(cs)
Set Derivative (D= 0-5.0)	CC 00 01 **F3** 02 d1 d2 cs	CC 00 01 **F3** 03(qb)(d1)(d2)(cs)
UNIT ERROR RESPONSES		
Bad Command	N/A	CC 00 01 **0F** 02 01(ed)(cs)
Bad Checksum	N/A	CC 00 01 **0F** 02 03(ed)(cs)
MISCELLANEOUS		
Start Unit	CC 00 01 **81** 01 01 7B	CC 00 01 **81** 01 01 7B
Stop Unit	CC 00 01 **81** 01 00 7C	CC 00 01 **81** 01 00 7C
Request Acknowledge	CC 00 01 **00** 00 FE	CC 00 01 **00** 02(v1)(v2)(cs)
Request Status	CC 00 01 **09** 00 F5	CC 00 01 **09** 04(b1)(b2)(b3)(b4)(cs)

command bytes shown in **bold**
qb = qualifier byte
d1,d2 = 16 bit signed integer of the value being sent or received
cs = the checksum of the string (see text)
ed = echo back of the command byte as received
v1.v2 = protocol version
* = limited to the range of the unit

b1, b2, b3, b4 = 4 bytes, each with 4 groups of 2 bits. Each 2 bit group indicates the state of a display LED.
0 = Off, 1 = On, 2 = Undefined, 3 = Flashing

	b1	b2	b3	b4
bit7 bit6	FLOW FAULT	LOW TEMP	HEAT	N/A
bit5 bit4	LEVEL FAULT	RESISTIVITY	COOL	REMOTE SETPOINT
bit3 bit2	LEVEL WARN	MUTE	AUTO REFILL	REMOTE ON/OFF
bit1 bit0	HIGH TEMP	SYSTEM ON	REMOTE COMM	N/A

For example, when byte1 bits 1 and 0 are set to 1, the HIGH TEMP LED is flashing indicating a high temp warn condition. When byte1 bit 0 is set and bit 1 is cleared, the HIGH TEMP LED is on and there is a high temp fault.

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Table 2

QUALIFIER BYTE	
00 hex	0 precision, no units of measure
01 hex	0 precision, °C
02 hex	0 precision, °F
10 hex	0.1 precision, no units of measure
11 hex	0.1 precision, °C units
12 hex	0.1 precision, °F units
13 hex	0.1 precision, LPM
14 hex	0.1 precision, GPM
08 hex	0 precision, MOhm-cm
18 hex	0.1 precision, MOhm-cm
20 hex	0.01 precision, no units of measure

Example: The temperature of 45.6°C would be represented by the qualifier 11 hex, followed by the 2 bytes 01 C8 hex (456 decimal).

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