HX Analog
Recirculating Chiller

NESLAB Manual P/N 002023
Rev. 02/25/92

Installation, Operation, and Maintenance Manual

NESLAB

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Retain all cartons and packing material until the unit is operated and found to be in good condition.

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

Warranty

All NESLAB units are shipped with a warranty card. The top portion of the card remains with the unit. The bottom portion must be filled out and returned to NESLAB.

The unit has a warranty against defective parts and workmanship for one full year from date of shipment. Refer to the last page of this manual for complete warranty details.

After-sale Support

NESLAB is committed to customer service both during and after the sale. If you have questions concerning the operation of your unit or the information in this manual, contact our Sales Department. If your unit fails to operate properly or if you have questions concerning spare parts or Service Contracts, contact our Service Department.

Before calling, please refer to the serial number label on the rear of the case top to obtain the following information (see Section II, Description for the serial number label location):

- unit part number _____

- unit serial number _____

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 Preface, After-sale Support).

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

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

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 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 NESLAB 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.

Section II General Information

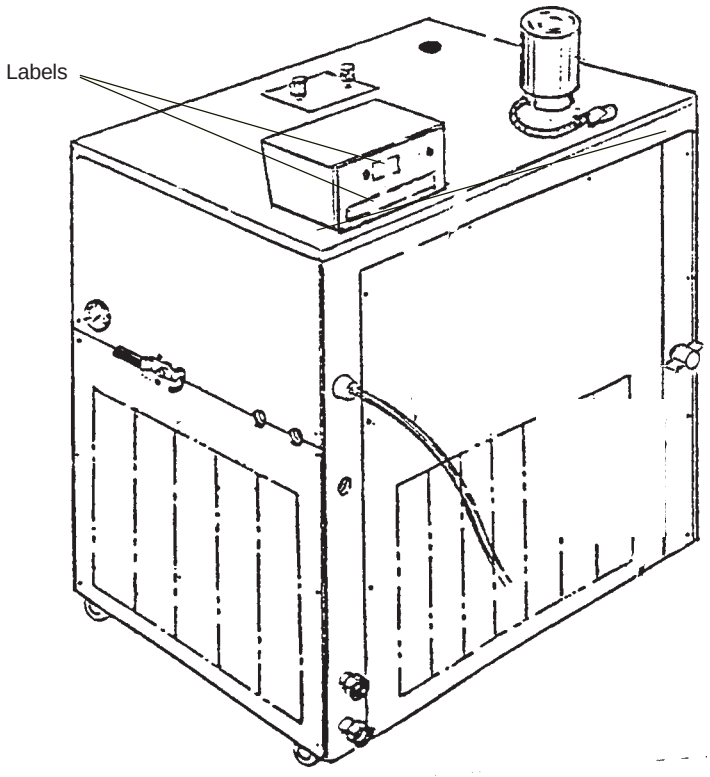
Description

The 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.

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 serial number label, or the pump identification label, or both, for specific information. Both labels are located on the rear of the temperature control box.



Specifications

	HX-75	HX-100	HX-150
Temperature Range	+5°C to +35°C		
Temperature Stability	±0.1°C		
Unit Dimensions (H x W x D) *Inches* *Centimeters*	35 ¾ x 23 ¼ x 18 ¾ 90.8 x 59.0 x 47.6	38 ¼ x 26 ¼ x 21 ¼ 96.8 x 66.7 x 53.6	39 ¾ x 26 ¼ x 21 ¼ 101.0x 66.6 x 53.6
Reservoir Volume *Gallons* *Liters*	5.0 19.0	8.0 30.3	
Shipping Weight *Pounds* *Kilograms*	261 118	300 136	320 145

	HX-200	HX-300	HX-500	HX-750
Temperature Range	+5°C to +35°C			
Temperature Stability	±0.1°C			
Unit Dimensions[1] (H x W x D) *Inches* *Centimeters*	45 7/8 x 33 ¾ x 25 ¼ 116.5 x 85.7 x 64.1		50 5/8 x 46 x 28 ¾ 128.3 x 116.8 x 73.0	63 ¾ x 46 x 29 162.0 x 116.8 x 73.6
Reservoir Volume *Gallons* *Liters*	15.0 56.8		28.0 106.0	40.0 151.0
Shipping Weight *Pounds* *Kilograms*	471 214	531 241	746 338	971 440

1. HX-750 with a water-cooled refrigeration system has the same dimensions as the HX-500.

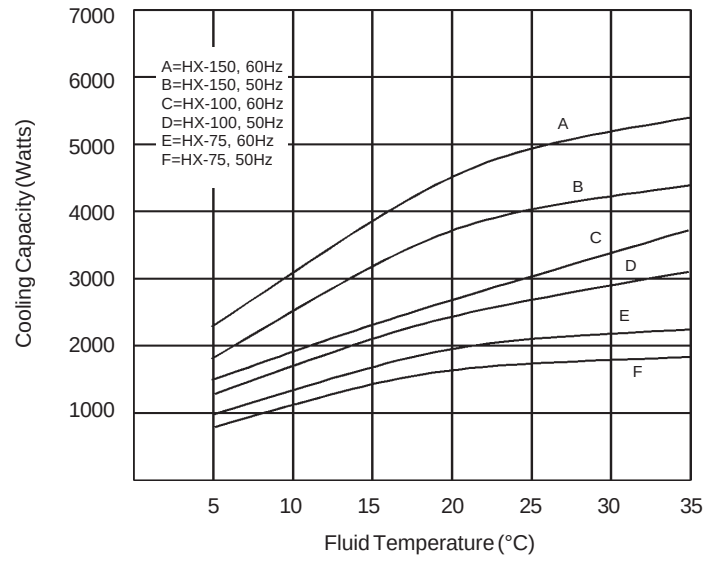
Cooling Capacity

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

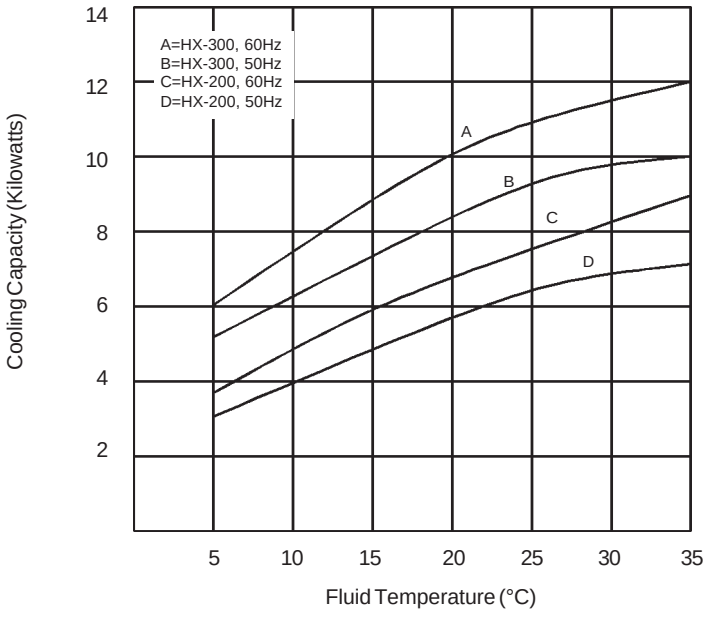
Cooling capacities for models HX-75 through HX-750 were obtained under the following conditions:

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.*

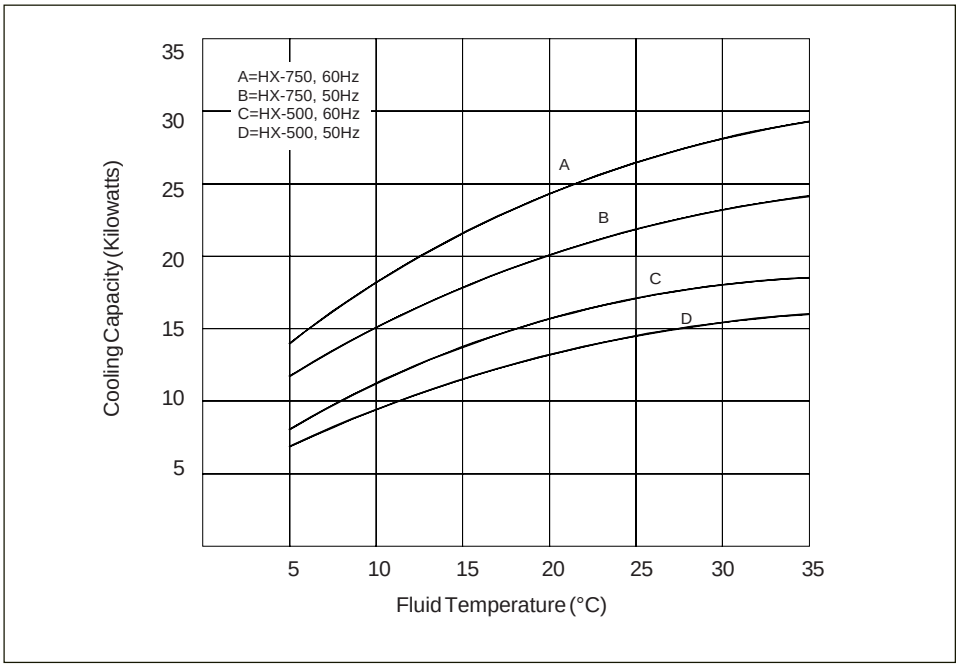
HX-75, 100, & 150



HX-200 & 300



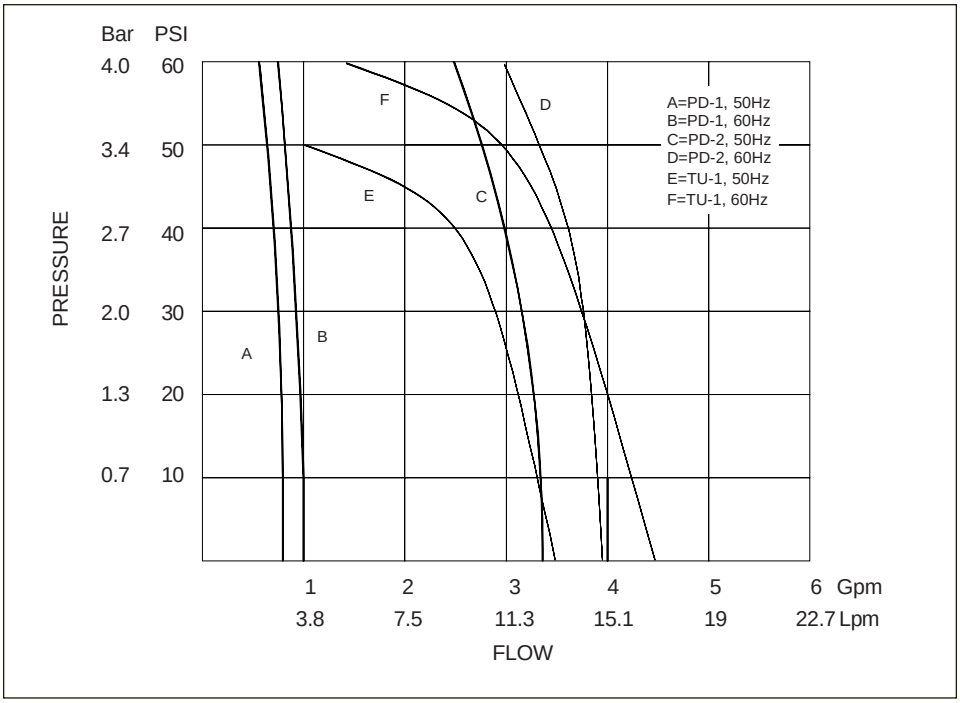
HX-500 & 750



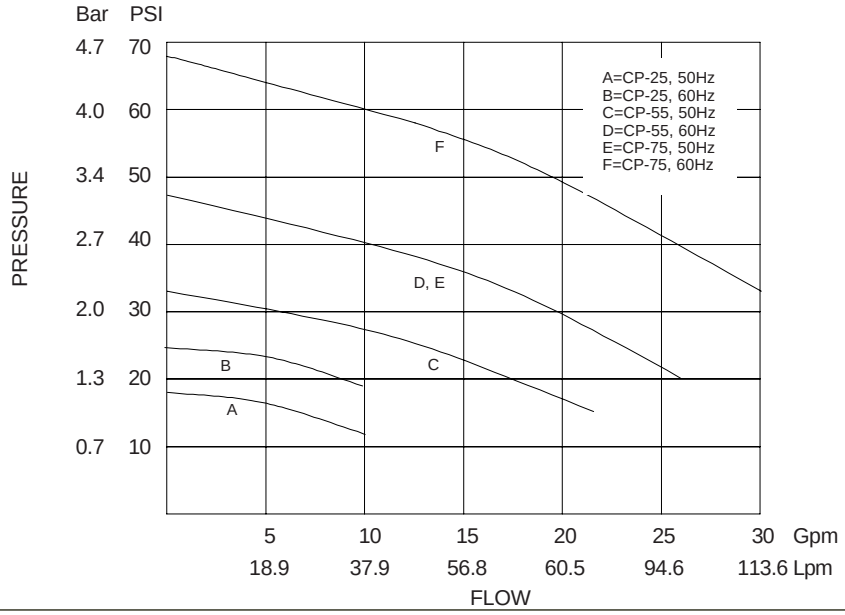
Pump Capacity

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

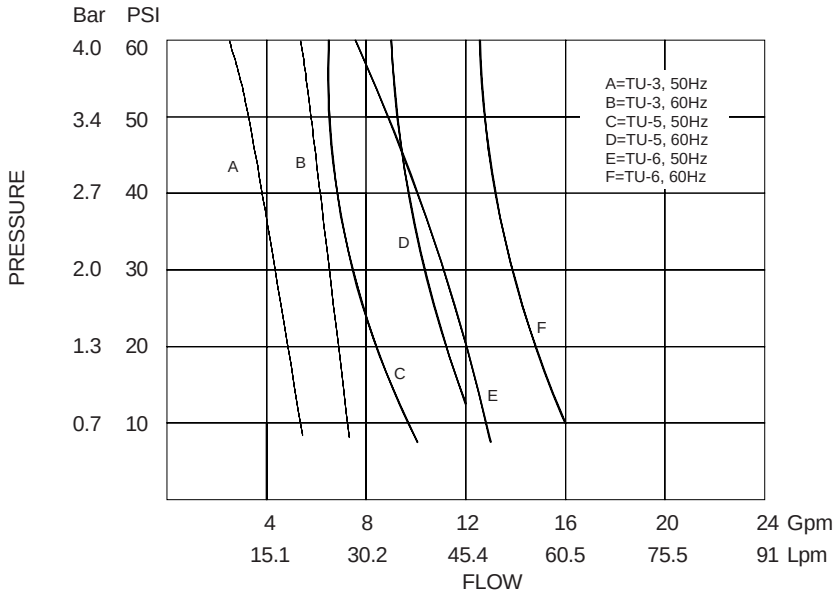
PD1, PD2 & TU1



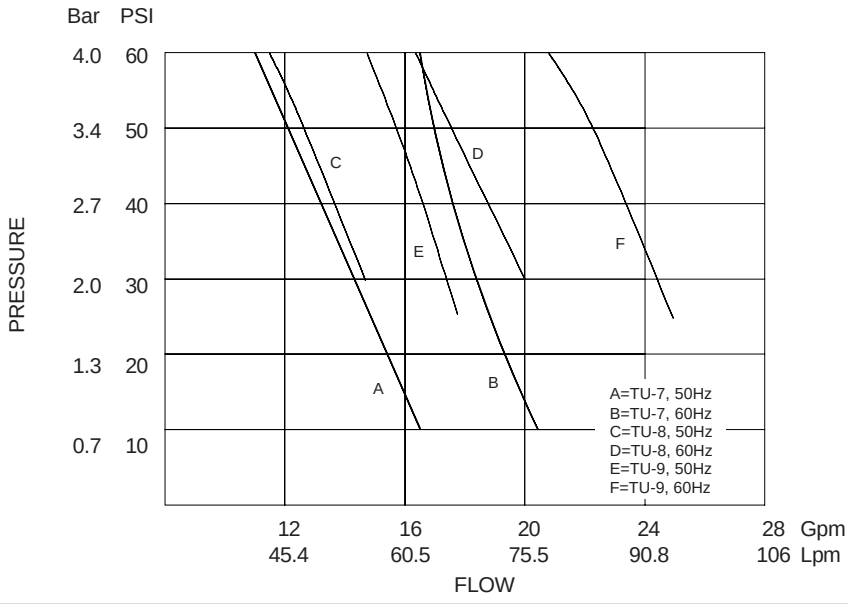
CP



TU-3, 5 & 6



TU-7, 8 & 9



Section III Installation

Site (Air-cooled Units)

The unit should be located in a laboratory or clean industrial environment where ambient temperatures are inside the range of +55°F to +95°F (+13°C to +35°C). The unit will retain its full rated capacity in ambient temperatures to approximately +75°F (+24°C). Above +75°F, reduce the cooling capacity 1% for every 1°F above +75°F, to a maximum ambient temperature of +95°F. In degrees Celsius, 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 through 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-200 — HX-750, air is drawn through the front of the unit and discharged through the side and rear. A minimum of 5 feet (1.5 meters) on all four sides of the unit is necessary for adequate ventilation.

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.

Excessively dusty areas should be avoided and a periodic cleaning schedule should be instituted (see Section VII, Condenser Cleaning).

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 derated.

	HX-75	HX-100	HX-150	HX-200
Air Intake				
Cubic feet per minute	600	710	1050	2000
Liters per minute	17000	20100	29730	56640

	HX-300	HX-500	HX-750
Air Intake			
Cubic feet per minute	1900	5000	5600
Liters per minute	53800	141750	158800

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 for the unit to be moved for access on all four sides. A minimum access clearance of 3 feet (1 meter) on two adjacent sides is recommended.

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. If the facility cooling water does not meet these standards, the cooling capacity will be derated.

As the temperature of the cooling water supply increases, the required flow rate and pressure of the cooling water supply increases. For example, with a model HX-150, if the temperature of the cooling water supply is +65°F, the flow rate must be at least 1.5 gallons per minute, with a pressure differential of at least 3.5 PSI. However, if the temperature of the cooling water supply is +85°F, the flow rate must be at least 4.0 gallons per minute, with a pressure differential of at least 10 PSI.

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

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

	Temperature of cooling water supply			
	+55°F (+13°C)	**+65°F (+18°C)**	**+75°F (+24°C)**	**+85°F (+29°C)**
HX-75				
Flow Rate				
Gallons per minute	0.7*	1.0	1.5	3.0
Liters per minute	2.8*	3.7	5.7	11.4
Pressure Drop				
PSI	1.5*	2.0	3.5	8.0
Bar	0.10*	0.13	0.24	0.55
HX-100				
Flow Rate				
Gallons per minute	1.0*	1.5	2.0	3.5
Liters per minute	3.7*	5.7	7.6	13.2
Pressure Drop				
PSI	2.0*	3.5	5.0	10.0
Bar	0.13*	0.24	0.34	0.69
HX-150				
Flow Rate				
Gallons per minute	1.0*	1.5	2.5	4.0
Liters per minute	3.7*	5.7	9.5	15.1
Pressure Drop				
PSI	2.0*	3.5	6.0	10.0
Bar	0.13*	0.24	0.41	0.69
HX-200				
Flow Rate				
Gallons per minute	1.8*	2.5	3.5	6.0
Liters per minute	6.8*	9.5	13.2	22.7
Pressure Drop				
PSI	5.0*	6.0	7.0	18.0
Bar	0.34*	0.41	0.48	1.24
HX-300				
Flow Rate				
Gallons per minute	2.5*	4.0	6.5	11.0
Liters per minute	9.5*	15.1	24.6	41.6
Pressure Drop				
PSI	6.0*	8.0	13.5	25.0
Bar	0.41*	0.55	0.93	1.72
HX-500				
Flow Rate				
Gallons per minute	3.5	5.0	8.0	16.0
Liters per minute	13.2	18.9	30.3	60.6
Pressure Drop				
PSI	13.0	17.0	23.0	57.0
Bar	0.89	1.17	1.58	3.93
HX-750				
Flow Rate				
Gallons per minute	6.0	8.0	12.5	16.6
Liters per minute	22.7	30.3	47.3	62.8
Pressure Drop				
PSI	14.0	20.0	28.5	40.0
Bar	0.96	1.38	1.96	2.76

*Estimated values

Electrical Requirements

Refer to the table below to determine electrical requirements of your unit. Verify the requirements by reviewing the ratings listed on the serial number label on the rear of the case top or rear of analog temperature controller.

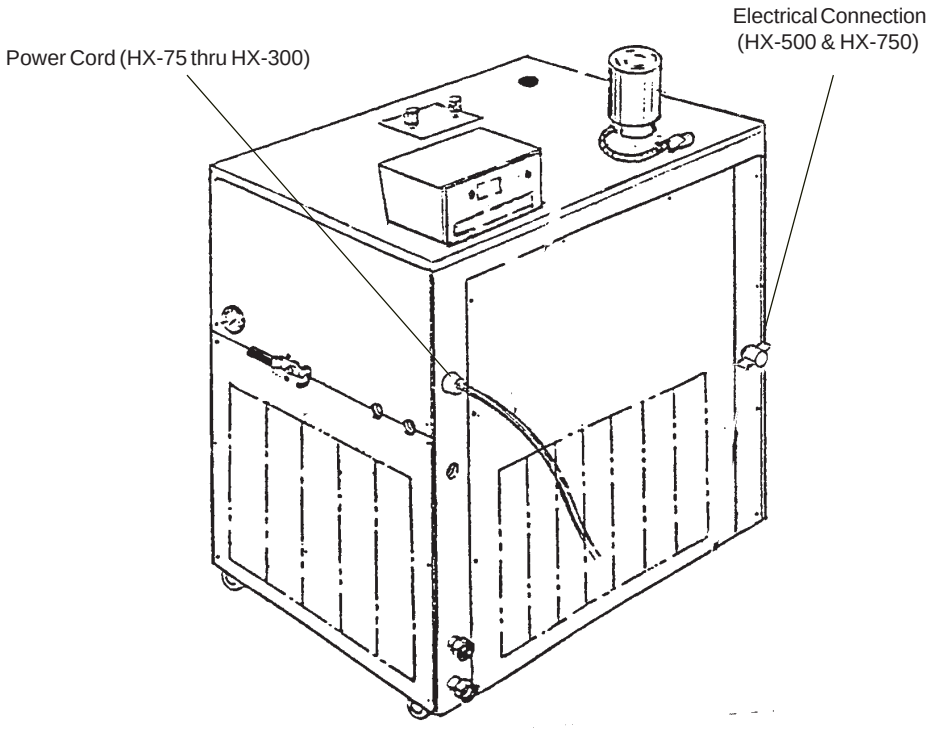
	HX-75	HX-100	HX-150
Volts	208/230 220/240		
Hertz	60 50		
Phase	1 1		
Plug	NEMA L6-30P or L6-20P		

	HX-200	HX-300		HX-500	HX-750
Volts	208/230	200/220	380/420	208/230	380/420
Hertz	60	50	50	60	50
Phase	3	3	3	3	3
Plug	NEMA L15-30P or L16-20P			N/A	

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 have an 8 foot (2.4 meter) power cord installed on the unit at the time of shipment.

NOTE: Custom units equipped with heaters may not have a power cord. See Section VI, Special Features.



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

Models HX-500 and HX-750 are supplied with a disconnect box. Installation of the cable is the user's 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.

Models HX-200 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, 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.

Plumbing Requirements

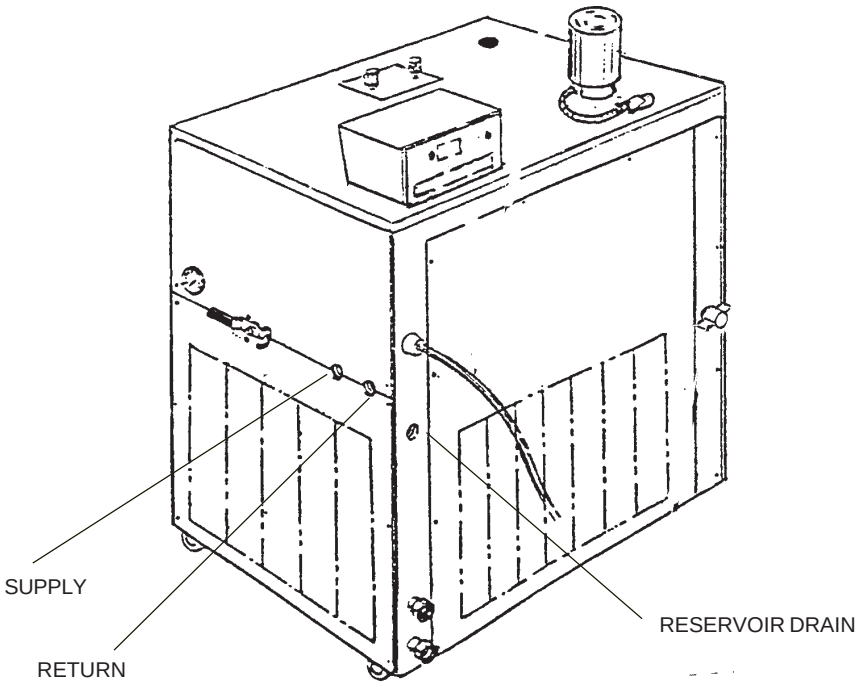
Air-cooled and water-cooled units

Before installing the unit to an instrument that previously used tap water as a cooling fluid, flush the instrument several times to remove any rust or scale that has built up. 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 FPT.

Remove the protective plugs from the SUPPLY and RETURN connections. Connect the SUPPLY fitting to the inlet of the instrument being cooled. Connect the RETURN fitting to the outlet of the instrument being cooled.

The RESERVOIR DRAIN connection on the rear of the unit is a ½ inch FPT fitting connected internally to the unit's fluid reservoir. This fitting provides a means 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.

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.

Flexible tubing, if used, should be heavy wall or reinforced construction. All tubing should be rated to withstand 110 psi at +35°C. Make sure all tubing connections are securely clamped. Avoid running tubing near radiators, hot water pipes, etc. If substantial lengths of tubing are necessary, insulation may be required to prevent loss of cooling capacity.

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

It is important to keep the distance between the unit and the instrument being cooled as short as possible, and to use the largest diameter tubing practical. Tubing should be straight and without bends. If diameter

reductions must be made, they should be made at the inlet and outlet of the instrument being cooled, not at the 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 TAP WATER and DRAIN). On models HX-75 through HX-300, these fittings are ½ inch FPT. On models HX-500 and HX-750, these fittings are 1 inch FPT.

Remove the plastic protective plugs from the TAP WATER and DRAIN connections. Connect the TAP WATER fitting to the facility cooling water supply. Connect the DRAIN fitting to a drain.

Fluids

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

Never use flammable or corrosive fluids with this unit. Distilled and deionized water may be aggressive and cause material corrosion. Please contact NESLAB before subjecting this unit to prolonged exposure to distilled or deionized water.

Tap water is the recommended fluid for operation from +8°C to +35°C.

Below +8°C, a non-freezing solution is required. A 50/50 mixture, by volume, of water and laboratory grade ethylene glycol is suggested.

Do not use automobile anti-freeze. Commercial anti-freeze contains silicates that can damage the pump seals. Use of automobile anti-freeze will void the manufacturer's warranty.

For units with extended temperature ranges above +35°C, tap water is the recommended fluid up to +80°C. Above +80°C, the user is responsible for the fluid(s) used.

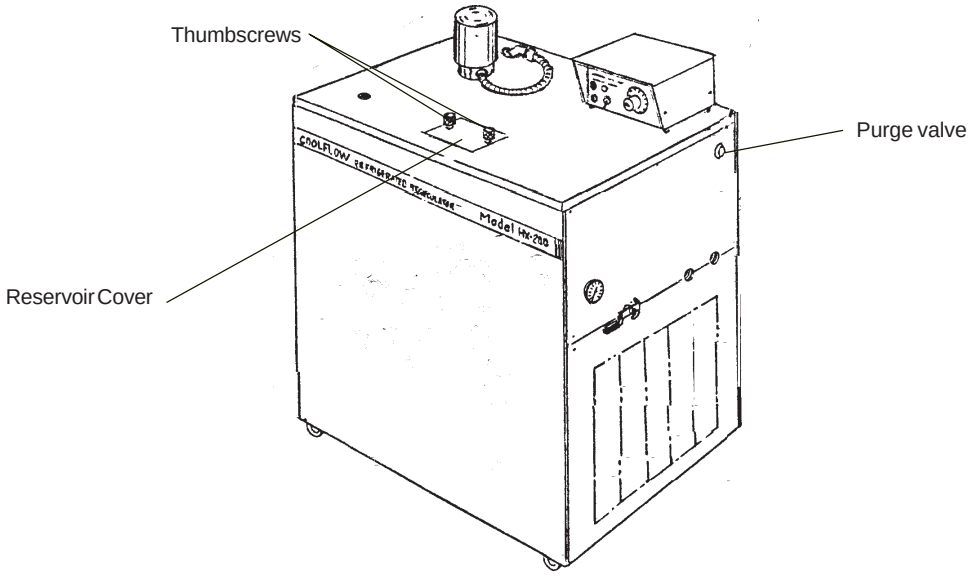
Filling Requirements

The reservoir cover is located at the left corner of the case top. 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.



Pump Purging

Models HX-100 through HX-300 with a CP-55 pump may require pump purging. Refer to the pump identification label on the rear of the control box to identify the specific pump in your unit.

Pump purging is necessary to purge air trapped in the pump head cavity. Once the unit is started, open the flow control valve (see Section V, Flow Control). It there is no flow in the SUPPLY line, or if the flow is restricted, purging is necessary (see Section 11, Pumps to review the pump flow and pressure specifications).

Place a container directly under the purge valve, located on the right side of the unit, above the SUPPLY and RETURN connections. Start the unit and open the flow control valve. Turn the PURGE valve about 1/4 clockwise. After a few moments, cooling fluid should flow from the purge valve.

Once flow is established, close the PURGE valve and the flow control valve. The pump is now purged and the unit is ready for operation.

Section IV Operation

Start Up

Before starting, check all electrical and plumbing connections and make sure the recirculating system (the HX, your application, and the recirculation lines) has been properly filled with cooling fluid.

For water-cooled units — ensure that the facility water is turned on.

Models HX-200 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, 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.

To start the unit, place the Power On/Off switch in the On position. The pump and refrigeration system will start, and the POWER indicator will light. After starting recheck the fluid level, a "top off" may be needed. To shut the unit off, place the Power switch in the Off position.

When the unit is shut off, wait approximately 5 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.

Refrigeration Control

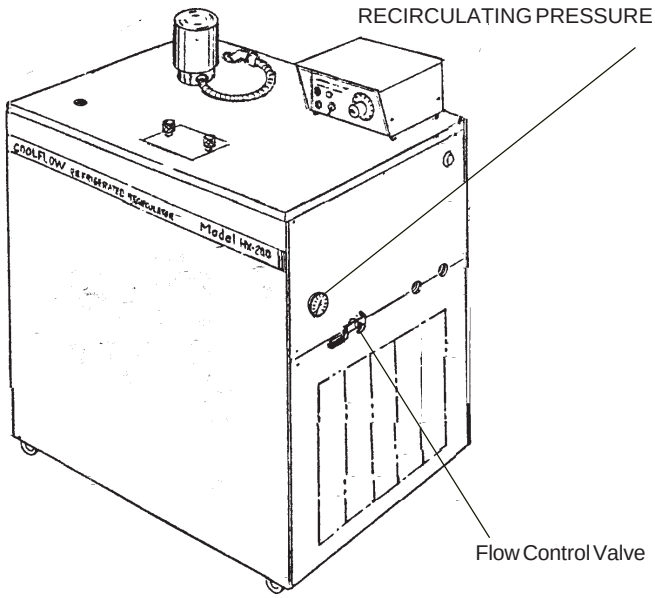
Turn the calibrated dial until the desired temperature aligns with the reference line.

The refrigeration compressor runs continuously, unless the fluid temperature exceeds +40°C. A hot gas by-pass system is used to maintain constant temperature in all units.

The HEAT and COOL indicators, located on the control panel, indicate the status of the refrigeration system. The HEAT indicator is lit when the unit is in the hot gas by-pass mode. The COOL indicator is lit when the refrigeration system is removing heat from the cooling fluid. As the fluid temperature approaches the temperature setpoint, the indicators cycle on and off to indicate the duty cycle of the system. The unit can be in COOL or HEAT, but never both at the same time. A balance between COOL and HEAT controls the temperature.

Flow Control

The flow control handle is connected to a valve that controls the flow rate of the cooling fluid to the instrument being cooled. The handle is located on the right side of the unit and is labelled RECIRCULATING FLOW CONTROL.



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

Never “crank” the valve wide open from the closed or slightly open position.

Pressure Gauge

Units with a PD-1, PD-2, or any TU type pump are equipped with a pressure gauge. Refer to the pump identification label on the rear of the controller to identify the specific pump in your unit. The RECIRCULATING PRESSURE gauge is located next to the flow control handle. The gauge indicates the operating pressure of the system.

Pressure Relief Valve
(PD and TU Pumps Only)

Units with a PD-1, PD-2, or any TU type pump have an adjustable pressure relief valve. Refer to the pump identification label on the rear of the controller 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 operating pressure of the system is determined by the back pressure of the connected equipment and the setting of the flow control valve. If adjustment seems necessary, consult our Service Department for assistance.

Before calling, refer to the serial number label on the rear of the case top to obtain the following:

- unit part number
- unit serial number

High Pressure Cutout
(Water-Cooled Units Only)

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

Once the cause of the problem has been identified and corrected you must manually reset the cutout. The cutout location depends on the size of your unit. On the HX-75, it is behind the right side panel, on the HX-100 and HX-150 it is behind the left side panel, and on the HX-200 through HX-750 it is behind the rear panel.

Locate the white reset switch on the high pressure cutout. Press in on the switch until a "click" is heard. If the reset does not "click" the cutout was not activated and the unit shut down occurred for another reason.

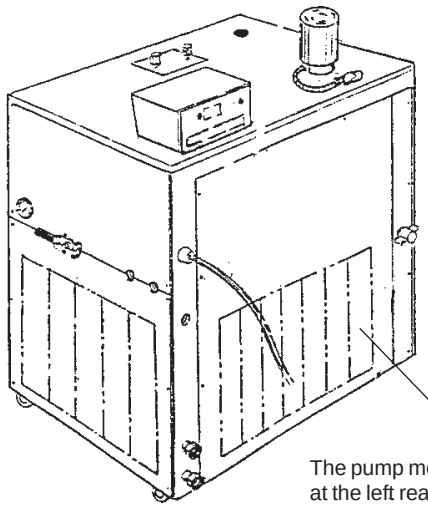
Section V Special Features

Pump Motor Overload Protector

Refer to the serial number label for the specific electrical requirements of your unit; specifically, identify the phase requirements of your unit.

Three phase units with three phase pump motors are equipped with a pump motor overload protector. 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.

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 at the left rear corner (mounted directly under the fluid reservoir). The fault indicator is visible through the rear access panel.

The unit's response to a fault will vary depending on the unit's configuration.

If the unit has a single phase pump motor, the unit will continue to run if an overload fault occurs. The pump will restart as soon as the protector resets. If the unit has a three phase pump motor, the pump and refrigeration system will both shut down until the protector resets.

If you are unsure of the phase of the pump motor in your unit, contact our Service Department (see Preface, After-sale Support).

Optional Heater Package (Digital)

A separate control box on top of the unit houses a heater high temperature limit device. This control box is labelled HEATER GUARD. On the front panel of the control box is a HEATER LIMIT °C setting knob, a RESET button, a HEAT indicator and a FAULT indicator.

The high temperature limit device will disconnect power to the heater if the heater surface temperature exceeds a preset limit. The RESET button will pop out and the FAULT indicator will light if the high temperature limit device is tripped.

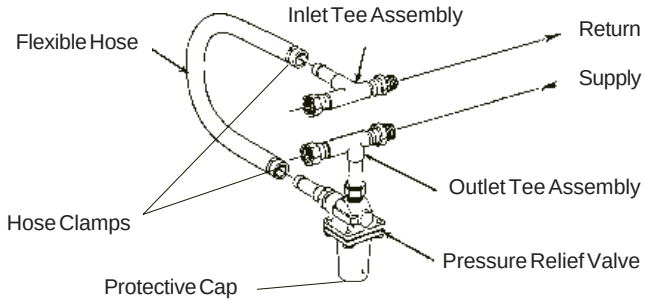
Adjust the HEATER LIMIT °C knob for the lowest value suitable for your application. The high temperature limit device senses the surface temperature of the heater, not the liquid temperature. The heater surface temperature may be several degrees hotter than the fluid being heated.

During normal operation, the HEAT indicator will cycle on and off as required by the unit's's temperature controller. Should the heater temperature exceed the set limit, due, for example, to low fluid level or control failure, the limit device opens a mechanical relay to remove power from the heater. To restore normal operation, correct the cause of the fault and then press the RESET button.

External Pressure Regulator (Optional)

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 pressure of the system is determined by the back pressure of the connected equipment and the flow rate of the recirculating fluid to your application.

Connect the EPR assembly as shown below. Tighten the hose clamps tight enough to prevent leakage. Do not over-tighten or the clamps will “bite” into the flexible tubbing 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.

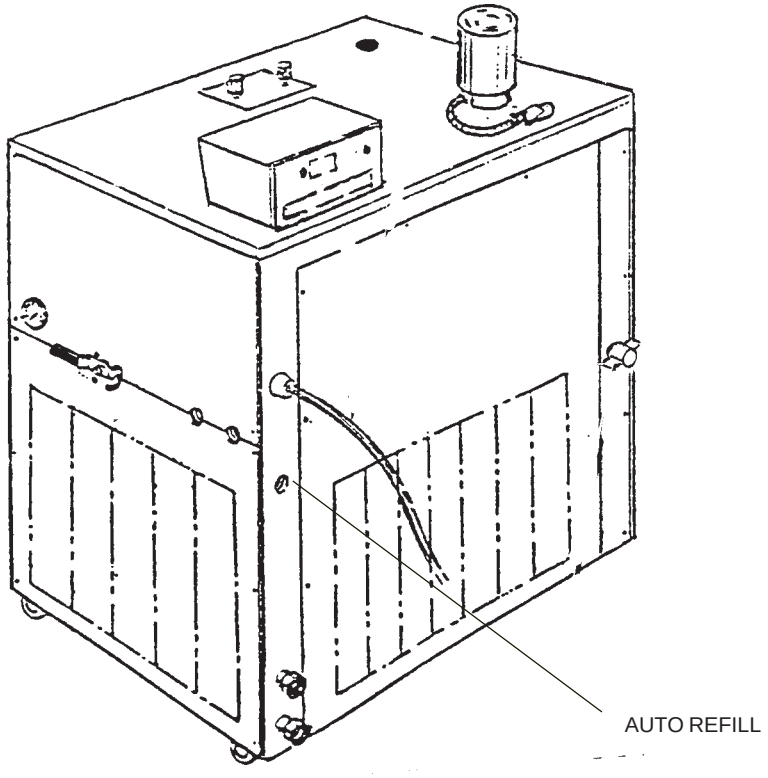
Automatic Refill Device (Optional)

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

The plumbing connection for the refill device is located at the right 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 make-up fluid source using $^{5}/_{16}$ or $^{3}/_{8}$ inch ID flexible tubing. Make sure all tubing connections are securely clamped.

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



Section VI Maintenance

Service Contracts

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

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.

The frequency of cleaning depends on the operating environment. It is recommended that a visual inspection of the condenser be made monthly after initial installation. After several months, the frequency of cleaning will be established.

Periodic vacuuming of the fins on the condenser is necessary.

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.

Algae

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

NESLAB recommends the use of Chloramine-T, one gram per gallon.

Section VII Service

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

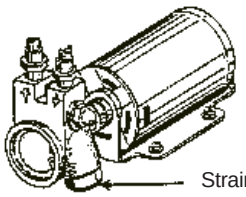
Pump Strainer
(PD and TU Pumps Only)

If debris is drawn into the recirculating system, the strainer will prevent the material from being sucked into the pump and damaging the pump vane. After initial installation, the strainer may become clogged with debris and scale. Therefore, the strainer must be cleaned after the first week of use. 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 the strainer removed.

PD-1 Pumps

The wire mesh pump strainer is located on the inlet (suction) side in the pump head. Remove the top right access panel to access the pump area. Unscrew the larger of the two acorn nuts on the pump head and remove the screen. Clean the screen by rinsing it with water.


Strainer

When the screen is clean, replace it in the pump head and tighten the acorn nut. Replace the access panel and close the case top.

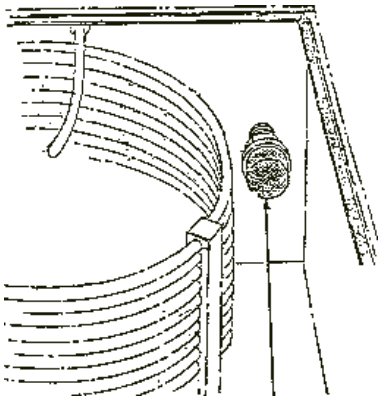
Refer to Section III, Filling Requirements for instructions on replacing the cooling fluid.

PD-2 and TU Pumps

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.

Cover the strainer with a plastic bag to help catch any debris which may become free.

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


Pump Strainer

Reservoir cover deleted for clarity

Phase Rotation

Refer to the serial number label on the rear of the controller for the specific electrical requirements of your unit; specifically, identify the phase requirements of your unit.

Three phase units with three phase pump motors have a phase rotation interlock. The interlock prevents the unit from starting if the phase rotation is wrong. 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.

Disconnect the unit from its power source, remove the rear panel and the junction box cover (if so equipped). Reverse any two line conductors on the line side of the relay.

Never remove the green ground wire.

Replace the junction box and the rear panel. Reconnect the unit to its power source. If the unit will not start, contact our Service Department.

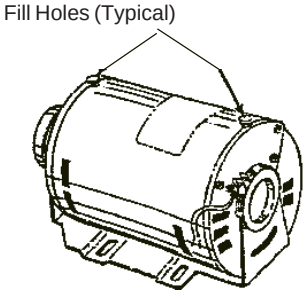
If you are unsure whether your three phase unit has a three phase pump motor, contact our Service Department (see Preface, After-sale Support).

Pump Lubrication

Units with PD-1 and PD-2 pumps require pump motor lubrication. Refer to the pump identification label on the rear of the controller to identify the specific pump in your unit.

Motors used to drive the pump are manufactured by several companies. These motors use sleeve type bearings with large oil reservoirs. Oiling instructions are generally posted on each motor. In the absence of 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



Section VIII Troubleshooting

Checklist

Unit will not start

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

Check house circuit breaker.

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

On water-cooled units, make sure the cooling water supply is connected to the TAP WATER connection, not the DRAIN connection. Ensure the facility water is turned on.

Check the High Pressure Cutout, it may need to be reset (see Section IV, Operation).

Unit will not circulate fluid

Check the tubing between the unit and your application for obstructions.

The pump strainer may require cleaning (PD and TU pumps only). Refer to the pump identification label on the rear of the analog temperature controller to identify the specific pump in your unit. For instructions on cleaning the pump strainer, see Section VII, Pump Strainer.

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.

Inadequate temperature control

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.

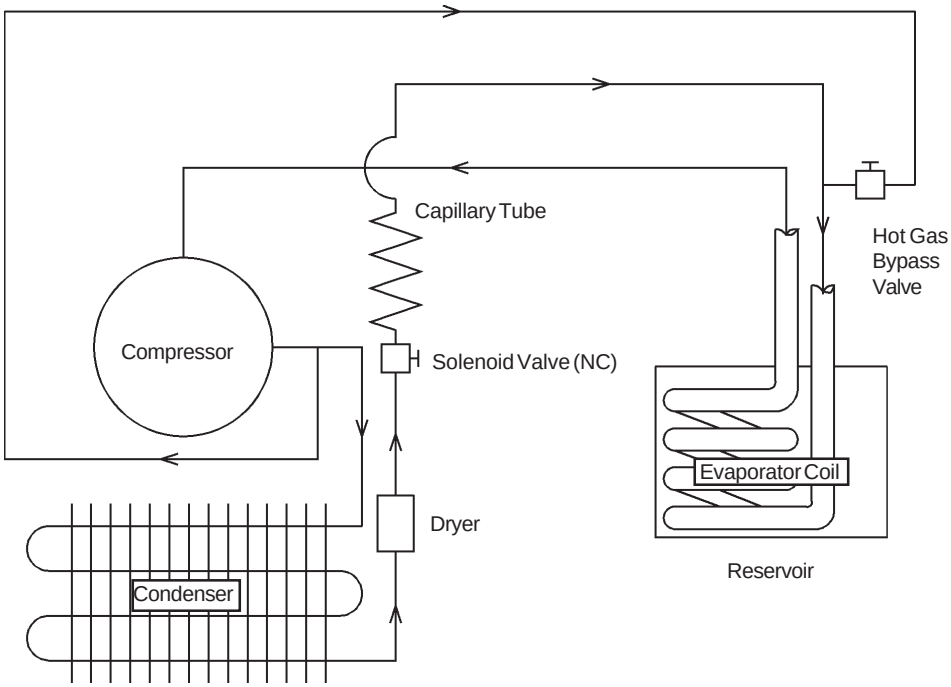
Service Assistance

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

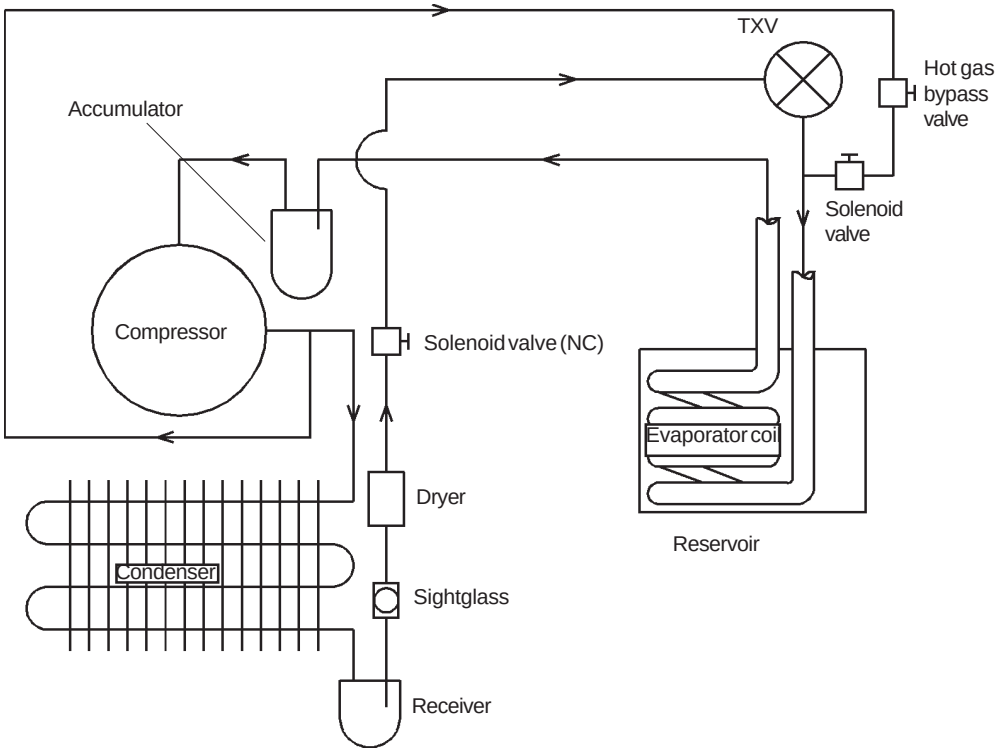
- unit part number
- unit serial number
- voltage of unit
- voltage of power source

Section IX Diagrams

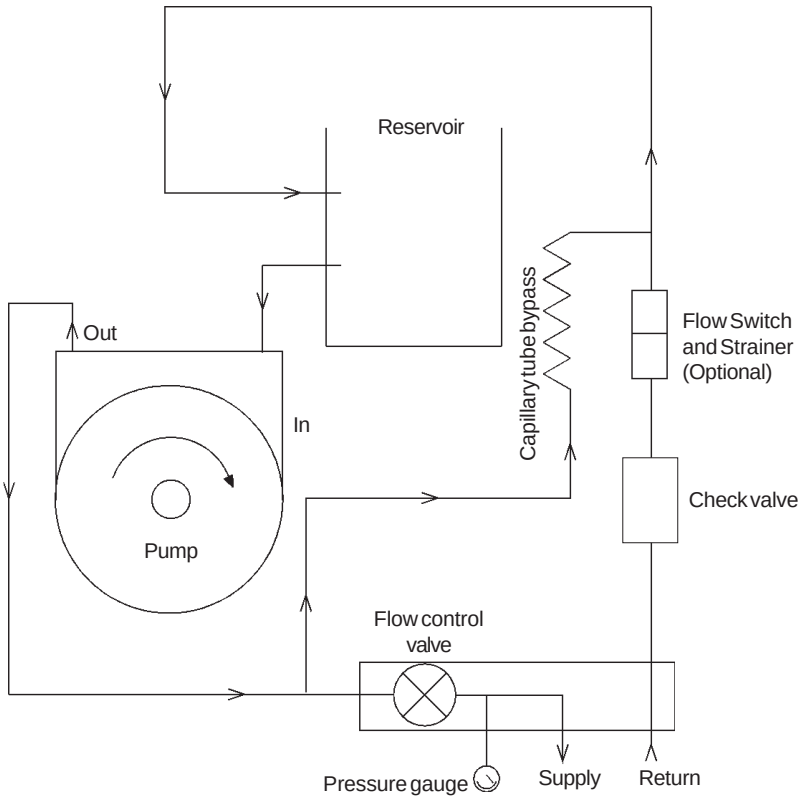
Refrigeration Flow Diagram (HX-75 through HX-150)



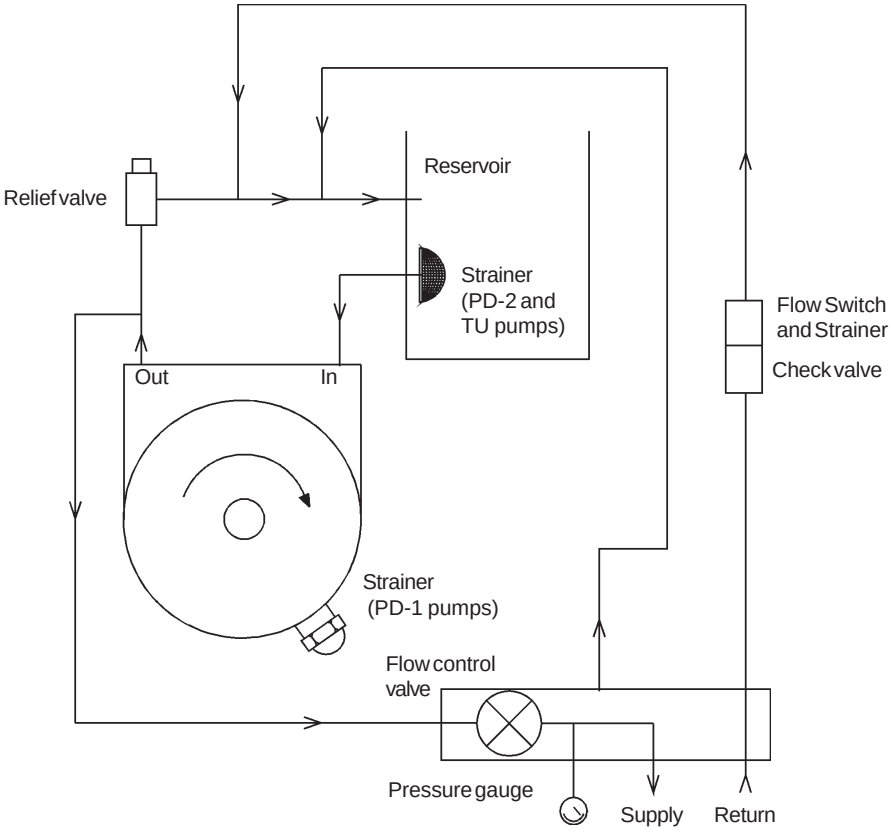
Refrigeration Flow Diagram (HX-200 through HX-750)



Pump Flow Diagram (CP Pumps)



Pump Flow Diagram (PD and TU Pumps)



Section X Warranty

NESLAB Instruments, Inc. warrants for one (1) year from date of shipment any NESLAB unit according to the following terms.

Any part of the unit manufactured or supplied by NESLAB and found in the reasonable judgement of NESLAB to be defective in material or workmanship will be repaired by an authorized NESLAB Service Center without charge for parts or labor. The unit including any defective part must be returned to an authorized NESLAB Service Center within the warranty period. The expense of returning the unit to the authorized NESLAB Service Center for warranty service will be paid for by the buyer. NESLAB's responsibility in respect to warranty claims is limited to making the required repairs or replacements, and no claim of breach of warranty shall be cause for cancellation or rescission of the contract of sale of any unit.

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

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

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

The foregoing express warranty is in lieu of all other warranties, expressed or implied, including warranties or merchantability and fitness for a particular purpose.

NESLAB's obligation under this warranty is strictly and exclusively limited to the repair or replacement of defective parts, and NESLAB does not assume or authorize anyone to assume for them any other obligation.

NESLAB assumes no responsibility for incidental, consequential, or other damages including, but not limited to loss or damage to property, loss of revenue, loss of use of the unit, loss of time, or convenience.

This warranty applies to units sold in the United States. Any units sold elsewhere are warranted by the affiliated marketing company of NESLAB Instruments, Inc. This warranty and all matters arising pursuant of it shall be governed by law of the State of New Hampshire, United States.