

# **HX Series Recirculating Chiller**

NESLAB Manual P/N 002142  
Rev. 08/25/97



**Installation, Operation,  
and Maintenance Manual**

# HX Series Recirculating Chiller Installation, Operation, and Maintenance Manual

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## Air-Cooled HX Series Quick Reference Operating Procedures

### 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,  $\pm 10\%$ .

The plumbing connections are located on the rear of the unit and are labelled SUPPLY and RETURN. These connections are  $\frac{3}{4}$  inch FPT. 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 hinged access panel on the left case top and remove the reservoir cover by unscrewing the thumbscrews. Fill the reservoir to within to a level just below the perforated hand guard. If the fluid capacity of your application and recirculation lines are significant, have extra fluid on hand.

Tap water is the recommended fluid for operation from +8°C to +35°C. Below +8°C, a non-freezing fluid must be used. A mixture of tap water and laboratory grade ethylene glycol is suggested.

### Operation

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

The unit must be connected to the power source for at least 12 hours to allow the oil to be heated and separated from the refrigerant

To start the unit, place the Power On/Off switch to the On position. The Cool and Idle 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 the unit is in the hot gas bypass mode. As the operating temperature approaches the setpoint, the LEDs cycle.

### Temperature Adjustment

To display the temperature setpoint, press and hold the Setpoint Read button. To adjust the temperature setpoint, press and hold the Setpoint read button and turn the Adjust knob until the desired temperature setpoint is indicated on the digital display. Once the setpoint is adjusted, release the Setpoint Read button. The display will now indicate the temperature of the fluid in the reservoir.

### Flow Control

The RECIRCULATING FLOW CONTROL handle controls the flow rate to your application. In the "+" position you receive full flow, the "-" 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 a visual inspection of the condenser be made monthly 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.

## Water-Cooled HX Series Quick Reference Operating Procedures

### 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 derated.

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

The plumbing connections are located on the rear of the unit and are labelled TAP WATER, DRAIN, SUPPLY and RETURN. Remove the plastic protective plugs from all the plumbing connections. Connect the TAP WATER fitting to the facility cooling water and the DRAIN fitting to a drain. Connect the SUPPLY fitting to the inlet of your application and the RETURN fitting to the outlet of your application.

To fill the reservoir open the hinged access panel on the left case top and remove the reservoir cover by unscrewing the thumbscrews. Fill the reservoir to within to a level just below the perforated hand guard. If the fluid capacity of your application and recirculation lines are significant, have extra fluid on hand.

Tap water is the recommended fluid for operation from  $+8^{\circ}\text{C}$  to  $+35^{\circ}\text{C}$ . Below  $+8^{\circ}\text{C}$ , a non-freezing fluid must be used. A mixture of tap water and laboratory grade ethylene glycol is suggested.

### 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.

The unit must be connected to the power source for at least 12 hours to allow the oil to be heated and separated from the refrigerant

To start the unit, place the Power On/Off to the On position. The Cool and Idle 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 the unit is in the hot gas bypass mode. As the operating temperature approaches the setpoint, the LEDs cycle.

### Temperature Adjustment

To display the temperature setpoint, press and hold the Setpoint Read button. To adjust the temperature setpoint, press and hold the Setpoint read button and turn the Adjust knob until the desired temperature setpoint is indicated on the digital display. Once the setpoint is adjusted, release the Setpoint Read button. The display will now indicate the temperature of the fluid in the reservoir.

### Flow Control

The RECIRCULATING FLOW CONTROL handle controls the flow rate to your application. In the "+" position you receive full flow, the "-" 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 a visual inspection of the condenser be made monthly 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.

## Preface

### Compliance

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

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

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

### Unpacking

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

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.

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

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):

- *BOM number* \_\_\_\_\_

- *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.

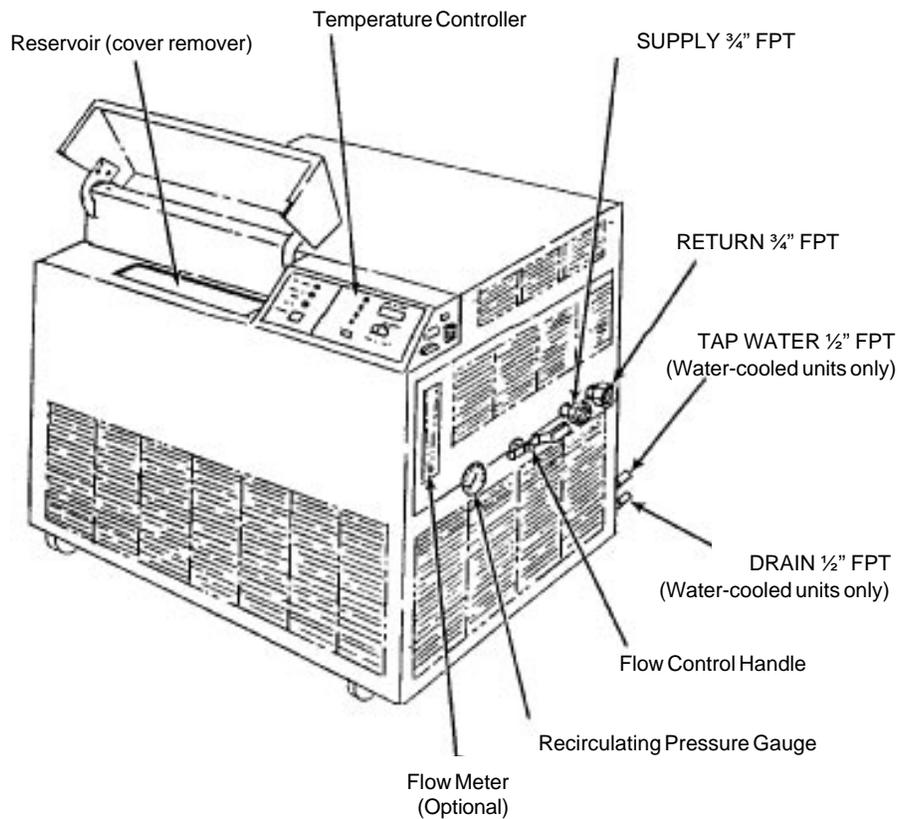
## Section II General Information

### Description

The HX Series Recirculating Chiller is designed to provide a continuous flow of cooling fluid at a constant temperature and volume. Each unit is listed by Underwriters Laboratories Inc., Standard for Commercial Refrigeration and Freezers, to comply with UL-471.

The unit consists of an air-cooled or water-cooled refrigeration system, a stainless steel fluid reservoir, a fluid recirculation pump, and a digital temperature controller.

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 electrical enclosure door.



## Specifications

	HX-200	HX-300
<b>Temperature Range</b>	+5°C to +35°C	
<b>Temperature Stability</b>	±0.1°C	
<b>Cooling Capacity</b> <i>Watts</i> <i>BTU/Hr</i>	6200 @ 20°C 21140 @ 20°C	10000 @ 20°C 30690 @ 20°C
<b>Pumping Capacity<sup>1</sup></b>	<p>The graph plots Pressure (PSI) on the y-axis (0 to 60) against Flow Rate (GPM) on the x-axis (0 to 25). Four curves are shown: CP-55 (highest pressure), TU-7, TU-5, and PD-2 (lowest pressure). All curves show a decrease in pressure as flow rate increases.</p>	
<b>Unit Dimensions</b> (H x W x D) <i>Inches</i> <i>Centimeters</i>	45 <sup>5</sup> / <sub>8</sub> x 33 <sup>3</sup> / <sub>4</sub> x 24 <sup>1</sup> / <sub>4</sub> 115.9 x 85.7 x 61.6	
<b>Reservoir Volume</b> <i>Gallons</i> <i>Liters</i>	15.0 56.8	
<b>Shipping Weight</b> <i>Pounds</i> <i>Kilograms</i>	450 204	525 238

1. Refer to the pump identification label on the electrical enclosure door.

## 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 +50°F to +104°F (+10°C to +40°C).

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

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 VI, Condenser Cleaning).

A reservoir fluid stirrer motor is located under the case top. 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.

**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 below 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, if the temperature of the cooling water supply is +65°F, the flow rate for an HX-200 must be at least 2.5 gallons per minute, with a pressure differential of at least 6.0 PSI. However, if the temperature of the cooling water supply is +85°F, the flow rate must be at least 6.0 gallons per minute, with a pressure differential of at least 18.0 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.

				<b>Temperature of cooling water supply</b>		
				<b>+65°F (+18°C)</b>	<b>+75°F (+24°C)</b>	<b>+85°F (+29°C)</b>
<b>HX-200</b>						
<b>Flow Rate</b>						
<i>Gallons per minute</i>				2.5	3.5	6.0
<i>Liters per minute</i>				9.5	13.2	22.7
<b>Pressure Drop</b>						
<i>PSI</i>				6.0	7.0	18.0
<i>Bar</i>				0.41	0.48	1.24
<b>HX-300</b>						
<b>Flow Rate</b>						
<i>Gallons per minute</i>				4.0	6.5	11.0
<i>Liters per minute</i>				15.1	24.6	41.6
<b>Pressure Drop</b>						
<i>PSI</i>				8.0	13.5	25.0
<i>Bar</i>				0.55	0.93	1.72

## Electrical Requirements



The unit construction provides extra protection against the risk of electric shock by grounding appropriate metal parts. It is the user's responsibility to assure a proper ground connection is provided.

Verify electrical requirements by reviewing the ratings listed on the nameplate on the electrical enclosure. Ensure the voltage of the power source agrees with the unit's voltage and frequency rating. The unit is designed to tolerate deviations of  $\pm 10\%$  from the rated line voltage.

Install the unit in conformance with National Electric Code, UL, and all other local, state and federal electrical codes. Check all wiring to ensure it is both properly connected and protected from the elements.

Units 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.

**NOTE:** Whenever power is applied, the unit's Main Power indicator will be illuminated.

## 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  $\frac{3}{4}$  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, located on the rear of the unit, is a  $\frac{1}{2}$  inch FPT fitting connected internally to the unit's fluid reservoir. This fitting is for draining the reservoir. The unit is shipped with a  $\frac{1}{2}$  inch MPT plug installed in this fitting. Remove the plug to drain the reservoir.

Two plumbing adapters ( $\frac{3}{4}$  inch MPT x  $\frac{5}{8}$  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  $\frac{1}{2}$  or  $\frac{5}{8}$  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). These fittings are  $\frac{1}{2}$  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.

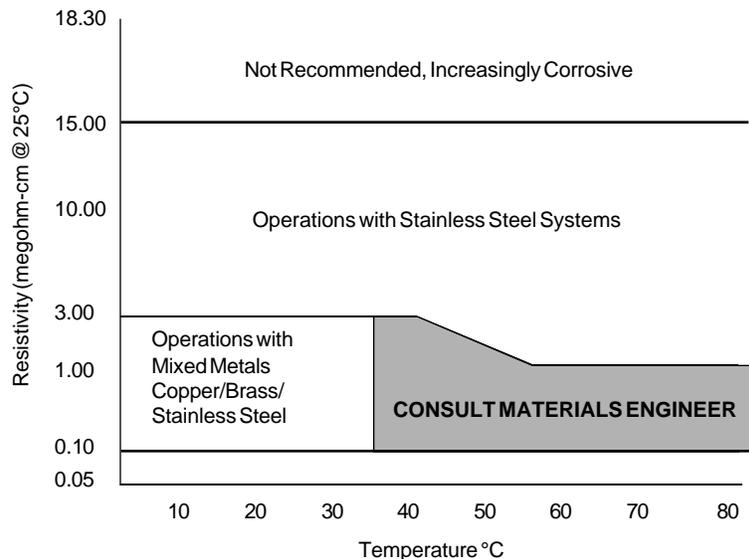


**Do not use automobile anti-freeze. Commercial anti-freeze contains silicates that can damage the pump seals. Use of automobile anti-freeze will void the manufacturer's warranty.**

## Water Quality Recommendations

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 (as NaCl). The recommended level for use in a water system is between 0.5 to 5.0 ppm



Water Quality Considerations

(as NaCl). Recommendation: Initially fill the tank with distilled/deionized water. Do not use untreated tap water as the total ionized solids level may be too high. Maintain this water quality at a resistivity of between 1 to 10 megohm-cm (compensated at 25°C) by using a purification system. The above two recommendations will reduce the electrolytic potential of the water and prevent or reduce the galvanic corrosion observed.

## **Filling Requirements**

Before filling, ensure the unit's reservoir drain plug is properly installed.

The reservoir cover is located under the hinged access panel at the left of the case top, see illustration on page 6. Open the panel, loosen the two thumbscrews and remove the reservoir cover.

Fill the fluid reservoir with cooling fluid to a level just below the perforated hand guard at the top of the reservoir.

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 just below the hand guard.

When the recirculating system is full, replace the reservoir cover and close the access panel.

## Section IV Temperature Controllers

### Temperature Controllers

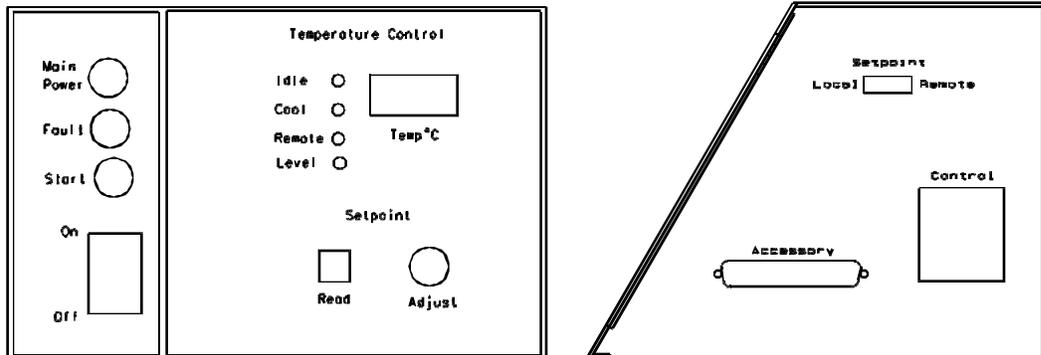
Three options are available, DL, DL+I (Interlocks), and DL+A (Alarm). Refrigeration control, start up and temperature adjustment work the same way with all three options

### Refrigeration Control

The refrigeration compressor runs continuously while a hot gas bypass system, designed to eliminate compressor cycling and premature wear, is used to maintain constant temperature.

The Cool and Idle indicators, located on the control panel, indicate the status of the refrigeration system. The Idle indicator is lit when the unit is in the hot gas bypass 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 the Cool or the Idle mode, but never both at the same time. A balance between Cool and Idle is needed to control temperature.

All units are equipped with high and low refrigeration pressure switches. Should either pressure switch activate, the unit will shut down. After the cause of the fault is identified and corrected, the switch will have to be manually reset before you can restart the unit.



DL/DL+I Temperature Controller

## Start Up

Before starting the unit, double check all electrical and plumbing connections and make sure the recirculating system (the HX, the instrument being cooled, and the tubing that connects them) has been properly filled with cooling fluid. Ensure the flow control valve is not fully closed (see Section V, Flow Control).

**NOTE:** For water-cooled units ensure the facility water is turned on.

The Main Power indicator on the controller illuminates only to indicate the unit's main power circuit is energized.

To start the unit, place the Power On/Off switch to the On position and then depress the Start switch. The pump and refrigeration will start and the Temp°C display will indicate the temperature of the reservoir fluid. To shut the unit off, place the Power On/Off switch to the Off position.

## Temperature Adjustment

To display the temperature setpoint, press and hold the Setpoint Read button. To adjust the temperature setpoint, press and hold the Setpoint Read button and turn the Adjust dial until the desired temperature setpoint is indicated on the Temp°C LED display. Once the setpoint is adjusted, release the Setpoint Read button. The Temp°C LED display will indicate the reservoir fluid temperature.

**Inadvertent movement of the Adjust dial will result in a change in the setpoint. The change will not be immediately reflected on the Temp°C LED display unless the Setpoint Read button is pressed. The display will eventually change as the unit responds to the new setpoint.**

## Level Indicator

The Level indicator on the DL and DL+I options is connected to a float switch in the reservoir. The indicator warns the user of a low cooling fluid level in the reservoir. A low fluid level condition occurs when the cooling fluid in the reservoir drops below the operating level. In addition to the indication the alarm, if installed, will sound. The indicator/alarm serves only as a warning. The unit will not shut down as a result of a low fluid level condition. The optional alarm can be muted using the Mute/Alarm toggle switch located inside the main electrical enclosure, see page 21.

## DL Option

The Fault indicator illuminates when the compressor contactor is off. The cause of the fault must be found and corrected before restarting the unit.

## **DL+I Option**

The Digital with Interlock temperature controller is a Digital temperature controller with up to four monitoring options: low temperature, high temperature, low fluid level, and low flow. The controller can be built with any combination of these four monitors. If an interlock detects a fault the Fault indicator illuminates and the alarm, if installed, will sound. The alarm can be muted using the Mute/Alarm toggle switch located inside the main electrical enclosure, see page 21.

### **Fault Response**

Units are configured to shut off in the event that a fault. The relay contacts connected to the controller receptacle will open and the Fault indicator will light. The cause of the fault must be identified and corrected before the unit can be restarted.

You can allow the unit to operate if a fault occurs. This option is set by positioning the Bypass/Normal toggle switch in the main electrical enclosure to Bypass, see page 21 for additional information.

### **Temperature Interlocks**

The optional high and low temperature interlocks are connected to sensors that monitor the temperature of the cooling fluid as it exits the reservoir. The monitors protect the system from exposure to excessively hot or cold cooling fluid. A temperature fault occurs when the fluid temperature exceeds the set temperature limit.

The temperature monitors are located in the main electrical enclosure. To adjust either temperature monitor, turn the appropriate calibrated dial to the desired temperature limit.

### **Low Fluid Level Interlock**

The low fluid level interlock is connected to a float switch in the reservoir. A fault will occur if the reservoir cooling fluid level drops below the operating level.

### **Low Flow Interlock**

The low flow monitor is connected to a flow switch in the RETURN line. A low flow fault occurs when the flow rate of the returning cooling fluid drops below 0.3 gallons per minute (1.0 liters per minute).

When starting a unit, the Start switch must be held depressed until the flow switch “closes” (approximately 5 seconds). If time is not allowed for the flow switch to close, the unit will stop when the Start switch is released.

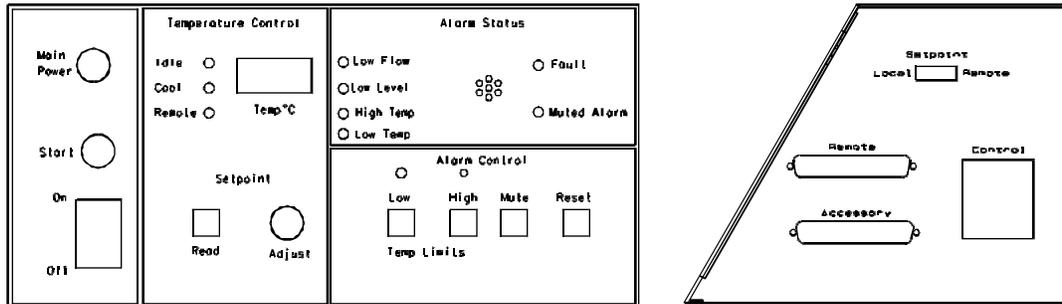
## Interlock Relay Contacts

A set of 15A, 125V contacts are connected to a receptacle on the right side of the controller. This is not a power inlet or outlet. The receptacle is isolated from the circuitry. Its ground pin is connected to the chassis. The Normally Open and Normally Closed contacts are provided for customer use. The contacts will transfer when a fault condition occurs.

## DL+A Option

### Description

This option features an alarm function as well as additional monitoring capabilities. The monitoring feature will indicate which input caused a fault to be detected. This feature will aid you in troubleshooting your system. Additionally, the temperature display can be remotely monitored using the remote "D" connector on the right side of the temperature controller.



### Alarm Control

Alarm Control adjusts the high and low temperature limits of the alarm, activates/deactivates the audible portion of the alarm., and resets the alarm.

To display the high or low temperature limit, press the corresponding button. When the button is pressed, the limit is indicated on the Temp°C display.

To adjust either temperature limit, press the corresponding button and turn the slotted potentiometer located directly above the button (a small screwdriver is required). Limits are adjustable from -45°C to +100°C. The high and low values must be at least 4°C apart for the unit to operate.

The alarm will sound when a limit is exceeded.

The Mute button on the Alarm Control panel alternately activates and mutes the audible alarm as indicated by the Muted Alarm indicator. When the alarm is muted, it will remain muted until the Mute button is depressed again, or until the Reset button on the Alarm Control panel is depressed.

The alarm annunciator can be disabled by moving a shorting plug on the alarm circuit board. When disabled, the Muted Alarm indicator will be illuminated at all times. See the Shorting Plug Positions section on page 30 for additional information.

The alarm does not automatically reset after a fault condition is corrected; you must manually reset the alarm using the Reset switch on the Alarm Control panel.

### **Alarm Status**

The Alarm Status section indicates the status of the fault monitors. Four amber indicators display the status of the Low Level, High Temperature, Low Temperature, and Low Flow fault monitors. In the event of a fault, the cause of the fault must be identified and corrected before the unit can be restarted.

The FAULT TIME DELAY potentiometer (P4) allows adjustment of a preset time delay period following an initial “out of limits” condition. The potentiometer is on the alarm circuit board located behind the Temperature Control panel. The time delay can be set from 20 to 120 seconds. (See Potentiometer Adjustment on page 32 for additional information.)

If the red Fault indicator and any amber indicator are both on steady, a monitor has detected the indicated as outside limits. A fault will be declared only if the preset time limit is exceeded on the Fault Time Delay.

If a fault does occur, the red Fault indicator and the amber indicator will both start to flash. In addition the alarm, if enabled, will sound.

If the red Fault light extinguishes but the amber indicator continues to flash, the limit was exceeded but cleared itself prior to the preset time delay. (This advisory feature can also be defeated by repositioning a shoring plug located behind the controller panel, see Shorting Plug Positions on page 30 for additional information.)

Any subsequent operations occurring as a result of the fault will cause the appropriate indicator to illuminate in a steady state condition, i.e. a low flow causing a high temp. The indicator which caused the fault will continue to flash.

### **Monitoring Capabilities**

The Low Level indicator is connected to a float switch in the reservoir. If a low cooling fluid level condition is detected, the Low Level indicator will light. If the condition is not corrected within 30 seconds the Fault indicator turns on and the audible alarm, if enabled, will sound. The unit will shut down and a set of relay contacts will open (the status of the relay contacts can be monitored using pins 14 and 15 of the Remote connector receptacle on the controller's side panel, see Remote Connector on pages 27 and 28 for additional information.

The Low level indicator can be disabled by moving a shorting plug on the alarm circuit board. When disabled, the Muted Alarm indicator will be illuminated at all times. See the Shorting Plug Positions section on page 30 for additional information.

The Low Flow indicator is connected to a flow switch in the RETURN line. A low flow fault occurs when the flow rate of the returning cooling fluid drops below 0.3 gallons per minute (1.0 liters per minute). If a low flow condition is detected, the Low Flow indicator will light. If the condition is not corrected within several seconds a Fault occurs and the audible alarm, if enabled, will sound. The unit will shut down and the relay contacts will open.

This feature can also be disabled by moving a shorting plug on the alarm circuit board. When disabled, the Muted Alarm indicator will be illuminated at all times. See the Shorting Plug Positions section on page 30 for additional information.

The High/Low Temp indicators are connected to sensors that monitor the temperature of the cooling fluid as it exits the reservoir. The monitors protect the system from exposure to excessively hot or cold cooling fluid. The limits are set using the potentiometers on the temperature controller panel. If either limit is exceeded the applicable indicator will flash and the alarm, if enabled, will sound. In the event of a high or low temperature fault the unit will shut down and the relay contacts will open.

## Main Electrical Enclosure

The Main Electrical Enclosure is located behind a hinged access panel located on the rear of the unit.



**Disconnect the unit from its power source before opening the Main Electrical Enclosure.**

### **PUMP O/L**

The PUMP O/L indicator illuminates when the pump motor has shut down due to an overload condition. Manually reset the fault condition before restarting the unit. Reset the fault by depressing the grey reset switch on the 1MOL overload relay.

### **REMOTE/LOCAL**

The REMOTE/LOCAL toggle switch allows you to select the source for starting and stopping the unit. When the switch is in the REMOTE position, control is derived from the input connected to the Control receptacle on the right side of the temperature controller. The Remote indicator on the temperature controller will illuminate. In the LOCAL position, the unit's Start switch is in control.

When the LOCAL/REMOTE switch is set to REMOTE, the controller's On/Off switch must be in the On position for the unit to operate. An external switch is necessary to complete the circuit and start the unit.

If the controller's On/Off switch is in the Off position and the toggle switch is in REMOTE, then external switches cannot start the unit. This allows an operator or service person to override the external controls and shut down the unit.

### **BYPASS/NORMAL**

The BYPASS/NORMAL toggle switch determines the unit's response after a power loss. In the BYPASS position, the unit will start when power is restored. In the NORMAL position the unit will have to be manually restarted using the Start switch. On units with the DL+I option this switch is also used to bypass the interlocks so the unit will not shut down if a fault occurs.

### **RUN/OFF**

The RUN/OFF toggle switch impacts the operation of the unit's pump. When the switch is in the RUN position, the pump will continue to operate regardless of the status of the compressor. In the OFF position, the pump will stop when the compressor is not operating.

### **MUTED/ALARM**

The MUTED/ALARM switch is only on the DL and DL+I option. It is used to mute the optional alarm.

## 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 the instrument being cooled.

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.

On units with DL+I or DL+A options the flow control valve must be opened slightly to allow fluid to circulate through the flow switch that monitors the flow rate. A flow rate of more than 0.3 gallons per minute (1.0 liters per minute) is necessary. If the flow is completely shut off, or if the flow is not adequate, a low flow fault will occur and the unit will not start.



**To prevent “water hammering” always move the flow control handle slowly.**

### Flow Meter (Optional)

An optional flow meter may be installed in the right side of the pump compartment. The meter measures the flow rate in gallons per minute. The flow rate range displayed depends on the type of pump installed in the unit.

### Pressure Gauge

Units with PD or TU pumps are equipped with a pressure gauge. Refer to the pump identification label on the electrical enclosure to identify the specific pump installed in the 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**

Units with a PD or TU type pump have an adjustable pressure relief valve. Refer to the pump identification label on the electrical enclosure 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.

## **Pump Motor Overload Protector**

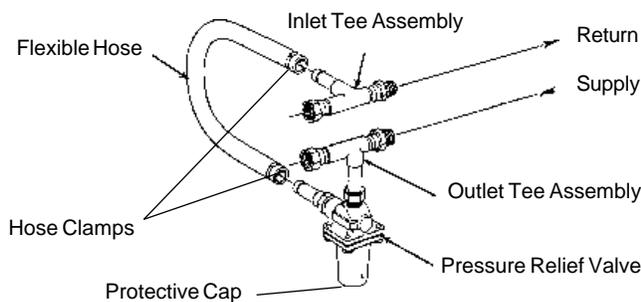
Three phase units with three phase pump motors are equipped with a pump motor overload protector. The overload protector prevents the pump motor from exposure to excessive current. If an overload fault occurs, due, for example, to excessive pressure or flow, or excessive ambient temperature, the overload protector will shut off the pump motor. The unit's compressor will continue to operate. The fault must be manually reset after the cause is identified and corrected (see Preface, After-sale Support).

The indicator and the overload relay (with reset switch) are both located in the main electrical enclosure. The indicator illuminates when a fault is detected.

## 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 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

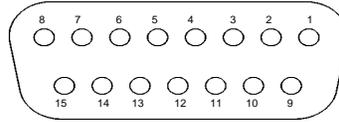
When adjusting the relief valve some leaking may occur, place a container under the valve during adjustment.

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.

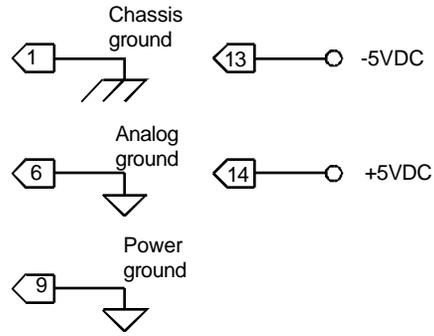
## Accessory Connector



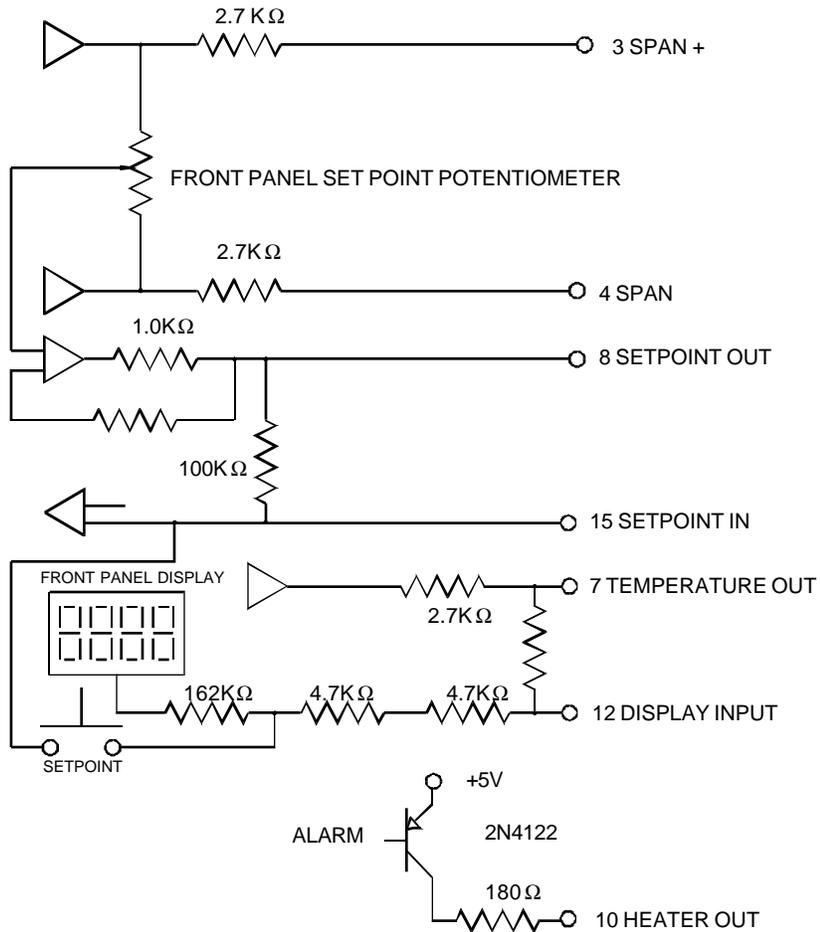
15 pin D-subminiature female receptacle

Pin #	Function
1	Chassis ground.
2	No connection.
3	Span +. Indicates the maximum setpoint value the unit can be set to operate. The temperature scale is 10mV/°C, referenced to analog ground, pin 6 (example: +350mV = +35.0°C).
4	Span -. Indicates the minimum setpoint value the unit can be set to operate. The temperature scale is 10mV/°C, referenced to analog ground, pin 6 (example: +50mV = +5.0°C).
5	No connection.
6	Analog ground. The analog ground is physically separated from the power ground throughout the unit. To prevent offsets that result ground currents, the analog and power ground are only connected at the power supply. Analog ground should only be used as a reference pin.
7	Sensor temperature (current limited through 2.7K OHM resistor). The fluid temperature, as measured by the controller's sensor located in the reservoir, can be read at this pin. The temperature scale is 10mV/°C, referenced to analog ground, pin 6 (example: +150mV = +15.0°C).
8	Setpoint out. The present temperature setpoint can be read at this pin. The temperature scale is 10mV/°C, referenced to analog ground, pin 6 (example: +150mV = +15.0°C).
9	Power ground.
10	Heater output. Will source 3V at 6mA.
11	No connection.
12	Digital display (input only). An external voltage can be displayed on the operator panel digital display by applying the voltage to this pin. The display has a low input resistance and a full scale rating of ±1.99VDC. Input is referenced to analog ground, pin 6. The maximum voltage applied to the display should be limited to ±2VDC.
13	-5V. Power supply of -5VDC (15mA maximum).
14	+5V. Power supply of +5VDC (15mA maximum).
15	Setpoint in. The temperature setpoint can be controlled by applying a known voltage to this pin. The temperature scale is 10mV/°C, referenced to analog ground, pin 6 (example: +230mV = +23.0°C).

# Accessory Connector Circuitry Details

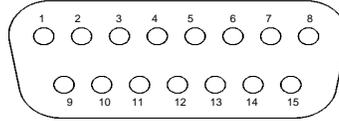


Access Receptacle Equivalent circuits



Access Receptacle Circuitry Details

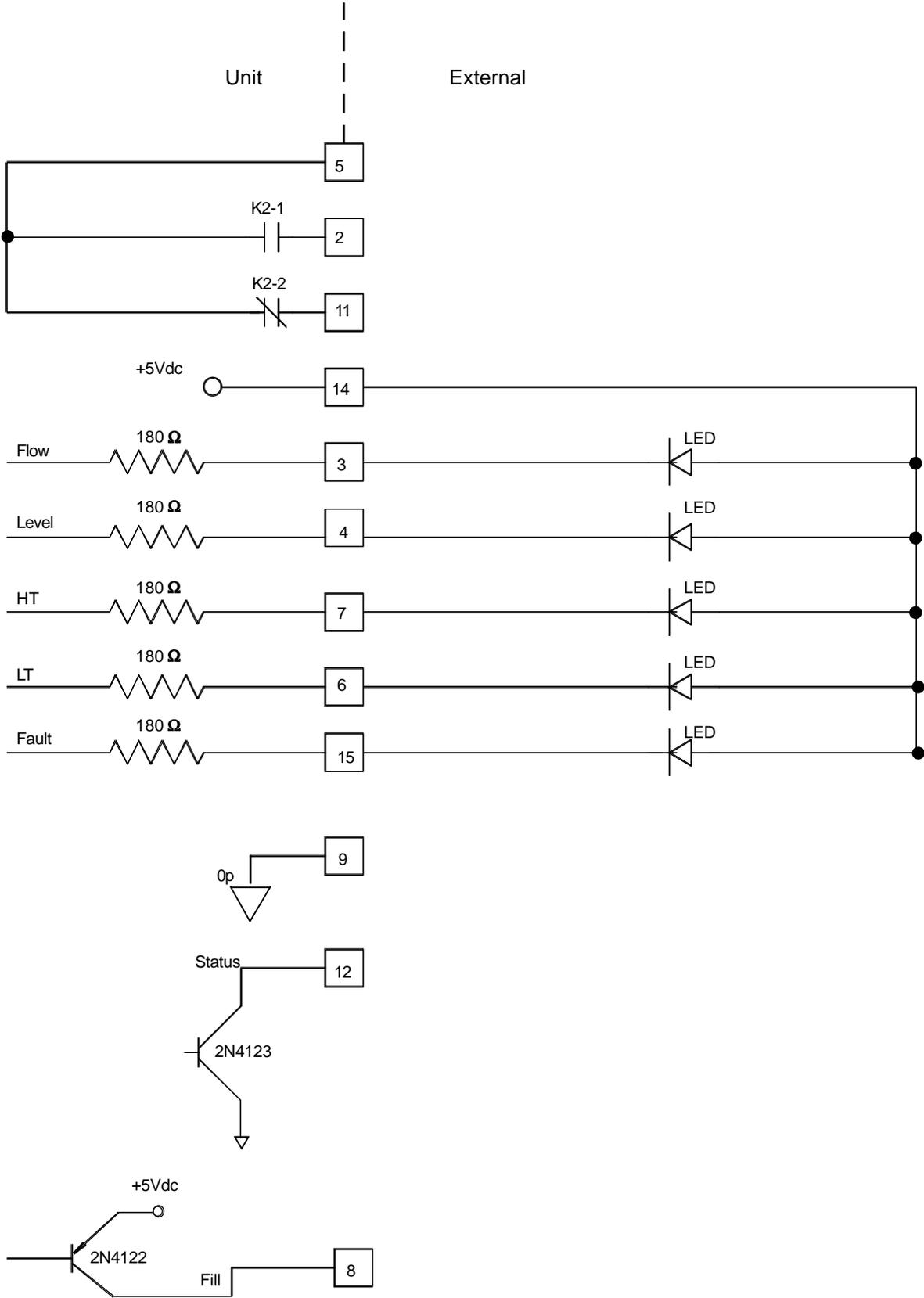
## Remote Connector



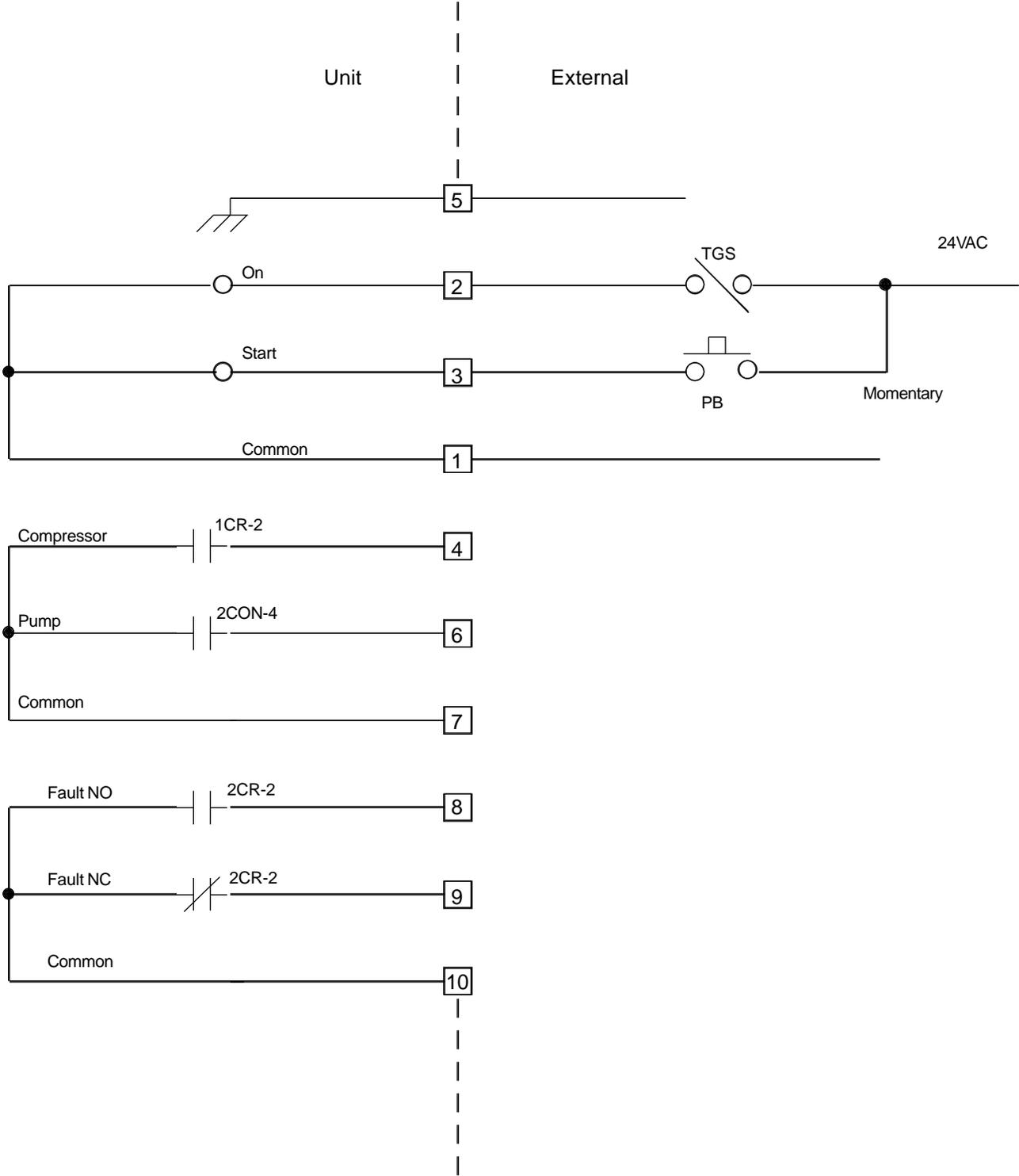
15 pin D-subminiature female receptacle

<b>Pin #</b>	<b>Alarm Circuitry</b>	<b>Control Circuitry</b>
1		Reset - connect to OP
2	Relay - Normally Open	
3	Flow LED	
4	Level LED	
5	No connection.	
6	Low Temp LED	
7	High Temp LED	
8	Fill Signal	
9	Op	
10	Not Used	
11	Relay - Normally Closed	
12	Status	
13	Not Used	
14	-5VDC	
15	Fault LED	

# Remote Connector Circuitry Details (2RECP)



# Control Connector Circuitry Details (3RECP)



## Shorting Plug Positions

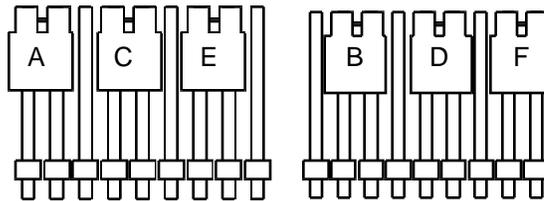


**Disconnect the unit from the main power source before repositioning any shorting plugs.**

The Temperature Controller circuit board has shorting plugs used to modify the unit's operation. The circuit board is located behind the Temperature Controller face panel. You gain access to the circuit board by removing the two screws at the top of the panel and then carefully lowering the face of the panel. The plugs are directly behind the TEMP°C LEDs.

The figures below represent a typical 9-pin header plug. Use the following table to position the shorting plugs for the desired performance. (The pins on the circuit board are labeled.)

Position	Performance
A	LED displays tenths of degrees.
B	LED displays degrees.
C	Decimal point displayed.
D	Decimal point off.
E	Idle indicator reflects heater duty cycle.
F	Idle indicator reflects status of hot gas bypass mode.



Typical 9-Pin Header Plugs

The DL+A option contains some additional shorting plugs on the alarm portion of the Temperature Controller circuit board. There are three plugs on the top front of the circuit board. (The pins are not labelled. Viewing from the top, A is the full left position.)

Position	Performance
A	Alarm annunciator on.
B	Alarm annunciator off.
C	Amber fault indicator stays lit if fault clears before preset time delay.
D	Amber fault indicator extinguishes if fault clears before preset time delay.
E	Run to fail mode disengaged.
F	Run to fail mode engaged.

There are four additional shorting plugs on the back of the alarm circuit board. Three are located in the lower left hand corner, one in the upper right hand corner between two potentiometers. (The pins are not labelled. Viewing from the side, A is the top position.)

Position	Performance
A	Low flow fault disengaged.
B	Low flow fault engaged.
C	Low level indicator disengaged.
D	Low level indicator engaged.
E	Low level fault disengaged.
F	Low level fault engaged.

The single plug between the potentiometers is used to calibrate the High/Low Temp Limits display. Repositioning the plug allows you to use the Temp°C LED when you calibrated the temp limit potentiometers, see Potentiometer Adjustments/Calibration on the next page

## Potentiometer Adjustments/ Calibration

### TEMP °C Display

There are six potentiometers at the top of the Temperature Controller circuit board. Pots #1 and #2 are used to calibrate the temperature sensor. You can use the unit's reservoir to calibrate the sensor, or you can remove the sensor from the unit and immerse it in an external container of temperature controlled fluid.

Place a reference thermometer in the fluid and set the setpoint for 0°C. When the fluid approaches the setpoint, as measured by the reference thermometer, adjust pot #1 until the display equals the reference thermometer.

Reset the setpoint for 20°C. When the fluid approaches the setpoint, as measured by the reference thermometer, adjust pot #2 until the display equals the reference thermometer.

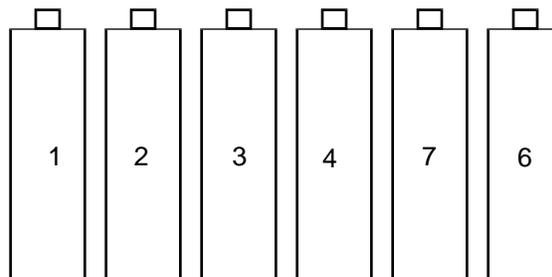
To complete the calibration reset the setpoint to 0°C. When the fluid approaches the setpoint adjust pot #1 until the display equals the reference thermometer.

Potentiometers #3 and #4 are used to set the maximum and minimum setpoint readings on the TEMP°C LED.

To set the maximum reading, turn the ADJUST dial fully *clockwise*, then depress and hold the SETPOINT switch. Adjust pot #3 until the desired temperature is displayed.

To set the minimum reading, turn the ADJUST dial fully *counter clockwise*, then depress and hold the SETPOINT switch. Adjust pot #4 until the desired temperature is displayed.

Potentiometers #7 and #6 are factory preset and require no adjustment.



TEMP°C LED Potentiometers

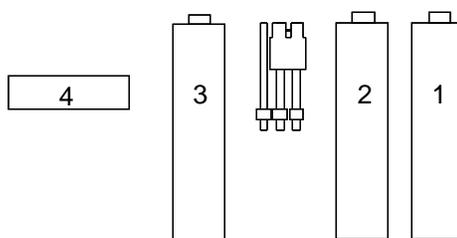
### Alarm Calibration

The DL+A option has two potentiometers and a shorting plug are located on the back side of the alarm circuit board. They are used to calibrate the alarm temperature sensor. Again you can use the unit's reservoir, or you can remove the sensor and immerse it in an external container of temperature controlled fluid. Reposition the shorting plug as shown below. Place a reference thermometer in the fluid and set the setpoint for 0°C. When the fluid approaches the setpoint, as measured by the reference thermometer, adjust pot #1 until the display equals the reference thermometer.

Reset the setpoint for 20°C. When the fluid approaches the setpoint, as measured by the reference thermometer, adjust pot #2 until the display equals the reference thermometer.

To complete the calibration reset the setpoint to 0°C. When the fluid approaches the setpoint adjust pot #1 until the display equals the reference thermometer. Reposition the shorting plug to its original position.

Potentiometers #3 is used to adjust the proteud threshold. Potentiometer #4 adjusts the time for the fault delay.



DL+A Potentiometers

## 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.



**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).

### Configuration

#### Service Access Panels

Five service access panels (two on the rear, two on the right side and one on the top) allow easy access to the pump and refrigeration assemblies. The panels on the right side are designed to allow removal without disconnecting the HX from the instrument being cooled.



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

#### Reservoir Cover

Access to the inside of the fluid reservoir is necessary to clean the reservoir.



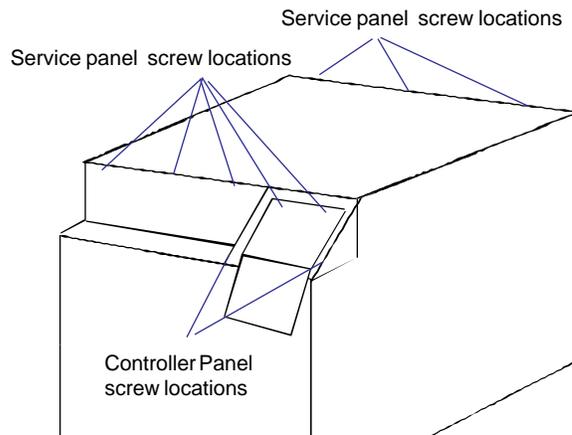
**Disconnect the unit from its power source before removing the reservoir cover.**

Remove the top service panel. Screws are located inside the reservoir fill access door, behind the control panel, and on the rear of the unit. The controller panel has one screw on either side (one inside the reservoir fill access door) holding the panel in position.

The reservoir cover has two sections. Remove the screws holding the cover in position as well as the screws holding the two sections together. Lift the front section from the unit. You should now be able to carefully rotate the rear section away from the unit without disconnecting any of the wiring.



**Care must be taken not to damage the switches, probes, and stirrer motor blades located under the reservoir cover.**



## Reservoir Cleaning

Periodic reservoir cleaning is necessary. We recommend that a visual inspection of the reservoir be made monthly 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.**

Remove the top panel. Remove the reservoir cover as described in Configuration. 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 secure the case top. Refer to Section III, Filling Requirements for instructions on replacing the cooling fluid.

## Pump Strainer

Units with PD or TU pumps require pump strainer cleaning. Refer to the pump identification label on the electrical enclosure to identify the specific pump installed 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 frequency of cleaning 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 cover 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.

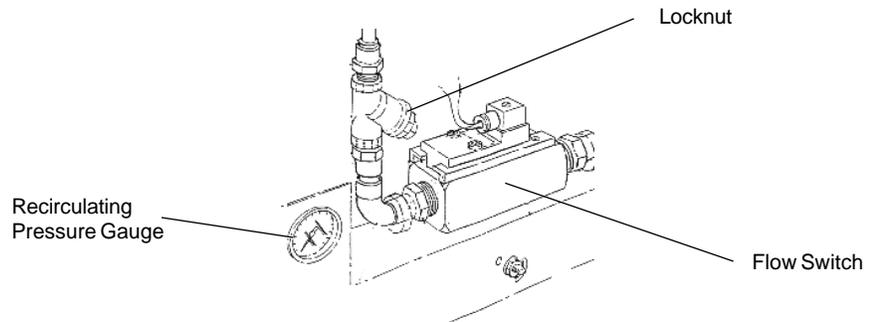
Unscrew the strainer and rinse it with water. Replace the strainer. Refer to Section III, Filling Requirements for instructions on replacing the cooling fluid.

## Flow Switch Strainer (Optional)

The flow filter strainer is located behind the top right access panel on the inlet side of the flow switch.

Unscrew the locknut and remove the screen. Clean the screen by rinsing it with water.

Replace the strainer and locknut. Refer to Section III, Filling Requirements for instructions on replacing the cooling fluid.



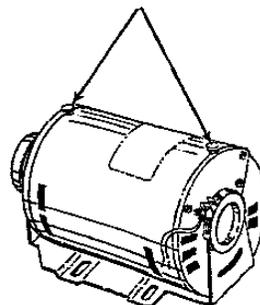
## Pump Motor Lubrication

Units with PD pumps require pump motor lubrication. Refer to the pump identification label on the electrical enclosure 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

Fill Holes (Typical)



## **Phase Rotation**

Three phase units with three phase pump motors are equipped with a phase rotation interlock. Refer to the serial number label on the electrical enclosure for the specific electrical requirements of your unit. The interlock prevents the unit from starting if the phase rotation is wrong. If the unit will not start, see Section IX, Checklist. If the options in the checklist are not applicable, the problem may be phase rotation.

Disconnect the unit from its power source, open the rear panel and locate the junction box. Reverse any two line conductors on the line side of the relay.

**Never remove the green ground wire.**

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

## Section VIII Troubleshooting

### Checklist

#### Unit will not start

Verify main power circuit is energized. The green Main Power light on the controller panel should be lit when the unit is energized.

On units with DL+I and DL+A options, the flow control valve must be opened slightly to allow fluid to circulate through the flow switch that monitors the flow rate. A flow rate of more than 0.3 gallons per minute (1.0 liters per minute) is necessary. If the flow is completely shut off, or if flow is not adequate, a low flow fault will occur and the unit will not start.

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

On water-cooled units, ensure the facility water is on and make sure the cooling water supply is connected to the TAP WATER connection, not the DRAIN connection. Check the High Pressure Cutout, it may need to be reset (see Section V, Operation).

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

#### Unit will not circulate fluid

Check the tubing 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 pump identification label on the electrical enclosure to identify the specific pump in your unit. For instructions on cleaning the pump strainer, see Section VIII, 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.

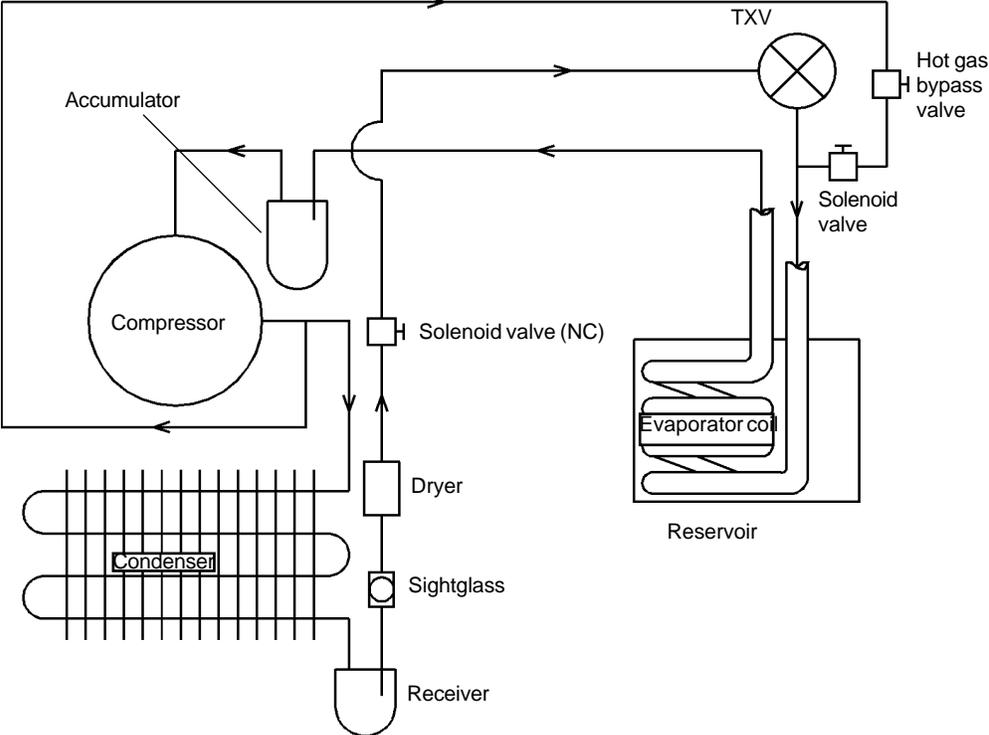
### Service Assistance

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:

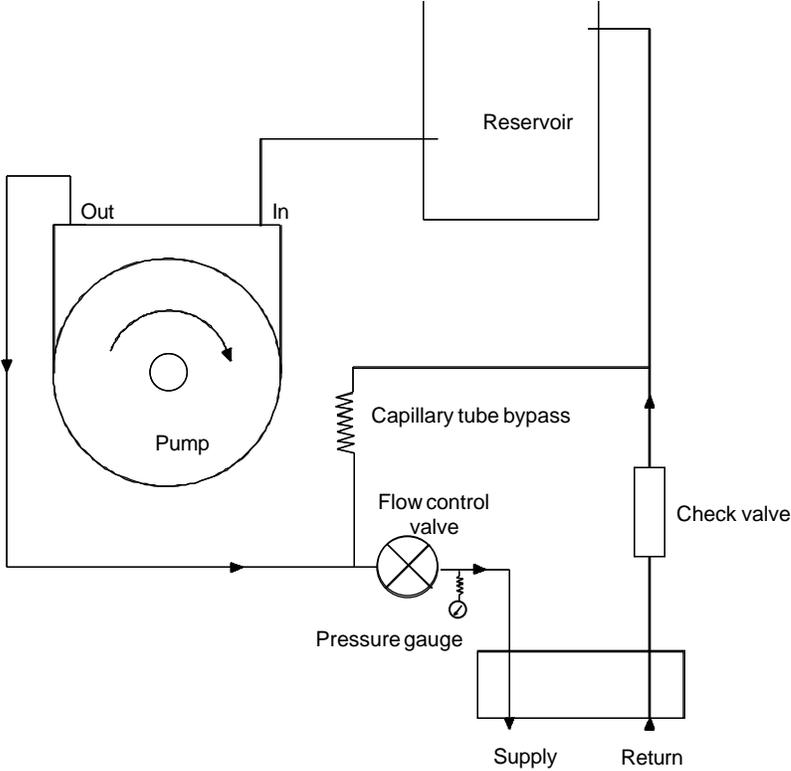
- *BOM number*
- *Serial number*

# Section IX Diagrams

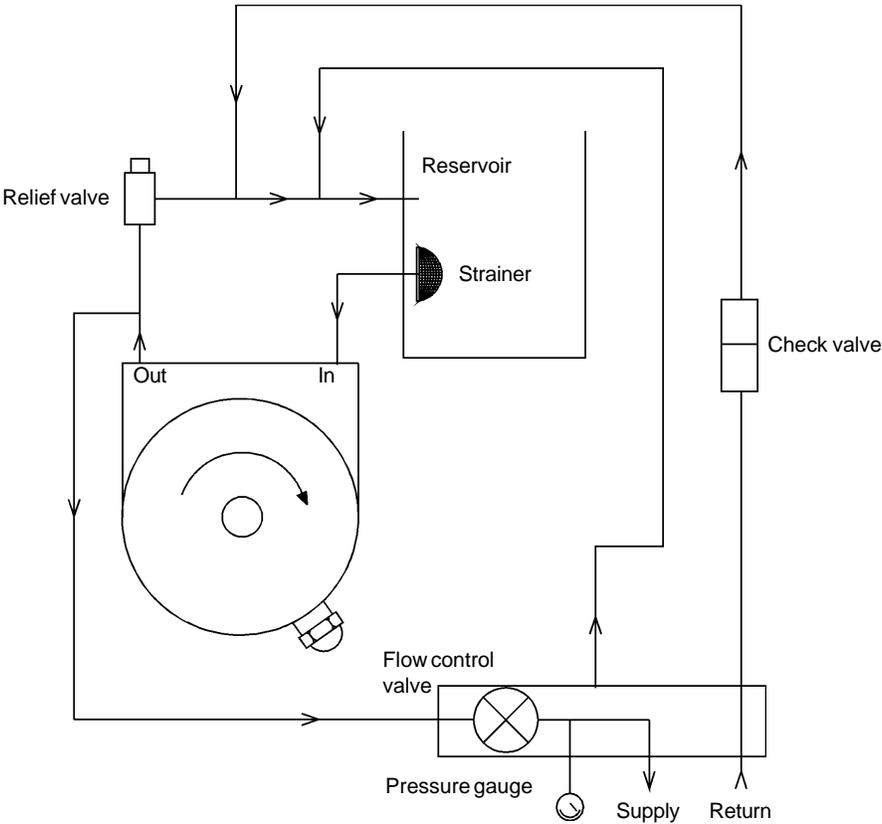
## Refrigeration Flow Diagram



**Pump Flow Diagram (CP Pumps)**



**Pump Flow Diagram (PD and TU Pumps)**



## Appendix DeltaTemp

DeltaTemp programming software is now available for free download from NESLAB ONLINE BBS (Bulletin Board System) at 603-427-2490.

DeltaTemp software allows you to write custom temperature programs for NESLAB digital units (any unit with a digital temperature readout AND a 10-15 pin INTERFACE port). The menu-driven program provides a table format for entering temperature parameters and a visual graph confirmation of the program you have designed. Program time can range from 0 to 999 minutes with unlimited looping. Choose upper and lower temperature limits and monitor system status with an audible alarm. DeltaTemp can also record your results on a printed graph or file. DeltaTemp is a DOS program, and requires an IBM or 100% compatible computer.

DeltaTemp may require use of a computer interface device, depending on which NESLAB unit is being used. Refer to the setup diagram in the DeltaTemp folder for full details.

To download the software, go to: CONFERENCES / SOFTWARE / DeltaTemp.

The folder also contains the operating manual, setup diagrams, application notes, and directions on making your own interface cable.

NESLAB ONLINE is a FirstClass® system accessible by general terminal software (Windows Terminal accessory, ClarisWorks Communications, Z-Term, Pro-Comm, or similar).

To use the full graphics and features of the BBS we recommend using FirstClass® Client software. FirstClass® Client is available for Macintosh or Windows platforms. It is available from many sources:

### NESLAB ONLINE

Mac: Conferences/Software/Macintosh

Windows: Conferences/Software/Windows

### AMERICA ONLINE

Mac: Computing/software center/mac communications forum/industry connection/softarc

Windows: Computing/software center/communications programs

### COMPUSERVE:

Mac: TWEUROPA/Teletools/FCMAC.ZIP

Windows: PCBBS/BBS programs/FC300.EXE

### WORLD WIDE WEB

<http://www.softarc.com/try.htm>

## WARRANTY

NESLAB Instruments, Inc. warrants for 12 months 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 judgment of NESLAB to be defective in material or workmanship will be repaired at an authorized NESLAB Repair Depot without charge for parts or labor. The unit, including any defective part must be returned to an authorized NESLAB Repair Depot within the warranty period. The expense of returning the unit to the authorized NESLAB Repair Depot for warranty service will be paid for by the buyer. NESLAB's responsibility in respect to warranty claims is limited to performing the required repairs or replacements, and no claim of breach of warranty shall be cause for cancellation or rescission of the contract of sales of any unit. With respect to units that qualify for field service repairs, NESLAB's responsibility is limited to the component parts necessary for the repair and the labor that is required on site to perform the repair. Any travel labor or mileage charges are the financial responsibility of the buyer.

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

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

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

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 BUT NOT LIMITED TO 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 COMPONENT PARTS AND NESLAB DOES NOT ASSUME OR AUTHORIZE ANYONE TO ASSUME FOR IT 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 PROFITS OR REVENUE, LOSS OF THE UNIT, LOSS OF TIME, OR INCONVENIENCE.

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