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Endocal RTE-Series
Refrigerated Bath/Circulator

NESLAB Manual P/N 013853
Rev. 03/22/93

Instruction and Operation Manual

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Endocal RTE-Series Refrigerated Bath/Circulator Instruction and Operation Manual

Table of Contents

PREFACE

Unpacking ..... 1`
Warranty 1
After-sale Support 1

SECTION I
Safety

Warnings 3

SECTION II
General Information

Description 4
Specifications 4

SECTION III
Installation

Site 6
Electrical Requirements 6
Plumbing Requirements 7
Fluids 9
Filling Requirements 9
Thermometer 9

SECTION IV
Controllers

Controllers 10
Controller Mounting 10
Controller Connection 10
Refrigeration Control 10
Boost Heater 11
Basic 12
Analog 12
Digital 13
Programmable 14

SECTION V
Special Features

High Temperature/Low Liquid Level Safety 18
Accessory Receptacle 19

SECTION VI Maintenance

Service Contracts 23
Cleaning 23
Algae 23

SECTION VII Troubleshooting

Checklist 23
Service Assistance 24
Technical Support 24

SECTION VIII Warranty 25

Preface

Unpacking

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

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.

Units have a warranty against defective parts and workmanship for one full year from date of shipment. See back page for more 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, 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 obtain the following information from the unit's serial number label:

- *part number*
- *serial number*

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Section I Safety

Warnings

Make sure you read and understand all instructions and safety precautions listed in this manual before installing or operating your unit. If you have any questions concerning the operation of your unit or the information in this manual, contact our Sales Department.

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.

Observe all warning labels.

Never remove warning labels.

Never operate damaged or leaking equipment.

Never operate the unit without bath fluid in the bath.

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

Always empty the bath before moving the unit.

Never operate equipment with damaged line cords.

Refer service and repairs to a qualified technician.

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

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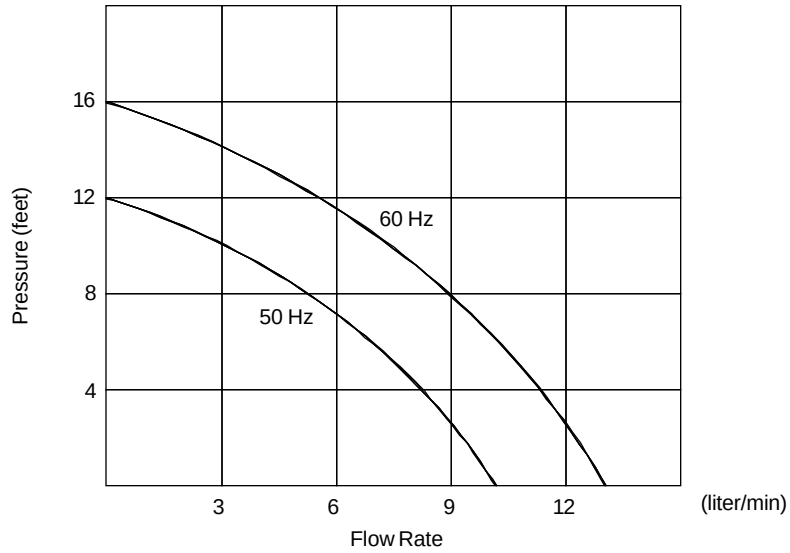
Section II General Information

Description

The Endocal RTE-Series Refrigerated Bath/Circulators are designed to provide temperature control for applications requiring a fluid work area or pumping to an external system.

The units consist of an air-cooled refrigeration system, circulation pump, stainless steel bath, a work area cover, and a temperature controller.

Specifications

	RTE-110	RTE-210	RTE-220
Temperature Range			
Basic controller	-25°C to +100°C	-24°C to +100°C	-23°C to +100°C
Analog controller	-25°C to +100°C	-24°C to +100°C	-23°C to +100°C
Digital controller	-30°C to +130°C	-28°C to +130°C	-26°C to +130°C
Programmable controller	-30°C to +130°C	-28°C to +130°C	-26°C to +130°C
Temperature Stability[1,2]		±0.1°C	
Temperature Stability[1,3]		±0.01°C	
Cooling Capacity[1,4]	>500 watts at +20°C >300 watts at 0°C >175 watts at -10°C	>475 watts at +20°C >300 watts at 0°C >150 watts at -10°C	>475 watts at +20°C >300 watts at 0°C >125 watts at -10°C
Pump Capacity[1]			

1. Specifications listed for units operating at +20°C bath temperature, +21°C (+70°F) ambient, with tap water as bath fluid.
2. Temperature stability of units with a Basic temperature controller.
3. Temperature stability of units with an Analog, Digital or Programmable temperature controller.
4. 60 Hz units. Derate cooling capacity 17% for 50 Hz units.

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	RTE-110	RTE-210	RTE-220
Heater[5]			
(Watts)			
Main	800		800
Boost	NA		850
Bath Work Area			
(H x W x D)			
Inches	5 x 5 x 5.75	10 x 10 x 5.75	10 x 10 x 9
Centimeters	12.7 x 12.7 x 14.6	25.4 x 25.4 x 14.6	25.4 x 25.4 x 22.8
Bath Volume			
Gallons	1.3	3.2	5.3
Liters	5.0	12.3	20.2
Unit Dimensions[6]			
(H x W x D)			
Inches	20 x 8.785 x 12.375	20 x 12.375 x 17.25	23 x 12.375 x 17.25
Centimeters	49.8 x 22.5 x 31.4	49.8 x 31.4 x 43.8	58.4 x 31.4 x 43.8
Unit Dimensions[7]			
(H x W x D)			
Inches	25 x 8.785 x 12.375	25 x 12.375 x 17.25	28 x 12.375 x 17.25
Centimeters	63.5 x 22.5 x 31.4	63.5 x 31.4 x 43.8	71.1 x 31.4 x 43.8
Shipping Weight			
Pounds	70	90	98
Kilograms	32	41	45

5. Model RTE-220 with Basic temperature controllers do not have a boost heater.
6. Units equipped with Basic temperature controllers.
7. Units equipped with Analog, Digital, or Programmable temperature controllers.

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Section III Installation

Site

Locate the unit on a sturdy table or bench top. Ambient temperatures should be inside the range of +50°F to +80°F (+10°C to +27°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. Air is drawn through the front panel and discharged through the rear panel. The unit must be positioned so the air intake and discharge are not impeded. A minimum clearance of 12 inches (30 centimeters) at the front and rear of the unit is necessary for adequate ventilation. Inadequate ventilation will reduce cooling capacity and, in extreme cases, can cause compressor failure.

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

The unit will retain its full rated capacity in ambient temperatures up 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 terms of Celsius, derate the cooling capacity 1% for every 0.5°C above +24°C, to a maximum ambient temperature of +35°C.

Electrical Requirements

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

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

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.

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Plumbing Requirements

Hose Connections

The pump connections are located at the rear of the pump box and are labelled PUMP INLET and PUMP OUTLET. These connections are stainless steel serrated hose connections that accept 3/8 inch ID flexible tubing and two teflon O-rings.

Flexible tubing, if used, should be of heavy wall or reinforced construction. 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 external system 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, make them at the inlet and outlet of the external system, not at the unit.

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

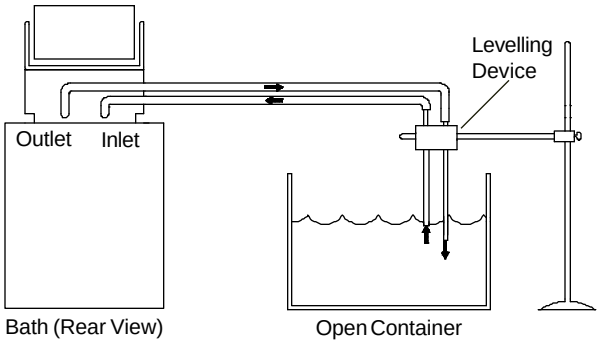
Pumping

The pump is designed to deliver a flow of 13 liters/minute (3.5 gallons minute) at 0 feet head. To prevent unwanted flow, the bath is supplied with two stainless steel disks which block the PUMP INLET and PUMP OUTLET. The disks must be removed when flow is required. To prevent leaking around the inlet and outlet connections, be sure the two teflon O-rings remain in place. To prevent distortion of the O-rings, only tighten the connections "hand-tight". Once the hose connections are made, the pump must be properly plumbed to an external system. It is important the bath is not in operation until all plumbing work is done.

If the bath is not used for external circulation, make sure the stainless steel disks are in place prior to operating the bath.

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Circulating to an open container



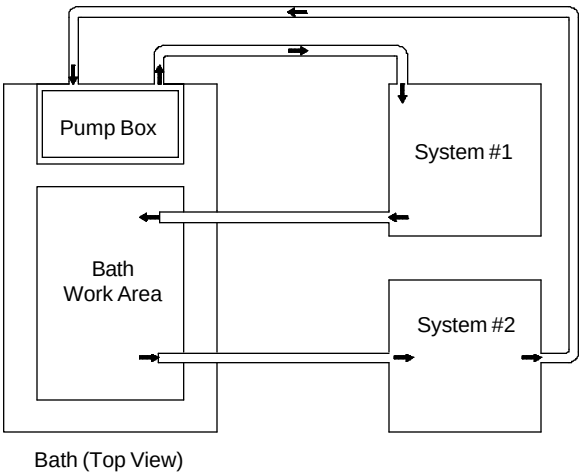
A stainless steel leveling device is available to aid circulation to an open vessel. Contact our Sales Department for more information (see Preface, After-sale Support).

Support the leveling device over the open container with a ringstand. Stagger the tubes in the leveling device so one tube is submerged in the vessel fluid, and the other tube is level with the fluid surface. Connect the deeper tube to the PUMP OUTLET and the other tube to the PUMP INLET.

Adjust the flow rate using the accessory flow control valve connected to the PUMP OUTLET, or by partially restricting the outlet tubing. When properly adjusted, the pump inlet will draw an occasional air bubble to prevent over flow, and the pump outlet will force fluid through the submerged tube to prevent aeration of the vessel.

To avoid siphoning the bath work area when the unit is shut off, lift the leveling device out of the vessel and above the level of the unit.

Circulating through two closed loops



The pump can be used to circulate through two closed loop systems. Connect the shortest practical length of flexible tubing from the PUMP OUTLET to the inlet of external system #1. Connect the outlet of system #1 directly into the bath work area. Connect tubing from the bath work area to the inlet of system #2. Connect the outlet of system #2 to the PUMP INLET.

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Drain

The unit is equipped with a drain located at the back of the unit at the base of the bath. The drain consists of a drain port and a drain fitting.

The drain has a 3/8 inch O.D. stainless steel serrated fitting. The fitting will accept 5/16 or 3/8 inch I.D. tubing.

To drain the bath, turn the fitting 1 turn counter-clockwise.

Fluids

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



Never use flammable or corrosive fluids with this unit.

Tap water is the recommended fluid for operation from +8°C to +80°C.

Below +8°C, a 50/50 mixture, by volume, of tap water and laboratory grade ethylene glycol is suggested.

Above +80°C, the user is responsible for fluids used.

Filling Requirements

The bath work area has a high and low level marker to guide filling. The markers are 1 inch horizontal slits located in the center of the stainless steel baffle separating the work area and the pump assembly. The correct fluid level falls between these two markers. Maintain the correct fluid level or the heating and cooling coils will be exposed and may become damaged.

When pumping to an external system, keep extra fluid on hand to maintain the proper level as the circulating lines and external system are filled.



Never run the unit when the work area is empty.

Thermometer

Units with a Basic or Analog temperature controller are equipped with a glass tube thermometer. Insert the thermometer in the grommet located on the left side of the work area.

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Section IV Controllers

Controllers

Four standard temperature controllers are available with the unit: Basic, Analog, Digital, and Programmable. This section explain the installation and operation of the controllers.

Controller Mounting

Analog, Digital, and Programmable temperature controllers are designed as separate components from the unit. The controller can be mounted directly

on the pump box, or remotely from the bath. The controller yoke has screw holes allowing the controller to be mounted on a wall. Accessory cables are available from NESLAB for extended remote applications. Contact our Sales Department for more information (see Preface, After-sale Support).

To mount the controller on top of the pump box, locate the restraining clip in the center of the controller yoke. Position it on the mounting pin located in the center top plate of the pump box. Once secured, the controller can be tilted or swiveled to meet your needs.

Controller Connection

On units with Analog, Digital, or Programmable controllers, the components in the bath will accept a signal from the controller only when the controller and the pump box have been properly connected. Connect the 15 pin plug at the end of the controller's cable to the 15 pin socket on the rear of the pump box. Once the connection is made, the unit is ready for operation.

Refrigeration Control

On units with Basic temperature controllers, the status of the refrigeration system is controlled by the REFRIG switch on the front of the control/pump box. When operating in the range of -30°C to +45°C (-30°C to +35°C for 220v/50Hz units), the refrigeration must be on: place the switch in the TEMP<45°C position. When operating in the range of +45°C to +100°C (+35°C to +100°C for 220v/50Hz units), the refrigeration must be off: place the switch in the TEMP>45° position. The REFRIG lamp indicates the status of the refrigeration system.

On units with Analog, Digital, or Programmable temperature controllers, the controller powers the refrigeration system to aid in rapid temperature change over the bath's operating range. The compressor will not run with the setpoint above +45°C. The compressor runs continuously if the setpoint is +45°C or less (+35°C or less for 220v/50Hz units) while the heater cycles to maintain the setpoint. However, if the setpoint is more than 2°C higher than the fluid temperature, the compressor will shut off to provide rapid heat up.

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If a rapid cool down at elevated temperatures is needed you will have to temporarily adjust the setpoint to below +45°C. The compressor will run to bring the temperature down. Reset the setpoint once cool down is achieved.

The HEAT LED indicates the status of the heater. As the temperature of the fluid in the bath approaches the temperature setpoint, the lamp will cycle on and off to indicate the approximate duty cycle of the heater.

When the unit is shut off (on units with Basic temperature controllers, when the refrigeration system 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.

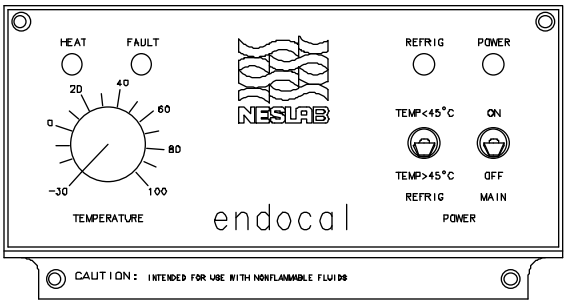
Boost Heater

Model RTE-220, with an Analog, Basic, Digital or Programmable temperature controller, has an automatic boost heater. The boost heater is designed to provide additional heat to the unit's large work area to aid rapid heating. Whether the boost heater is on or off depends on the difference between the bath temperature and the setpoint.

If the bath temperature is within 2.5°C of the setpoint, the boost heater remains off. If the bath temperature is 2.5°C below the setpoint, the boost heater will come on.

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Basic



Basic Temperature Controller (Front View)

Start Up

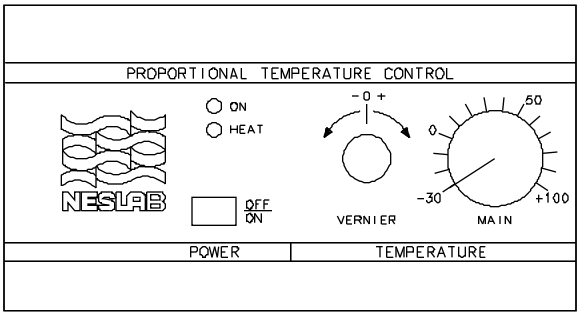
Before starting the unit, check all electrical and plumbing connections and make sure the work area has been properly filled with bath fluid.

To start the unit, place the MAIN ON/OFF switch in the ON position. The pump will start and the POWER LED will light.

Temperature Adjustment

To adjust the bath temperature, turn the calibrated TEMPERATURE dial and position the reference line as close to the temperature setpoint as possible.

Analog



Analog Temperature Controller (Front View)

Start Up

Before starting the unit, check all electrical and plumbing connections and make sure the work area has been properly filled with bath fluid.

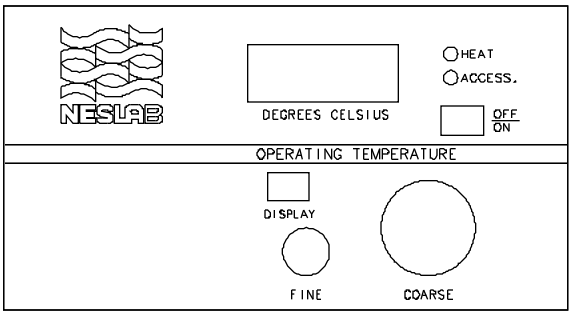
To start the unit, press the ON/OFF switch. The pump and refrigeration system will start and the ON LED will light.

Temperature Adjustment

To adjust the bath temperature, turn the calibrated MAIN dial and position the reference line as close to the temperature setpoint as possible. Use the VERNIER dial and the bath thermometer to make fine adjustments to the bath temperature.

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Digital



Digital Temperature Controller (Front View)

Start Up

Before starting the unit, check all electrical and plumbing connections and make sure the work area has been properly filled with bath fluid.

To start the unit, press the ON/OFF switch. The pump and refrigeration system will start and the digital display will indicate the temperature of the fluid in the bath.

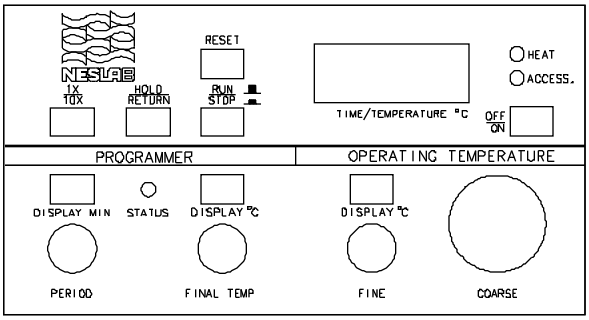
Temperature Adjustment

To display the temperature setpoint, press the DISPLAY switch. To adjust the setpoint, press the DISPLAY switch and turn the COARSE and FINE dials until the temperature setpoint is indicated on the LED display.

Inadvertent movement of the COARSE and FINE dials, regardless of the position of the DISPLAY switch, will result in a change of the setpoint. The change will not be immediately reflected on the LED display unless the DISPLAY switch is pressed. The display will eventually change as the unit responds to the new setpoint.

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Programmable



Programmable Temperature Controller (Front View)

Start Up

Before starting the unit, check all electrical and plumbing connections and make sure the work area has been properly filled with bath fluid.

To start the unit, push the ON/OFF switch. The pump and refrigeration system will start and the digital display will indicate the temperature of the fluid in the bath.

Temperature Adjustment

To display the temperature setpoint, press the DISPLAY°C switch (on the OPERATING TEMPERATURE section). To adjust the setpoint, press the DISPLAY°C switch and turn the COARSE and FINE dials until the temperature setpoint is indicated on the LED display.

Inadvertent movement of the COARSE and FINE dials, regardless of the position of the DISPLAY switch, will result in a change of the setpoint. The change will not be immediately reflected on the LED display unless the DISPLAY switch is pressed. The display will eventually change as the unit responds to the new setpoint.

Programming

DISPLAY°C

When pressed, the temperature setpoint is indicated on the LED display. When released, the display indicates the temperature of the fluid in the bath.

FINAL TEMP

Adjusts final temperature setpoint .

DISPLAY MIN

When pressed, the time span of the program is indicated, in minutes, on the LED display. When released the display indicates the temperature of the fluid in the bath.

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PERIOD
Adjusts time span of the program, in minutes.

STATUS
Indicates status of program clock.

If the light is off, the clock is stopped.

If the light flashes rapidly, the program clock is running.

If the light flashes slowly, power to the clock has been turned off or interrupted since the clock was last reset.

RUN/STOP
Starts and stops program execution.

In the RUN position, the program clock runs and the temperature setpoint changes linearly from the current fluid temperature to final temperature. In the STOP position, the program clock stops and the fluid temperature will remain at the current temperature. Returning to the RUN position resumes the program.

RESET
Resets the program clock and returns the fluid temperature to the starting temperature.

1X/10X
Adjusts PERIOD time range: 1X = 5 minutes to 180 minutes; 10X = 50 minutes to 1800 minutes.

HOLD/RETURN
Determines what will happen at the end of the program.

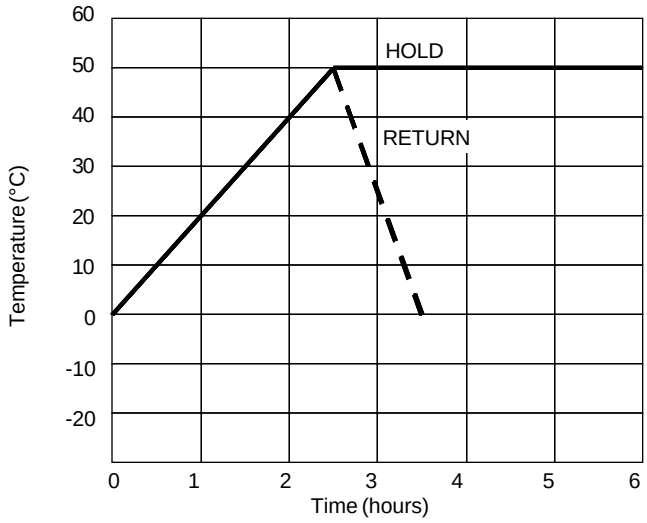
In the HOLD position, the setpoint will remain at the final temperature when the program is completed. In the RETURN position, the setpoint will return to the starting setpoint when the program is completed. The setpoint will change abruptly, but the fluid temperature will respond as quickly as the systems heating and cooling capacity allows.

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Mock Program

This mock program is designed to illustrate the relationship between specific

key functions, previously outlined, to an overall temperature program. This simple linear ramp will raise the bath temperature from 0°C to +50°C in a time span of 2.5 hours.



Start the unit and reset the programmer clock.

Start the unit by pressing the ON/OFF switch. The pump and refrigeration system will start and the digital display will indicate the temperature of the fluid in the bath.

To reset the program clock, place the RUN/STOP switch in the STOP position and press the RESET switch. The STATUS LED will go out, indicating the programmer is ready to accept a program.

Set starting temperature at 0°C.

Press the DISPLAY°C (under OPERATING TEMPERATURE section) and adjust the temperature setpoint for 0°C. (See Temperature Adjustment for more detailed instructions.) While the fluid temperature is stabilizing, set the remaining parameters of the program.

Set final temperature at +50°C.

Press the DISPLAY°C (under PROGRAMMER section) and turn the FINAL TEMP dial until the final temperature, +50°C, is indicated on the LED display.

Set time span.

All time parameters associated with the programmer are interpreted in minutes. The time span of 2.5 hours translates to 150 minutes. Place the 1X/10X switch in the 1X position. Press DISPLAY MIN and turn the PERIOD dial until the time span, 150 minutes, is indicated to the LED display.

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Set end function.
To hold the fluid temperature at the final setpoint, place the HOLD/RETURN switch in the HOLD position.

Run
The program is ready to run once all parameters have been set and the bath temperature has stabilized at 0°C.

To start the program, place the RUN/STOP switch in the RUN position. The STATUS LED will flash rapidly, indicating the program is executed.

Programming Notes
The unit's limitations must be considered when designing programs. Temperature or time parameters which exceed the performance capabilities of the bath will result in unsatisfactory operation.

The Programmable controller can function as a Digital controller by disengaging the program clock. When the unit is turned on, the STATUS LED will flash slowly indicating the controller has received power. Place the RUN/STOP switch in the STOP position and momentarily press RESET. The program clock will reset and the STATUS LED will go out. The controller will now function as a Digital controller provided the RUN/STOP switch remains in the STOP position.

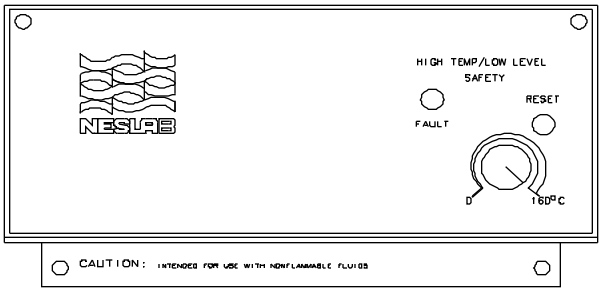
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Section V Special Features

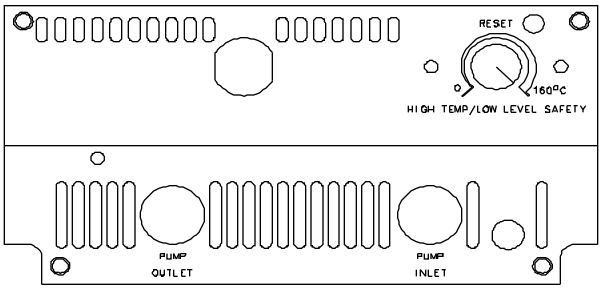
High Temperature/ Low Liquid Level Safety

The adjustable High Temperature/Low Liquid Level Safety (HIGH TEMP/ LOW LEVEL) prevents the heater from reaching excessively high temperatures that can cause serious damage to your unit. A single temperature sensor, located on the heater coils in the bath, monitors both conditions. A High Temperature/Low Liquid Level fault occurs when the temperature of the sensor exceeds the set temperature limit. In the event of a fault, the unit will shut down. The cause of the fault must be identified and corrected before the unit can be restarted.

The safety is not pre-set and must be adjusted during initial installation.



Pump Box (Front View)



Basic Temperature Controller (Rear View)

To set the safety, locate the HIGH TEMP/LOW LEVEL SAFETY adjustment dial on the front of the pump box (on units with Basic temperature controllers, the dial is located on the rear of the pump box). Turn the dial fully clockwise and press the RESET switch.

Start the unit. Adjust the temperature setpoint for a few degrees higher than the highest desired fluid temperature and allow the bath to stabilize at the temperature setpoint. Turn the HIGH TEMP/LOW LEVEL SAFETY dial counter-clockwise until you hear a click and the unit shuts down. The red FAULT LED on the pump box will light to indicate a fault has occurred.

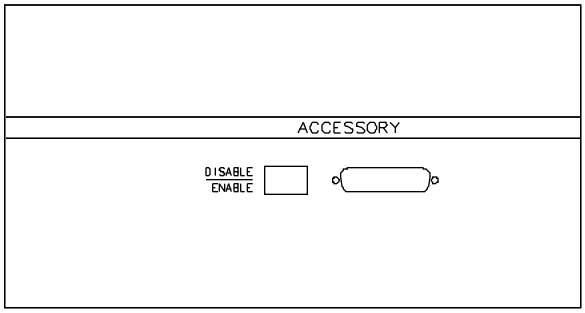
The safety is now set. Allow the fluid temperature to cool below the cutout temperature, then press the RESET switch.

If a fault ever occurs, RESET must be pressed before the unit will start.

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Accessory Receptacle

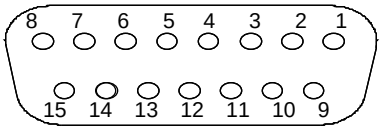
All Digital and Programmable temperature controllers are equipped with a 15 pin “D” sub-miniature female receptacle on the rear of the control box. The receptacle allows the bath to be monitored and controlled from a remote location. To activate the receptacle, press the two position ENABLE/ DISABLE switch next to the receptacle. The yellow ACCESS LED on the front of the control box will light when the receptacle is enabled. When the receptacle is not being used, the switch must be in the DISABLE position.



Digital/Programmable Temperature Controller (Rear View)

LINE VOLTAGE SHOULD NEVER BE APPLIED TO THE PINS IN THIS RECEPTACLE. ADDITIONALLY, NO VOLTAGE EXCEEDING 5VDC (EXCEPT WHERE NOTED) SHOULD BE APPLIED. NEVER APPLY VOLTAGE TO THE GROUND PINS.

The pins can function as an input, output, or both input and output.



Accessory Receptacle Pin Designations

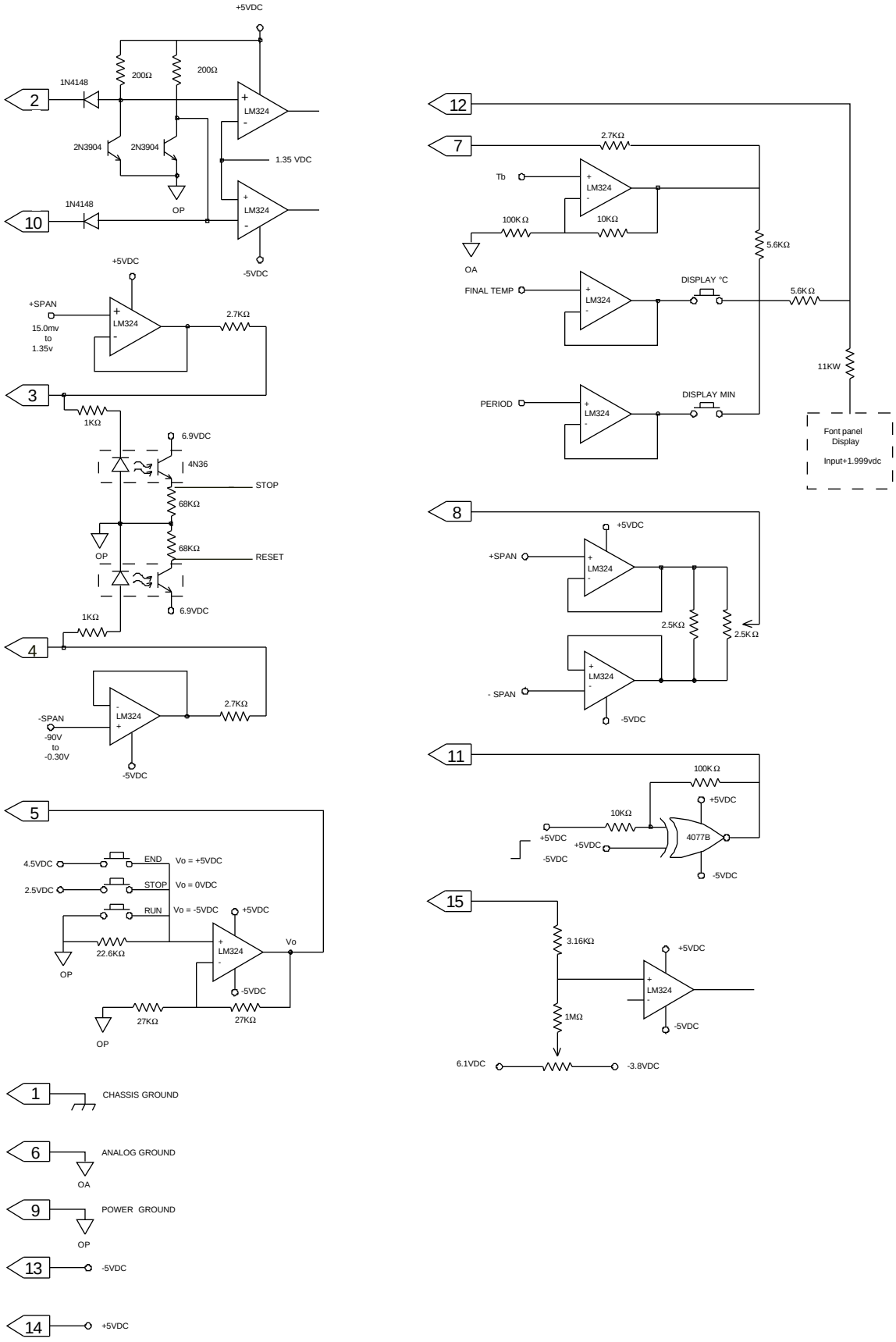
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Pin #	Function	Description
1		Chassis ground
2	Output: Compressor status	A high level on this pin, approximately +4VDC, indicates the compressor is running. A low level, approximately 0VDC, indicates the compressor is off. An LED connected between this pin and pin 9 will indicate the compressor status. This pin can be connected to multiple switching devices or one 3-32V solid state relay.
	Input: Compressor Off	When this pin is connected to pin 9, the compressor will shut off.
3	Output: Span + (Programmable Temperature Controllers Only)	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: +1350mV = +135°C). Output resistance of 2.7K Ω.
	Input: STOP (Programmable Temperature Controllers Only)	Connect this pin to a voltage source between -5VDC and -20VDC to place the programmer in the STOP mode. Pin 13 (referenced to power ground, pin 9) can be used as a voltage source.
4	Output: Span - (Programmable Temperature Controllers Only)	Indicates the minimum setpoint value the unit can operate. The temperature scale is 10mV/°C, referenced to analog ground, pin 6 (example: -150mV = -15°C). Output resistance of 2.7K Ω.
	Input: RESET (Programmable Temperature Controllers Only)	Connect this pin to a voltage source adjusted between +3.5VDC and +20VDC to reset the programmer. Pin 14 (referenced to power ground, pin 9) can be used as a voltage source.
5	Output: Program Status (Programmable Temperature Controllers Only)	The voltage value on this pin indicates one of three conditions: 1. When the voltage value is approximately +3.5VDC, the programmer has completed the program. 2. When the voltage value is approximately 0VDC, the programmer clock has been stopped. The programmer is in the STOP mode. 3. When the voltage value is approximately -5VDC, the programmer clock is running.
6	Analog ground	Analog ground is grounded internally and should not be grounded anywhere else. Analog ground represents reference “0”. This pin should be used only as a reference pin when no current is flowing. See pin 9.

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Pin #	Function	Description
7	Output: Sensor temperature	The fluid temperature, as measured by the controller's temperature sensor located in the bath, can be read at this pin. The temperature is scale 10mV/°C, referenced to analog ground, pin 6 (example: +150mV = +15°C). Output resistance of 2.7K Ω.
8	Output: Temperature setpoint	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°C). Output resistance of 600 Ω.
9	Power ground	Power ground is connected to chassis ground internally. This pin should be used for functions that require the unit to draw input or output current. See pin 6.
10	Output: Boost heater status	A high level on this pin, approximately +4VDC, indicates the boost heater is on. A low level, approximately 0VDC, indicates the boost heater is off. An LED connected between this pin and pin 9 will indicate the boost heater status. This pin can be connected to multiple switching devices or one 3-32V solid state relay.
	Input: Boost Heater Off	Connect this pin to pin 9, power ground, and the boost heater will shut off.
11	Output: Band detector	A negative voltage, approximately -5VDC, on this pin indicates the controller is operating within the proportional band. A positive voltage, approximately +5VDC, indicates the present bath temperature is outside of the controller's proportional band. Measurements are referenced to power ground, pin 9. Output resistance of 1.8K Ω.
12	Input: Digital Display	An external voltage can be displayed on the controller's digital display by applying the voltage to this pin. This pin is reserved for use with NESLAB electronic accessories. Contact our Sales Department for more information.
13	Output: -5V	Power supply of -5VDC. Damage will occur if this pin is connected to pin 14.
14	Output: +5V	Power supply of +5VDC. Damage will occur if this pin is connected to pin 13.
15	Input: Temperature setpoint	An external input can provide a temperature setpoint for the controller by applying a known voltage to this pin. The temperature scale is 10mV/°C, referenced to analog ground, pin 6 (example:+230mV = +23°C). The ACCESSORY ENABLE/DISABLE switch must be in the ENABLE position to control the setpoint from this pin.

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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

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.

Periodic vacuuming of the condenser is necessary. The frequency of cleaning depends on the operating environment. After initial installation, we recommend the front panel be removed and a visual inspection of the condenser made monthly. After several months, the frequency of cleaning will be established.



The unit must be turned off before the front panel is removed.

Algae

To restrict the growth of algae in the bath, we recommend the bath cover be kept in place and that all circulation lines be opaque. This will eliminate the entrance of light required for the growth of most common algae.

If algae becomes a problem, contact our Service Department for a recommendation (see Preface, After-sale Support).

Section VII Troubleshooting

Checklist

Unit will not start

Make sure the voltage of the power source meets the specified voltage, ±10%. Refer to the serial number label on the rear of the unit to identify the specific electrical requirements of your unit.

Units with an Analog, Digital, or Programmable controller: make sure the controller is properly connected to the pump box.

Check the High Temperature/Low Liquid Level Safety. If the FAULT light is on, make sure the fluid level in the bath is between the marks in the baffle and the HIGH TEMP/LOW LEVEL SAFETY setting is greater than the fluid temperature. Push the RESET switch and attempt to restart.

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Loss of cooling capacity
Be sure the cooling capacity of the unit has not been exceeded if circulating to an external system.

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.

Proper ventilation is required for heat removal. Make sure ventilation through the front and rear panels is not impeded and the panels are free of dust and debris.

Ice build up on the cooling coils can act as insulation and lower the cooling capacity. Raise the temperature of the bath to de-ice the cooling coil and increase the concentration of non-freezing fluid.

No temperature control
Units with a Digital or Programmable controller: the ENABLE/DISABLE switch on the rear of the controller must be in the correct position. If the ACCESSORY receptacle is being used, the switch must be in the ENABLE position. If not in use, the switch must be in the DISABLE position. The ACCESS light on the front of the unit indicates the status of this switch.

No external circulation
Make sure the stainless steel disks on the PUMP INLET and PUMP OUTLET have been removed.

Check for obstructions, kinks, or leaks in the circulation tubing.

Circulation will cease when the pump head has been exceeded.

Service Assistance

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

Part number
Serial number
Voltage of unit
Voltage of power source

Technical Support

Our Service Department can provide you with a wiring diagram and a complete list of spare parts for your unit. Before calling, please obtain the following information:

Part number
Serial number

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Section VIII 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, 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 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, 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.

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