

USERGUIDE
UGH002/0514

Thermolator® heaTrac Series

**Oil Temperature Controller HTR1-500 with TH-1
or TH-2 controls**



Please record your equipment's model and serial number(s) and the date you received it in the spaces provided.

It's a good idea to record the model and serial number(s) of your equipment and the date you received it in the User Guide. Our service department uses this information, along with the manual number, to provide help for the specific equipment you installed.

Please keep this User Guide and all manuals, engineering prints and parts lists together for documentation of your equipment.

Date:
Manual Number: UGH002/0514
Serial number(s):
Model number(s):

DISCLAIMER: Conair shall not be liable for errors contained in this User Guide or for incidental, consequential damages in connection with the furnishing, performance or use of this information. Conair makes no warranty of any kind with regard to this information, including, but not limited to the implied warranties of merchantability and fitness for a particular purpose.

INTRODUCTION 1-1

Purpose of the User Guide	1-2
How the guide is organized	1-2
Your responsibility as a user	1-2
ATTENTION: Read this so no one gets hurt	1-3

DESCRIPTION 2-1

What is the Thermolator heaTrac?	2-2
Typical applications	2-2
How it works:	2-3
Specifications	2-6
Features and options	2-8

INSTALLATION 3-1

Unpacking the boxes	3-2
Preparing for installation	3-3
Connecting the cooling water supply	3-4
Connecting the main power	3-6
Testing the installation	3-7
Initial setup	3-8
Changing temperature units	3-9
Enabling and disabling passcode protection	3-10
Selecting the temperature control point (TH-2)	3-12
Entering setpoint deviation parameters	3-14
Activating SPI communication	3-15
Enabling the Auto Start feature (TH-2)	3-16

OPERATION 4-1

TH-1 control features	4-2
TH-2 control features	4-3
Positioning the control panel	4-4
Entering passcodes	4-5
Starting the Thermolator	4-6
Stopping the Thermolator	4-7
Performing an Auto Tune	4-10

MAINTENANCE 5-1

Preventative maintenance schedule	5-2
To access the Thermolator enclosure	5-3
Checking fluid level in the reservoir	5-4

TABLE OF CONTENTS

TABLE OF CONTENTS

MAINTENANCE(continued)

Performing System Tests	5-5
The Key/Display Test	5-6
Input Test	5-7
Output Test	5-8
Disabling and Enabling Outputs	5-9
Calibrating Temperature Sensors	5-10
Logging Operating Hours	5-12

TROUBLESHOOTING 6-1

Before Beginning	6-2
A Few Words of Caution	6-2
How to Identify the Cause of a Problem	6-3

DIAGNOSTICS

Shut Down Alarms	6-4
Warning Alarms	6-8
System Alarms	6-11
Thermolator Will Not Power Up	6-12

REPAIR

Checking and Replacing Fuses	6-13
Resetting and Replacing Overloads	6-14
Replacing the Motherboard	6-15
Replacing the Heater Contactor	6-16
Checking and Replacing Thermocouples	6-17
Repairing Solenoid Valves	6-18
Replacing Heater Elements	6-20
Removing the Pump	6-21

APPENDIX

Customer Service Information	A-1
Warranty/Guarantee Information	A-2
MP Pumps HTO Series Operation and Maintenance	B-1
Technical Information	C-1
Thermolator SPI commands	D-1
Material Safety Data Sheets	E-1

PARTS/DIAGRAMS

Spare Parts Lists	PD-1
TH-1 Wiring	PD-5
TH-1 Circuit Board	PD-6
TH-1 Wiring	PD-7
TH-2 Circuit Board	PD-8

INTRODUCTION

- *Purpose of the User Guide 1-2*
- *How the guide is organized 1-2*
- *Your responsibilities as a user .1-2*
- *ATTENTION: Read this so
no one gets hurt 1-3*

PURPOSE OF THE USER GUIDE

This User Guide describes the Conair Thermolator® TH-1 and TH-2 oil temperature controllers and explains step-by-step how to install, operate, maintain and repair this equipment.

Before installing this product, please take a few moments to read the User Guide and review the diagrams and safety information in the instruction packet. You also should review manuals covering associated equipment in your system. This review won't take long, and it could save you valuable installation and operating time later.

HOW THE GUIDE IS ORGANIZED

Symbols have been used to help organize the User Guide and call your attention to important information regarding safe installation and operation.



Symbols within triangles warn of conditions that could be hazardous to users or could damage equipment. Read and take precautions before proceeding.



Numbers within shaded squares indicate tasks or steps to be performed by the user.



A diamond indicates the equipment's response to an action performed by the user.



An open box marks items in a checklist.



A shaded circle marks items in a list.

YOUR RESPONSIBILITY AS A USER

You must be familiar with all safety procedures concerning installation, operation and maintenance of this equipment. Responsible safety procedures include:

- Thorough review of this User Guide, paying particular attention to hazard warnings, appendices and related diagrams.
- Thorough review of the equipment itself, with careful attention to voltage requirements, intended uses and warning labels.
- Thorough review of instruction manuals for associated equipment.
- Step-by-step adherence to instructions outlined in this User Guide.

We design equipment with the user's safety in mind. You can avoid the potential hazards identified on this machine by following the procedures outlined below and elsewhere in the User Guide.

 **ATTENTION:**
READ THIS SO NO
ONE GETS HURT



WARNING: Improper installation, operation or servicing may result in equipment damage or personal injury.

This equipment should be installed, adjusted, and serviced by qualified technical personnel who are familiar with the construction, operation and potential hazards of this type of equipment.

All wiring, disconnects and fuses should be installed by qualified electrical technicians in accordance with electrical codes in your region.

Always maintain a safe ground. A properly sized conductive ground wire from the incoming power supply must be connected to the chassis ground terminal inside the electrical enclosure. Improper grounding can result in personal injury and erratic machine operation.

Do not operate the equipment at power levels other than what is specified on the the equipment serial tag and data plate.



WARNING: Electrical shock hazard

This equipment is powered by three-phase main voltage, as specified on the machine serial tag and data plate.

Always disconnect and lock out the incoming main power source before opening the electrical enclosure or performing non-standard operating procedures, such as troubleshooting or maintenance. Only qualified personnel should perform procedures that require access to the electrical enclosure while power is on.



CAUTION: Hot surfaces

Surface temperatures inside the Thermolator can exceed 500° F (260° C). Always allow the unit to cool to below 100° F (38° C) before opening, servicing or disassembling the unit.

 **ATTENTION:**
READ THIS SO NO
ONE GETS HURT



WARNING: Hazardous substance

The electrical contactors in the Thermolator have mercury contactors. Mercury is considered a hazardous substance and must be dealt with accordingly. Material Safety Data Sheet (#7439-97) has been included in the instruction packet. This sheet explains the potential hazards, how to avoid them and how to clean up and dispose of the mercury if it spills.

DESCRIPTION

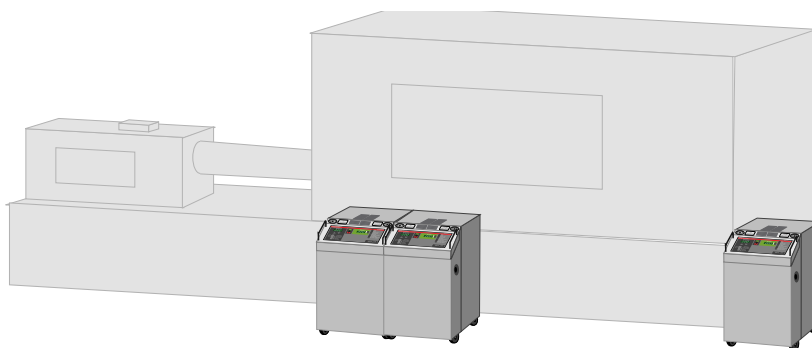
- ***What is the Thermolator
heaTrac? 2-2***
- ***Typical applications 2-2***
- ***How it works 2-5***
- ***Specifications: heaTrac 2-6***
- ***Features and options 2-8***

WHAT IS THE THERMOLATOR HEATRAC?

The Thermolator heaTrac circulates oil at a temperature to add or remove heat as needed to maintain a uniform temperature setpoint in the process. The heaTrac offers an enhanced TH-2 control, with additional diagnostic features and autostart capabilities.

Both the TH-1 and TH-2 models are available in single or multiple-zone configurations. Multiple-zone models can control up to two temperatures at different locations in the process. Two-zone models have common cooling water manifolds and electrical connections.

The best model for your application depends on the process temperature you need to maintain and the quality of the cooling water supply.



TYPICAL APPLICATIONS

TH-1 and TH-2 models separate the cooling water from the process fluid, which is held in a reservoir. All heaTrac models are recommended for:

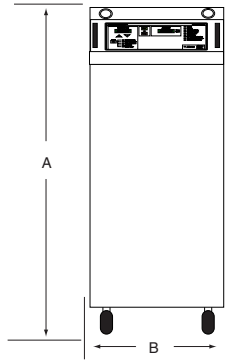
- Process temperatures up to 500°F (260°C).
- Use with chiller water, or with properly treated and filtered tower or city water..

How It Works:

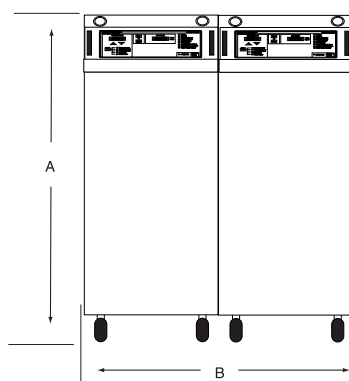


SPECIFICATIONS

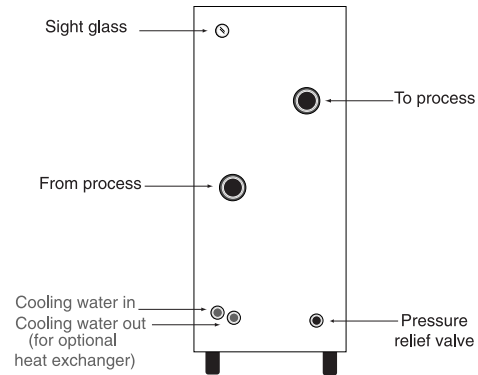
Dimensions and performance characteristics vary according to the model, voltage and components selected. See the cabinet style reference chart to determine dimensional information for your specific model. Additional technical information can be found in the Appendix of this User Guide.



HTR1-500 (single zone)



HTR2-500 (dual zone)



HTR1-500 rear view and connections

MODELS	HTR1-500				HTR2-500			
Performance Characteristics								
Minimum setpoint °F {°C}	70 {21}				70 {21}			
Maximum setpoint °F {°C}	500 {260}				500 {260}			
Pump Performance								
Pump Size Hp {kW}	1 {0.75}	1.5 {1.12}	2 {1.49}	3 {2.24}	1 {0.75}	1.5 {1.12}	2 {1.49}	3 {2.24}
Nominal flow gpm {l/min}	55 {208}	65 {246}	75 {284}	85 {322}	55 {208}	65 {246}	75 {284}	85 {322}
Pressure @ nominal flow psi {bar}	16 {1.1}	21 {1.5}	24 {1.7}	32 {2.2}	16 {1.1}	21 {1.5}	24 {1.7}	32 {2.2}
Dimensions inches {mm}								
A -Height	43 {1090}				43 {1090}			
B- Width	14 {355}				28 {710}			
C- Depth	31.5 {800}				31.5 {800}			
Weight lb {kg}								
Operating	300 {136}	305 {138}	310 {141}	320 {145}	600 {272}	610 {277}	620 {281}	640 {290}
Shipping	470 {213}	475 {216}	480 {218}	490 {222}	770 {349}	780 {354}	790 {358}	810 {367}
Water Connections NPT inches (Female)								
To/From Process	1.25				1.25			
Cooling Water Inlet/Outlet *	0.75				0.75			

FULL LOAD AMPS †														HTR1-500												HTR2-500											
Heater		6 kW				12 kW				18 kW				6 kW				12 kW				18 kW															
Voltage		208V	230V	460V	575V	208V	230V	460V	575V	208V	230V	460V	575V	208V	230V	460V	575V	208V	230V	460V	575V	208V	230V	460V	575V												
Pump																																					
1 Hp	{0.75 kW}	21.2	19.2	9.6	7.7	37.8	34.2	17.1	21.4	54.4	49.2	24.6	19.7	42.2	38.2	19.1	15.3	75.6	68.4	34.2	15.3	109.0	98.6	49.3	39.4												
1.5 Hp	{1.12 kW}	21.9	19.8	9.9	7.9	38.5	34.8	17.4	13.9	55.0	49.8	24.9	19.9	43.5	39.4	19.7	15.8	76.9	69.6	34.8	15.8	110.3	99.8	49.9	39.9												
2 Hp	{1.49 kW}	23.6	21.4	10.7	8.6	40.2	36.4	18.2	14.6	56.8	51.4	25.7	20.6	47.1	42.6	21.3	17.0	80.4	72.8	36.4	17.0	113.8	103.0	51.5	41.2												
3 Hp	{2.24 kW}	26.5	24.0	12	9.6	43.1	39.0	19.5	15.6	59.7	54.0	27.0	21.6	52.8	47.8	23.9	19.1	86.2	78.0	39.0	19.1	119.3	108.0	54.1	43.2												

SPECIFICATIONS NOTES:

* For units equipped with optional heat exchanger and cooling circuits.

† All voltages are 3 phase, 60 Hz.

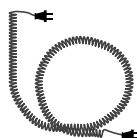
Specifications can change without notice. Check with a Conair representative for the most current information.

INSTALLATION

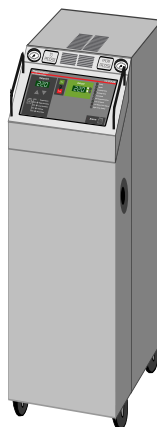
- *Unpacking the boxes 3-2*
- *Preparing for installation 3-3*
- *Connecting the water supply . .3-4*
- *Optional purge valve hookups .3-5*
- *Connecting the main power . . .3-6*
- *Testing the installation 3-7*
- *Initial setup 3-8*
- *Changing temperature units . . .3-9*
- *Enabling and disabling
 passcode protection 3-10*
- *Selecting the temperature
 control point (TH-2) 3-12*
- *Entering setpoint
 deviation parameters 3-14*
- *Activating SPI
 communication 3-15*
- *Installing the Auto Start
 feature 3-16*

UNPACKING THE BOXES

Thermolator heaTrac models come fully assembled. If they were specified at the time of the order, the optional cooling exchanger and valve is factory-installed.



Remote control cord
(TH-2 only)



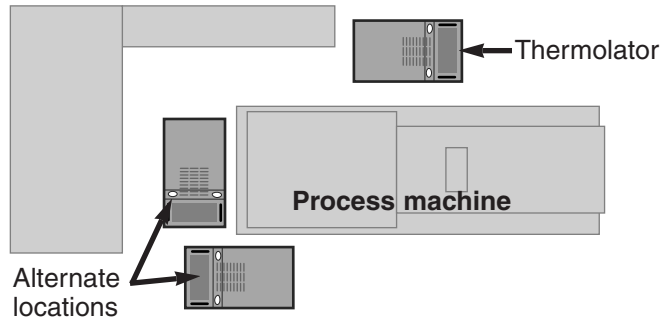
Thermolator heaTrac

- 1** **Carefully remove the Thermolator** and components from their shipping containers, and set upright.
- 2** **Remove all packing material**, protective paper, tape, and plastic. Check inside the electrical enclosure and behind the side panels for accessories or hardware that may have been placed there for shipping.
- 3** **Carefully inspect all components** to make sure no damage occurred during shipping, and that you have all the necessary hardware. If damage is found, notify the freight company immediately.
- 4** **Take a moment to record serial numbers** and specifications in the blanks provided on the back of the User Guide's title page. The information will be helpful if you ever need service or parts.
- 5** **You are now ready to begin installation.** Complete the preparation steps on the next page.

The Thermolator heaTrac is easy to install, if you plan the location and prepare the area properly.

PREPARING FOR INSTALLATION

1 Position the Thermolator as close to the process machine as possible.



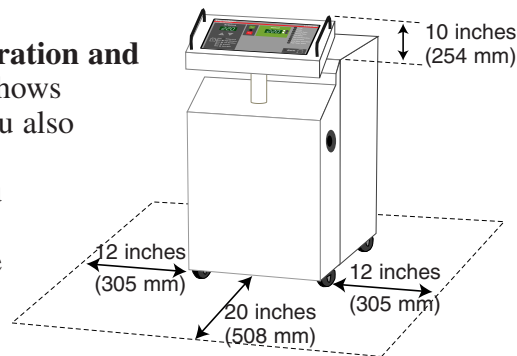
2 Make sure the installation area provides:

❑ **A three-phase power source supplying the correct current** for your Thermolator model. Check the serial tag on the side of the electrical enclosure for the required voltage, phase, frequency, full load amps, disconnect fuse size and minimum wire connection size. Field wiring should be completed by qualified personnel to the planned location for the Thermolator. All electrical wiring should comply with your region's electrical codes.

❑ **A clean, well-ventilated environment.**

The room temperature should not exceed 120° F (48° C) with 95% non-condensing humidity and should not fall below 32° F (0° C).

❑ **Minimum clearance for safe operation and maintenance.** The diagram at right shows minimum clearance for operation. You also need enough clearance in the rear for water hookups. For maintenance, you should move the Thermolator to provide at least 36 inches on any side of the Thermolator.



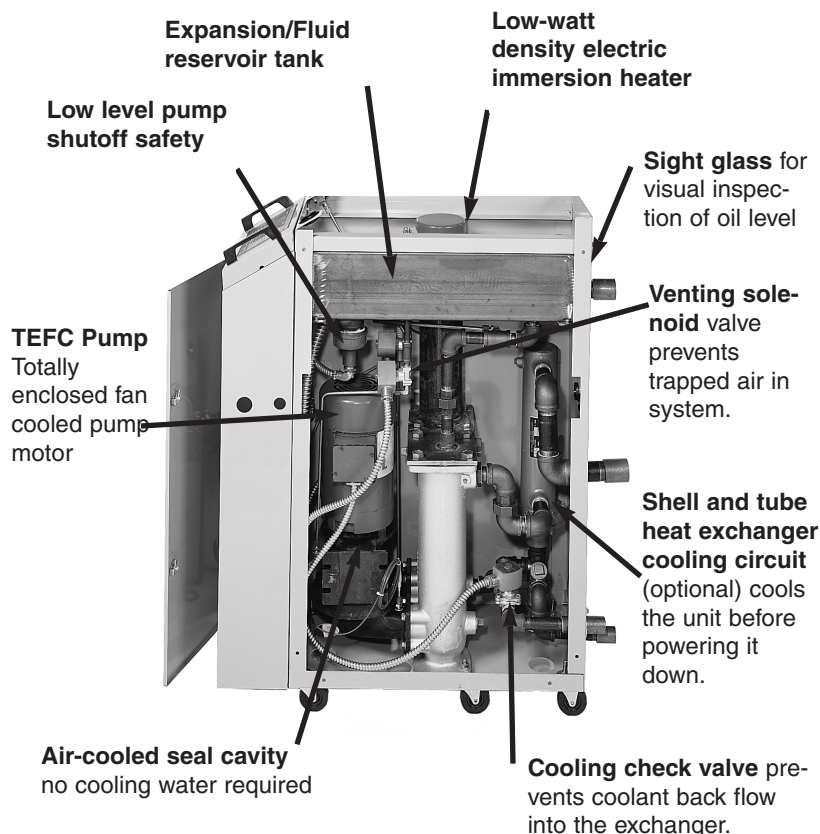
❑ **A source of water for cooling.**

City, tower or chiller water may be used, as long as the supply pressure is at least 15 psi and not more than 85 psi.

3 Install plumbing for process and cooling lines.

You will need two 1¹/₄-inch NPT male fittings for the process oil inlet and outlet and two 3/4-inch NPT male fittings for the cooling water inlet and outlet. Larger line sizes are acceptable as long as they are reduced at the Thermolator connections. Smaller line sizes are not recommended.

FEATURES OF THE HEATRAC



TH-1 CONTROL

Standard features include:

- **Actual temperature display** shows the actual temperature of the fluid entering the to-process line.
- **Setpoint temperature display** shows the fluid temperature setpoint during normal operation. Both of these window will display alarms, error codes modes and parameters if there is a problem with the temperature controller.
- **Status lights** indicate the operating status of the device. Green when the device is on and red when there is a problem.
- **RS485 communications** utilizing SPI protocol with baud rates and addresses programmable right on the operator panel.
- **Visual and (optional) audible alarms** alerts you to alarm conditions such as high/low deviation, low water pressure, pump overload or high temperature safety switch.
- **Setpoint adjustment buttons** Press the up or down arrows to change temperature and SPI parameters.

TH-2 CONTROL

All the features of the TH-1 plus:

- **Autostart capability** for convenient preheating of molds. Works with external timers or switches.
- **Choice of temperature control points** allows you to monitor and control from the process supply temperature or the process return temperatures or from an average of the two.
- **Remote control** with 15 foot cables, optional to 50 feet, and magnetic backs allow you to place the control where you want it.

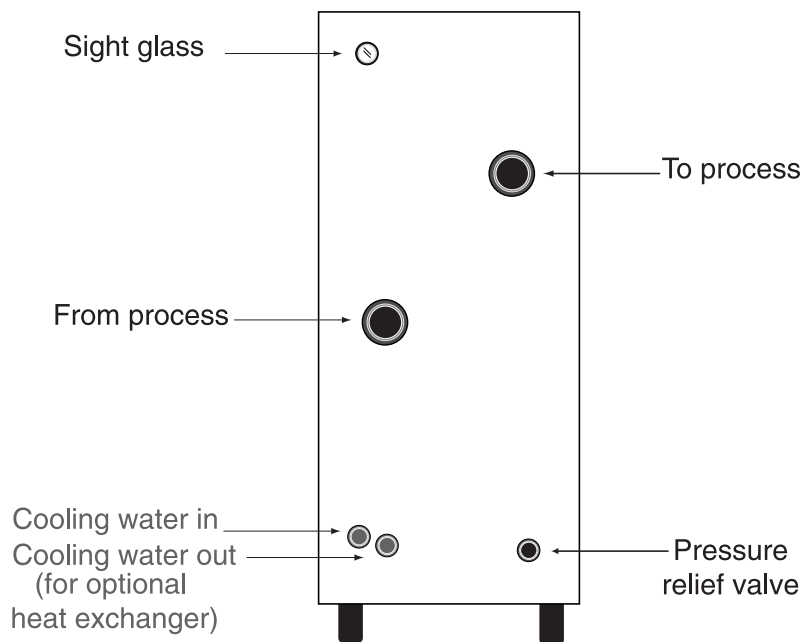
The Thermolator process inlets and outlets must be connected to the plumbing that will circulate the temperature-controlled water or fluid through the process. Optional cooling water inlets and outlets are connected to the cooling water supply.

- 1 Remove the shipping pipe plug** from the female connections on the back of the Thermolator.
- 2 Install pipe to the rear of the Thermolator.**
Use male 1¹/₄-inch NPT piping for process oil connections and male 3³/₄ inch NPT piping for water connections. Pipe and pipe threads must be clean and new. Clean threads with solvent, removing all oil, grease and dirt. Allow the threads to dry before proceeding.
- 3 Coat the pipe threads with thread sealant.**
Follow the sealant manufacturer's directions.
- 4 Connect the male pipe to the appropriate female connection on the back of the unit.** Start by hand until the threads engage, then use a pipe wrench to tighten the connection only enough to prevent leaks. **Do not over-tighten!**

CONNECTING PROCESS OIL AND COOLING WATER SUPPLY LINES

Tools for installation:

- ☐ Pipe wrench large enough for a 2-inch pipe
- ☐ Premium quality Teflon thread sealant rated for 500P F oil.



NOTE: We recommend that you install an external ball valve on the cooling water inlet of the Thermolator. This valve is useful for service when cooling option is installed.

CONNECTING THE MAIN POWER SUPPLY

IMPORTANT: Always refer to the wiring diagrams that came with your temperature control unit before making electrical connections. The diagrams show the most accurate electrical component information.



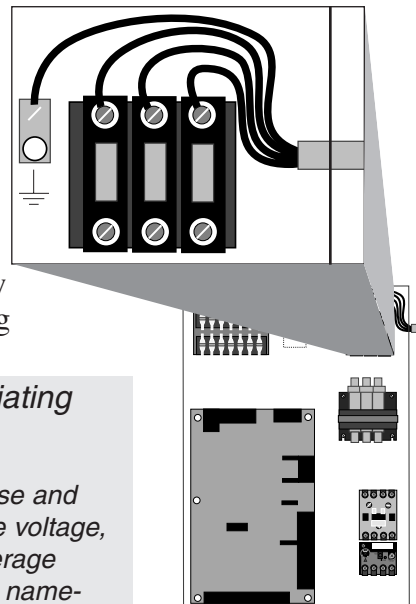
WARNING: Electrical shock hazard

This equipment is powered by three-phase main voltage. Always disconnect and lock out the main power source before performing any work involving electrical connections. All wiring, disconnects and fusing should conform to your region's electrical codes and should be installed only by qualified personnel.

Before beginning, note the electrical specifications on the nameplate mounted to the side of the unit. The electrical hookup must match these specifications with +/- 10% maximum voltage variance. An improper power supply could damage the unit as well as seriously injure an operator.

The electrical hookup also should run through a fused disconnect sized for the nameplate amperage and conforming to Article 250 of the National Electrical Code.

- 1** Open the unit's electrical enclosure.
- 2** Insert the main power wire through the knockout hole in the right side of the enclosure.
- 3** Secure the power wire with a rubber compression fitting or strain relief.
- 4** Connect the power wires to the terminals.
Connect the three hot wires to L1, L2, and L3 on the terminal block.
- 5** Connect the ground wire to the copper grounding mount.
If you have installed a disconnect device, follow the manufacturer's wiring instructions.



IMPORTANT! Before initiating power to the unit:

- ☐ Check the system for leaks.
- ☐ Verify that the disconnect fuse and minimum wire size meet the voltage, phase, frequency, and amperage specifications stated on the nameplate mounted on the side of the unit.
- ☐ Verify that resistance to ground on each phase is at least 1 meg ohm.



WARNING: Only qualified personnel should perform this procedure.

Parts of this test require opening the unit while it is energized. Only qualified personnel who have been trained in the use of electrical testing devices and in avoiding the safety hazards involved in safely troubleshooting this type of equipment should perform this test procedure.

TESTING THE INSTALLATION

- 1 Turn on the cooling water supply and check for leaks.** If any leaks appear, stop the test and fix the problem before continuing. The cooling water must be at least 15 PSI or the unit will function slowly during cooling.

- 2 Apply power to the unit.**
 - ◆ Indicator lights on the control panel blink green, then red, to test operation of the LEDs.
 - ◆ Setpoint and actual windows will display **888** for three seconds, followed by the software version. The windows then display the factory default setpoint of 100° F and the actual temperature.

- 3 Check the rotation of the pump.** Remove the top access panel. Verify that the pump rotation matches the direction indicated on the rotation sticker on top of the pump.

NOTE: If the rotation is incorrect, stop the test and disconnect power to the unit. Open the electrical enclosure and switch any two of the three power source wires on the terminal block. Return to Step 2 and check rotation again.

- 4 Replace the top access panel.**

- 5 Press the RUN key to start the unit.**

If everything is working correctly:

- ◆ The RUN/STOP light turns green.
- ◆ The unit initiates a 60-second venting sequence. Cooling and venting valves are active for 60 seconds. The pump is active for the final 30 seconds. Indicator lights will energize when the device is active.
- ◆ Normal operation begins. The heater turns on if the actual temperature is below setpoint. The optional cooling valve is active if the actual temperature is above setpoint.

The test is over. Proceed to initial setup if the unit operated normally; refer to the *TROUBLESHOOTING* section if it did not.

INITIAL SETUP



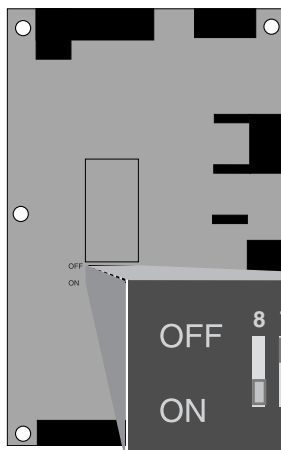
WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

The factory-set parameters and operating modes will satisfy most applications. But you can change some settings and enable or disable features as needed.

You can modify the parameters for high and low process temperature deviation warnings from the control panel. See **SETTING SETPOINT DEVIATION PARAMETERS**.

Dip switches on the motherboard inside the TH-1 and TH-2 electrical enclosure allow you to:



- ☐ Select the units of measure for temperature displays.
- ☐ Enable password protection.
- ☐ Enable the Auto Tune.
- ☐ Enable the Auto Start feature.
- ☐ Enable the Test Mode.
- ☐ Select the source point of temperature control.

Dip switch Configuration

No.	OFF	ON
1	Display units in °F	Display units °C
2	Auto Tune disabled	Auto Tune enabled
3	Passcode protect	Password reset/modify
4 *	Auto Start disabled	Auto Start enabled
5 *	Control point protect	Control point source select
6	Test Mode disabled	Test mode enabled
7 †	Controller type selection	Controller type selection
8 †	Controller type selection	Controller type selection

* Available only on TH-2 models.

† Switch 7 must be off and 8 must be ON for heaTrac oil units. not change these settings.

To change the dip switch settings, see the appropriate topic on the following pages.



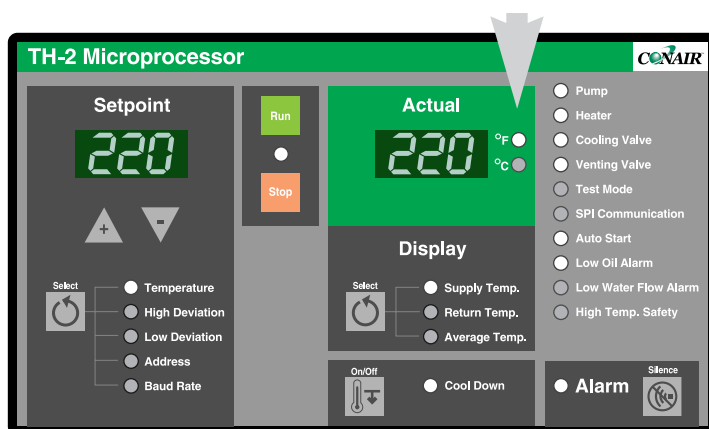
WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

CHANGING TEMPERATURE UNITS

The temperature units are factory-set as degrees Celsius or degrees Fahrenheit, as specified when the unit was ordered.

When the Thermolator is on, the indicator lights to the right of the Actual temperature display on the control panel will show which temperature unit has been set.

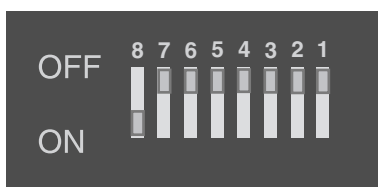


To change this setting, move Dip Switch 1 on the control circuit board.

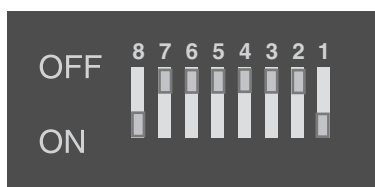
1 Disconnect and lock out main power to the Thermolator.

2 Open the electrical enclosure.

3 Change Dip Switch 1 to:
OFF for °F



ON for °C



NOTE: All dip switch illustrations in this manual show switches 7 OFF and 8 set to ON. Do Not Change these settings.

4 Close the electrical enclosure and restore main power to begin operating.

ENABLING AND DISABLING PASSCODE PROTECTION



WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

The TH-1 and TH-2 provide the ability to protect system parameters from unauthorized changes during normal operating mode. When system passcode protection is enabled, the following parameters cannot be changed unless you enter the correct passcode:

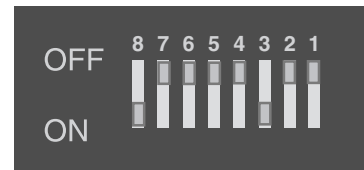
- The Process Setpoint
- High Deviation Alarm Setpoint
- Low Deviation Alarm Setpoint
- Baud Rate selection for serial communications
- Address selection for serial communications

When the unit is turned on for the first time, passcode protection is disabled. To enable passcode protection:

1 Disconnect and lock out main power to the unit.

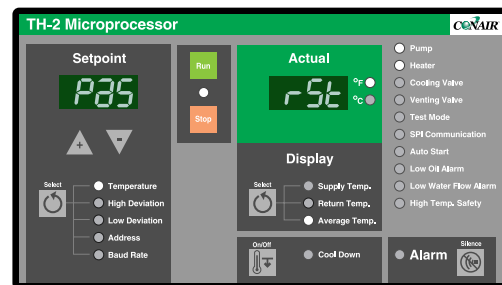
2 Open the electrical enclosure.

3 Set dip switch 3 to ON and switches 5 and 6 to OFF.



4 Close the electrical enclosure and restore power to the unit.

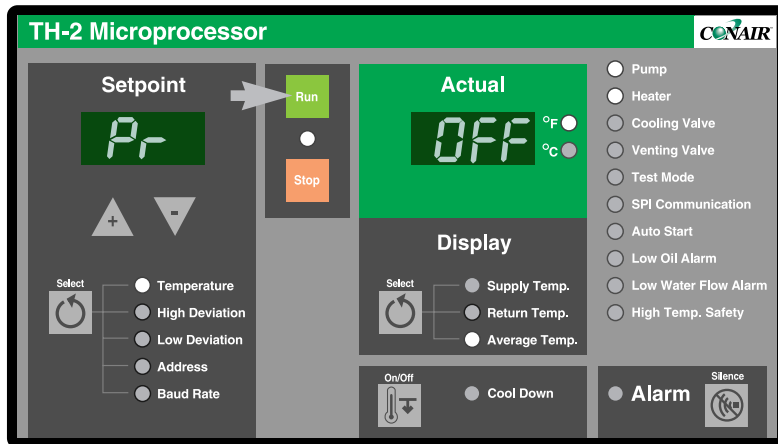
5 Press any button when the control displays “Pas rSt” (Passcode Reset). The control will display the last passcode used.



6 Select a new passcode using the ▲ and ▼ setpoint adjustment buttons.

Stop pressing the setpoint buttons when the passcode you want appears in the setpoint display window. Selecting “OFF” as the passcode will disable the passcode feature.

NOTE: All dip switch illustrations in this manual show switches 7 OFF and 8 set to ON. Do Not Change these settings.



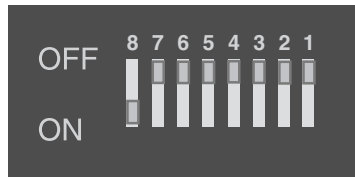
ENABLING AND DISABLING PASSCODE PROTECTION

- 7 Press the RUN button to save the passcode.**
 - ◆ The control will display “Pr OFF” to prompt you to remove power to the unit.

IMPORTANT: If RUN is not pressed, the new passcode will not be saved.

- 8 Turn off power to the unit.** Disconnect and lock out the main power supply.
- 9 Open the electrical enclosure.**
- 10 Set dip switch 3 to OFF.**
- 11 Close the electrical enclosure and restore power to the unit.**

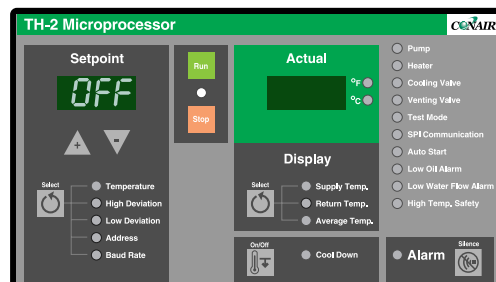
A passcode now is required to change system parameters.



Disabling Passcode Protection

To disable passcode protection and allow universal access to system parameters:

- 1 Follow Steps 1 through 5 in the previous section on enabling passcode protection.**
- 2 Hold down the ▼ setpoint adjustment button to select “OFF” as the new passcode.**
- 3 Follow steps 7 through 11 in the previous section.**



SELECTING THE TEMPERATURE CONTROL POINT

(TH-2 ONLY)



WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

MaxTrac models control the process temperature based upon the average of the temperatures recorded at the supply (to process) and return (from process) thermocouples.

TH-2 models allow you to select how the unit will measure and control the process temperature. The control point can be selected as the supply, the return or the average of the the two temperatures.

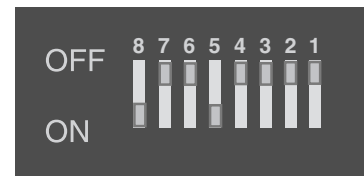
To select the control point source on TH-2 models:

1 Disconnect and lockout power to the unit.

2 Open the electrical enclosure.

3 Set dip switches 3 and 6 to the OFF position.

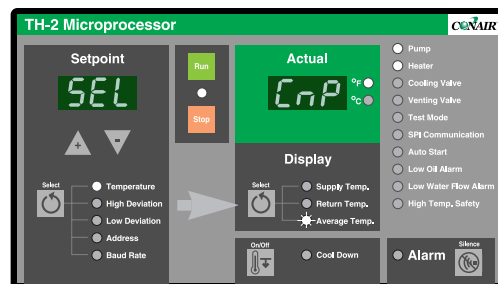
4 Set dip switch 5 to the ON position.



5 Close the electrical enclosure and restore power to the unit.

6 Press any button when the control displays “Cnt Pt”.

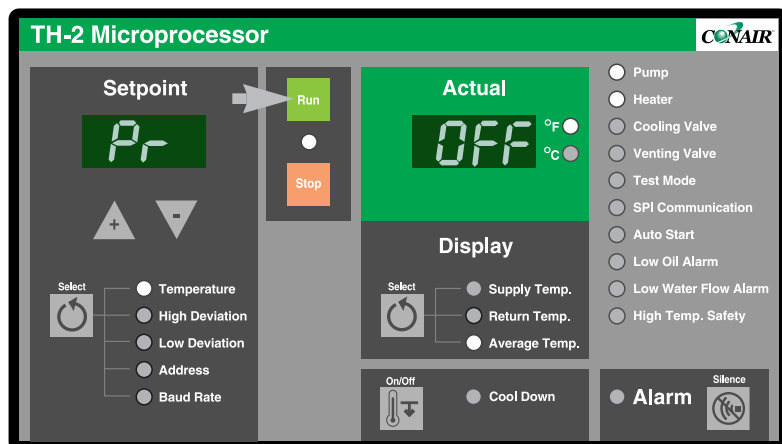
The controller will display “Sel CnP” and flashes the LED for the current control point.



7 Select a new control point using the Display button.

Stop pressing the select button until the indicator light next to the control point you want illuminates.

NOTE: All dip switch illustrations in this manual show switches 7 and 8 set to ON. If you have an Isolated Circuit model, these switches should be set to OFF.



SELECTING THE TEMPERATURE CONTROL POINT (TH-2 ONLY)

8 Press the RUN button to save the control point.

- ◆ The control will display “Pr OFF” to prompt you to remove power to the unit.

IMPORTANT: If RUN is not pressed, the new control point source will not be saved.

9 Turn off power to the unit. Disconnect and lock out the main power supply.

10 Open the electrical enclosure.

11 Set dip switch 5 to OFF.



12 Close the electrical enclosure and restore power to the unit.

The TH-2 will now control the process temperature based on actual temperatures recorded at the new control point source.

ENTERING SETPOINT DEVIATION PARAMETERS

You can establish a normal operating range around the process temperature setpoint using the high and low deviation parameters. If the process temperature exceeds the high deviation limit, or falls below the low deviation limit for longer than 15 minutes, the Thermolator will alert you to the unacceptable temperature variation with an alarm light.

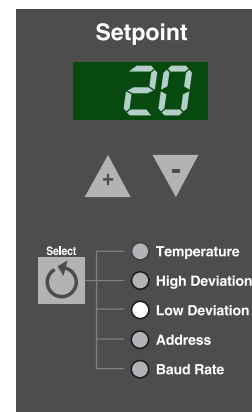
These temperature deviation limits will adjust automatically relative to the process temperature setpoint.

The factory default setting is the process temperature setpoint $\pm 25^{\circ}\text{F}$ (4°C). This parameter is adjustable to establish a narrower or wider acceptable temperature range for normal operation. The Low Deviation cannot be set to fall below the factory-set Low Safety temperature. The High Deviation cannot be set to exceed the factory-set High Safety temperature.

FACTORY DEFAULT SETTINGS		
Model	HTR1-500	
Process Setpoint	100° F (38° C)	
High Safety	510° F (266° C)	
Low Safety	60° F (16° C)	

To change the temperature deviation settings:

- 1 Press the Setpoint Select button to select the deviation parameter you want to change.**
- 2 Use the ▲ and ▼ setpoint buttons to enter the deviation temperature.** The setting is stored in memory even when the power is turned off. The recommended setting is $\pm 2\text{-}10^{\circ}\text{F}$.



NOTE: If you enabled passcode protection, you must enter the passcode to change this parameter. Too enter the passcode:

Hold down the Setpoint Select button for 5 seconds. When the control displays “1 PaS”, use the setpoint adjustment buttons to enter the passcode. Press the Setpoint Select button again. If the correct passcode was entered the controller will display ACC PAS for 3 seconds. If the passcode was incorrect, the controller will display rEJ PAS (rejected passcode).

Access to system parameters remain until power is cycled or the RUN or STOP button is pressed.

The heaTrac series Thermolators provide SPI compatible support for RS-485 serial communications with a host machine. You can use SPI communication to change or monitor the:

- Process temperature setpoint
- High and low temperature deviation alarms
- Process status (run and alarm conditions)
- Machine 1 status
- Machine 2 status
- Actual temperature to process
- Actual temperature from process

To use the SPI communication option, you must connect the Thermolator to the host machine and set the communication baud rate and node address using the setpoint select and adjustment buttons on the control panel.

ACTIVATING SPI COMMUNICATION

NOTE: To disable SPI, use the setpoint ▲ or ▼ arrow to select Address. Press the ▼ arrow until OFF is displayed in the setpoint window.

See the APPENDIX for additional SPI programming information.

1 Connect the host machine to the Thermolator.

Plug the male DB9 connector into the serial communications port on the Thermolator.

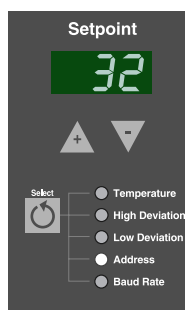
2 Apply power to the Thermolator.

3 Enter the passcode, if necessary.

Hold the Setpoint Select button for 5 seconds. When the control displays 1 PaS, use the setpoint adjustment buttons to enter the passcode.

4 Enter the node address.

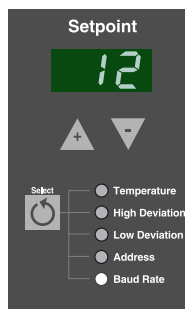
Press the Setpoint Select button to choose Address. Then press the setpoint ▲ or ▼ arrow until the address you want appears in the setpoint display. The address may be set to any number from 32 to 254 (a hexadecimal integer between 20 and FE), as long as that number has not been assigned to another machine connected to the same network.



5 Set the baud rate to 12, 24, 48 or 96.

The Thermolator must be set to send and receive data at the same baud rate as the host machine. Press the setpoint ▲ or ▼ arrow until the baud rate you want appears in the setpoint display window.

12 = 1200 bps 48 = 4800 bps
24 = 2400 bps 96 = 9600 bps



The green SPI status light on the control panel should flash when the unit is communicating. The LED will turn red, indicating an alarm, if SPI communication is not properly set up.

INSTALLING THE AUTO START FEATURE

(TH-2 ONLY)



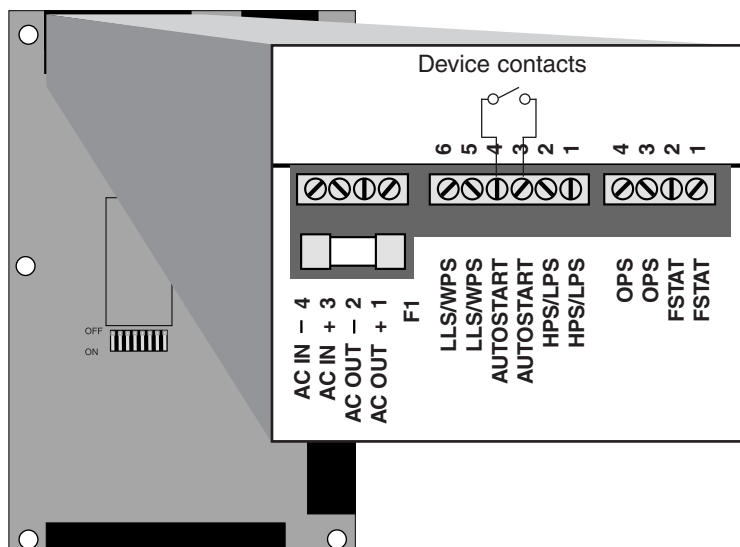
WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

If you have a TH-2 model, you can automatically start and stop the Thermolator from a remote switching or timing device that has power contacts rated 110VAC, such as the process machine control.

Wiring the device to the Thermolator is accomplished through a dry contact to the appropriate terminals on the motherboard. After wiring the device to the unit, Auto Start must be enabled by configuring a dip switch on the motherboard.

- 1 Disconnect and lockout power to the unit.**
- 2 Open the electrical enclosure.**
- 3 Punch a small hole in the left side of the electrical enclosure.** The hole must be large enough to accommodate conduit for the power contact wires from your switching or timing device.
- 4 Insert the two power leads from the device** through the conduit into the electrical enclosure.

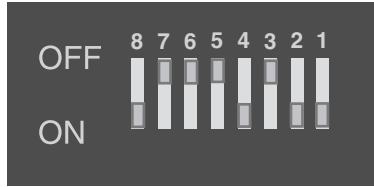


IMPORTANT: Always refer to the wiring diagrams that came with your temperature control unit before making electrical connections. The diagrams show the most accurate electrical component information.

- 5 Connect the 110VAC device contact wires to the Auto Start terminals.** Make sure terminals are screwed tight.

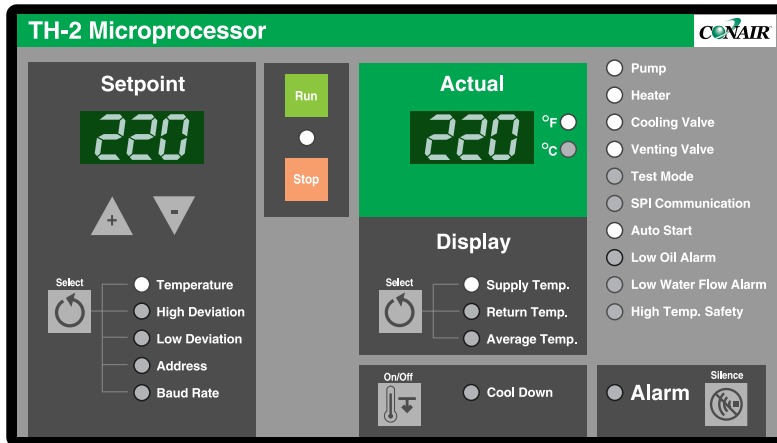
6 Set dip switch 4 to the ON position.

7 Close the electrical enclosure and restore power to the unit.



INSTALLING THE AUTO START FEATURE

(TH-2 ONLY)



NOTE: All dip switch illustrations in this manual show switches 7 and 8 set to ON. If you have an Isolated Circuit model, these switches should be set to OFF.

When Auto Start is enabled:

- ◆ The Auto Start indicator light flashes to indicate that the Thermolator can start at any time. The Thermolator will start whenever the remote switching or timing device sends a signal to start processing.
- ◆ The Auto Start indicator light is on whenever the Thermolator is under the control of the remote device.

To disable Auto Start:

Repeat steps 1,2 and 7, setting dip switch 4 to the OFF instead of the ON position.

OPERATION

- *TH-1 control 4-2*
- *TH-2 control 4-3*
- *Positioning the control panel . .4-4*
- *Entering a passcode 4-5*
- *Starting the Thermolator 4-6*
- *Stopping the Thermolator 4-7*
- *Performing an Auto Tune 4-8*

TH-1 CONTROL

All normal operating functions can be controlled from the TH-1 control panel. If you have the optional manual mold purge, the control button is located on the side of the Thermolator electrical enclosure.

Setpoint display

The window displays the setpoints entered for the fluid temperature, the high and low temperature deviation alarms, the SPI baud rate and the SPI address.

Run/Stop

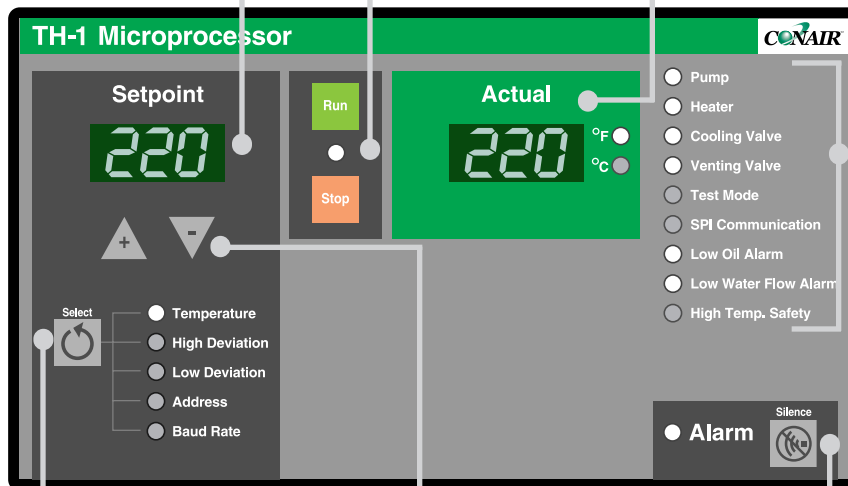
Press the RUN button to start normal operation. Press STOP to stop the temperature control unit.

- = Running
- = Stopped
- ☼ = Alarm (flashing)

Actual values display

The green window displays the temperature at the middle of the mold. This temperature is calculated as an average of the temperatures of the supply oil and return oil.

The lights indicate whether the temperature is in degrees Fahrenheit or Celsius.



Setpoint Select button

Press repeatedly until a green light appears next to the parameter you want to program or view.

NOTE: Default settings for the deviation setpoints are:
High = setpoint + 10°F
Low = setpoint - 10°F
A warning alarm occurs (indicator light turns red) whenever the actual temperature is outside this setpoint range. Recommend setting: $\pm 2-10^\circ\text{F}$.

Setpoint adjustment buttons

Press ▲ or ▼ to enter temperature and SPI parameters. Press ▲ to increase a value. Press ▼ to decrease a value.

TIP: Press and hold the button for faster scrolling speed.

Status lights

The lights indicate the operating status of the listed components. Except in Test Mode and Auto Start, the lights indicate:

- = Off or inactive
- = On or active
- = Alarm condition

Test Mode is used for initial programming. When test mode is enabled, normal operation is disabled.

- = Test Mode off
- = Test Mode on; unit disabled

Alarm

Press to acknowledge the alarm light and silence the optional audible alarm. The alarm light will flash until the cause of the alarm condition is fixed.

All normal operating functions can be controlled from the TH-2 control panel, including the optional mold purge.

TH-2 CONTROL

Setpoint display

The window displays the setpoints entered for the fluid temperature, the high and low temperature deviation alarms, the SPI baud rate and the SPI address.

Run/Stop

Press the RUN button to start normal operation. Press STOP to stop the temperature control unit.

- = Running
- = Stopped
- ☼ = Alarm (flashing)

Actual values display

The green window displays the temperature at the middle of the mold. This temperature is calculated as an average of the temperatures of the supply oil and return oil.

The lights indicate whether the temperature is in degrees Fahrenheit or Celsius.

The diagram shows the TH-2 Microprocessor control panel. It features a 'Setpoint' display showing '220', an 'Actual' display showing '220' with °F and °C indicators, and a 'Display' section with a 'Select' button and options for Supply Temp., Return Temp., and Average Temp. There are also 'Run' and 'Stop' buttons, a 'Cool Down' button, and an 'Alarm' button. A list of status lights on the right includes Pump, Heater, Cooling Valve, Venting Valve, Test Mode, SPI Communication, Auto Start, Low Oil Alarm, Low Water Flow Alarm, and High Temp. Safety.

Status lights

The lights indicate the operating status of the listed components. Except in Test Mode and Auto Start, the lights indicate:

- = Off or inactive
- = On or active
- = Alarm condition

Test Mode is used for initial programming. When test mode is enabled, normal operation is disabled.

- = Test Mode off
- = Test Mode on; unit disabled

Setpoint Select button

Press repeatedly until a green light appears next to the parameter you want to program or view.

NOTE: Default settings for the deviation setpoints are:
 High = setpoint + 10P F
 Low = setpoint - 10P F
 A warning alarm occurs (indicator light turns red) whenever the actual temperature is outside this setpoint range. Recommend setting: ± 2-10P.

Alarm

Press to acknowledge the alarm light and silence the optional audible alarm. The alarm light will flash until the cause of the alarm condition is fixed.

Cool Down On/Off

The Cool Down feature resets the setpoint temperature to 100P F to cool the system before stopping. Press to turn the feature on. Press again to turn it off.

Setpoint adjustment buttons

Press ▲ or ▼ to enter temperature and SPI parameters. Press ▲ to increase a value. Press ▼ to decrease a value.

TIP: Press and hold the button for faster scrolling speed.

Display Select button

Press repeatedly until a green light appears next to the parameter you want to program or view in the Actual values window. See the User Guide for programming information.

Auto Start

allows you to start and stop the Thermolator® from a remote switching or timing device, such as the processing machine control. This feature can only be enabled by configuring a dip switch on the control motherboard.

- = Disabled; Auto Start not available
- ☼ = (flashing) Enabled; unit can start at any time
- = On and under control of the remote device

POSITIONING THE CONTROL PANEL



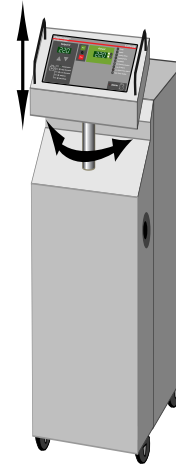
CAUTION: Improper use of the swiveling control panel can damage the unit.

- **Do not** rotate the control panel 360 degrees. This will twist and possibly damage the control wiring and connections to the motherboard in the electrical enclosure.
- **Do not** use the control panel handles or control cables to move the Thermolator. The handles are designed only for orientation of the control panel.
- **Do not** mount the detached TH-2 control panel to a hot surface.

The control panel on the TH-1 series Thermolators can be swiveled, raised and lowered to provide easy viewing and access. The TH-2 control panel also can be mounted up to 50 feet from the unit, using a remote control cable and the magnetic back on the back of the panel.

To raise and swivel the control panel:

Grasp the black control panel handles, and pull upward. Use the handles to rotate the control panel. Do not rotate the panel 360 degrees.



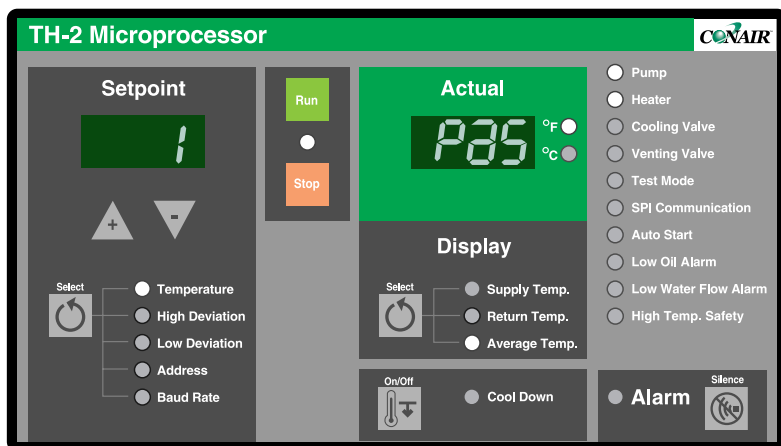
To lower the control panel:

Grasp the black control panel handles, and rotate the control until it is aligned with the unit. Do not rotate the panel 360 degrees. Gently push down on the handles until the control panel is flush with the unit.

To detach the TH-2 control panel:

The TH-2 control panel may be removed and mounted up to 50 feet from the unit. **Do not stretch the cable.** The cable is available in various lengths so that you can order the appropriate cable for your installation.

Grasp the black control panel handles and pull upward. Use the magnetic back to mount the control panel in the remote location. Connect the remote-mounted control to the unit with the cable provided.



ENTERING A PASSCODE

The TH-1 and TH-2 models have a security feature that prevents accidental or unauthorized changes to the setpoint temperature, high and low deviation limits, SPI address, and baud rate.

If passcode protection is enabled, you must enter the correct passcode to change these parameters. To enter the passcode:

- 1 Press and hold the Setpoint Select button  for 5 seconds.** The control will display 1 PaS to indicate a passcode is needed.
- 2 Press the Select  button until the correct passcode appears in the display.**
- 3 Press  again to enter the passcode.**
If the passcode is correct, the control displays ACC PAS for 3 seconds. If the passcode is incorrect, the control displays rEJ PAS (rejected passcode).
- 4 Press Setpoint  to select the parameter you want to change.**

You will have access to the system parameters until:

- The power is cycled off and on.
- The RUN or STOP button is pressed.
- No key has been pressed for 30 seconds.

NOTE: Pressing the STOP or RUN key while you are entering a passcode will abort the passcode entry sequence

STARTING THE THERMOLATOR

IMPORTANT: If you are operating the Thermolator for the first time since installation, you should perform an Auto Tune after two hours of normal operation. You should perform the Auto Tune periodically to ensure that the control correctly calculates how much heat and cooling should be applied to maintain the process setpoint. See “Performing an Auto Tune.”

Before starting the Thermolator, verify that the system has been installed correctly for your application. See the *INSTALLATION* section.

If Passcode Protection has been enabled, you must enter the correct passcode before you can change or enter any of the operating parameters, including the temperature setpoint.

1 Turn on the optional water supply to the Thermolator.

The supply must be at least 15 psi. Check for leaks in the cooling water and process fluid lines before continuing.

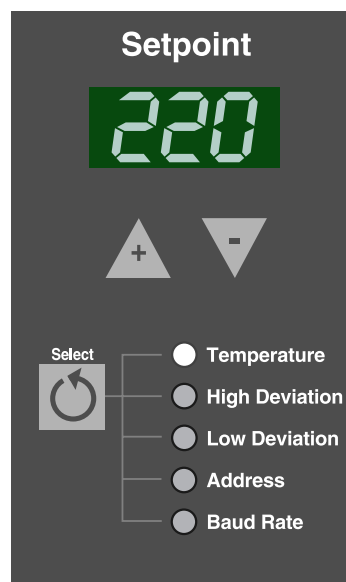
2 Turn on main power to the Thermolator.

The control initiates a brief self test.

- ◆ Indicator lights blink green, then red.
- ◆ Setpoint and actual windows will display **888** for three seconds, followed by the software version. The windows then display the factory default setpoint of 100° F and the actual temperature.

3 Enter the passcode, if necessary. Hold the Setpoint Select button for 5 seconds. When the control displays 1 PaS, use the setpoint adjustment buttons to enter the passcode. Press the Setpoint Select button again.

4 Enter the temperature setpoint. Press the Setpoint Select button until the green light appears next to Temperature. Press ▲ to increase or ▼ to decrease the temperature setting.



5 Press **Run** to start normal operation.

- ◆ The RUN/STOP light turns green.
- ◆ The unit initiates a 60-second venting sequence. Cooling and venting valves are active for 60 seconds. The pump is active for the final 30 seconds.
- ◆ Normal operation begins. The heater turns on when the actual temperature is below setpoint. The cooling valve turns on if the actual temperature is above the setpoint.

If the Alarm light turns on, press  to silence the optional audible alarm. Then see the *TROUBLESHOOTING* section.



WARNING: Electrical shock and hot surface hazards

Before attempting maintenance of any kind on the Thermolator, you must stop the unit; disconnect and lockout the main power supply; and allow the unit to cool to less than 100° F (38° C).



STOPPING THE THERMOLATOR

You must shut down the Thermolator whenever you:

- Change the water hookups.
- Shut down the process machine.
- Purge the process circuit of the oil.
- Run the unit's diagnostic tests.
- Perform routine or preventative maintenance.
- See an alarm condition that requires troubleshooting.
- Relocate, ship or store the unit.

To shut down the unit for purging the process lines, diagnostic testing, routine maintenance or troubleshooting, press the Stop button. Then refer to the appropriate topic or section in this User Guide.

To shut down the unit to change fluid hookups:

- 1 Press Stop cool and drain the unit of all oil or fluid.**

Drain the unit using the drain plugs on the back of the heater casting.

- 2 Once the unit is cool, remove the cooling water hookups.**



Drain plug

To shut down the unit for relocation or storage:

- 1 Press Stop and drain the unit of all fluid.**

Drain the unit using the two drain plugs.

- 2 Disconnect the power supply and all water feeds.**

- 3 Position the control panel to rest flush with the unit.**

In shipment or storage, the Thermolator can withstand an environment between -40° F (-40° C) and 150° F (65° C) with 95% relative humidity non-condensing.

PERFORMING AN AUTO TUNE



WARNING: Electric shock hazard

This equipment is powered by high voltage. Always disconnect and lock out the main power source before opening the unit or the electrical enclosure to modify factory settings. Failure to disconnect and lock out the main power source can result in severe personal injury.

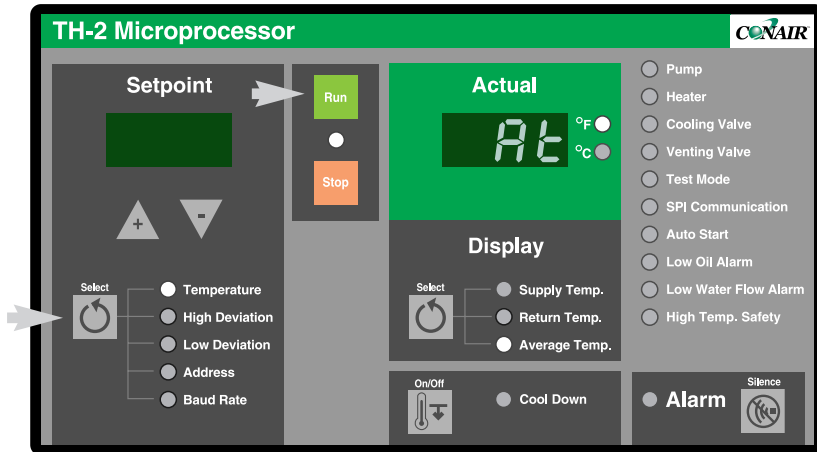
You should perform an Auto Tune after the first two hours of operation and whenever process variables change (changes in cooling water pressure, piping or molds; large ambient swings; new setpoint temperature) to ensure that the control continues to obtain good approximations of the PID constants used to compensate for the thermal lag of the system.

To ensure a successful Auto Tune, verify that:

- ☐ **The Auto Tune feature has been enabled.** Auto Tune is enabled or disabled via dip switch 2 on the motherboard.
- ☐ **The process value is stable.** A fluctuating process value will fool the software into making inaccurate tuning decisions. The software waits 5 minutes for the process value to stabilize before it starts the Auto Tune process. If the process value still fluctuates after 5 minutes, the Auto Tune terminates and the control displays the “At ti” error.
- ☐ **The control is in STOP mode and the process value is in ambient temperature.** This allows the software to obtain good approximations of process parameters, which are critical for performing an accurate tune. If this requirement is not met, then a good tune cannot be guaranteed.
- ☐ **The setpoint/process deviation is at least 25° F.** If the absolute value of setpoint - process temperature is not greater than or equal to 25° F, the Auto Tune will terminate. The control will display an “At dEV” error.

- 1** Press  to shut down the Thermolator.
- 2** Disconnect and lock out main power to the unit.
- 3** Enable Auto Tune.
Open the electrical enclosure.
Set dip switch 2 to ON.
Close the electrical enclosure
and restore power to the unit.
- 4** Restore power to the unit.

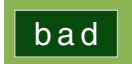
PERFORMING AN AUTO TUNE



- 5** Press **Run** and  (the Setpoint Select button) simultaneously to begin the Auto Tune. The Actual display will flash “At” and the current process temperature to indicate that an Auto Tune is underway.

If Auto Tune is successful, the controller automatically starts controlling using the new PID parameters.

If you press the STOP button or a fault occurs during the Auto Tune, the control enters stop mode and Auto Tuning immediately terminates. The actual display stops flashing “At.” If a fault occurred, the control will display the appropriate error message.

ERROR MESSAGE	ERROR DESCRIPTION
 	Insufficient setpoint/process deviation. If the absolute value of (setpoint - process value) is less than 25° F. The Auto Tune cannot be started until the temperature difference is at least 25° F.
 	Auto Tune timed out. Auto Tune will time out if a stable process value cannot be obtained 5 minutes into the tune, or if the tuning process takes longer than 30 minutes. If this error occurs, verify that you followed every requirement under “To ensure a successful Auto Tune” and perform a second tune.
 	Invalid PID constants were generated. The most likely causes of this error is a tune started inappropriately or an external element (i.e., loose thermocouple) that upset the process while tuning was in progress. Verify that you followed every requirement under “To ensure a successful Auto Tune” and perform a second tune.

MAINTENANCE

- *Maintenance schedule 5-2*
- *Accessing the Thermolator enclosure 5-3*
- *Checking fluid level in the reservoir 5-4*
- *Performing system tests 5-5*
- *Key/Display Test 5-6*
- *Input Test 5-7*
- *Output Test 5-8*
- *Disabling or enabling output monitors 5-9*
- *Calibrating temperature sensors 5-10*
- *Logging operating hours 5-12*

PREVENTATIVE MAINTENANCE SCHEDULE

Thermolator heaTrac TH-1 and TH-2 oil temperature controllers are essentially maintenance-free. However, to maintain the best performance, we recommend the following maintenance schedule.

● Whenever process variables change

☐ Perform an Auto Tune.

The Auto Tune ensures that the control continues to obtain good approximations of the PID constants used to compensate for the thermal lag of the system.. You should perform an Auto Tune after the first two hours of operation and whenever the process changes, such as after a mold change; installation of different pipe sizes; or change in process setpoint. **See the “Performing an Auto Tune” in the OPERATION section.**

● Daily

☐ Check for leaks in cooling and process lines.

Before and during operation, you should inspect the unit and all plumbing lines for leaks. If a leak develops, stop the Thermolator and repair it.

☐ Keep the unit and the area around it clean.

Check for and remove lint, dust or other obstructions on the unit, especially around air intake areas. Keep the floor around the unit dry.

☐ Check the process fluid level.

HTR1-500's have an internal reservoir that contains the process fluid. Check the level indicator on the back of the unit to make sure the reservoir contains an adequate amount of process fluid. Refill as needed with the specified heat transfer fluid.

● Monthly, or as often as needed.

☐ Inspect the fluid in the fluid reservoir.

For at least the first three months of operation, check the sight glass in the process fluid reservoir for debris or discoloration that could indicate fluid contamination or degradation. Replace as required.

● Quarterly (every 3 months)

☐ Inspect power cords, wires and electrical connections.

Check for loose or frayed wires, burned contacts, and signs of overheated wires. Check exterior power cords to the main power source and from the electrical box to the pump and heating elements. Check the ground wire and thermocouple connections. Replace any wire that appears damaged or has worn or cracked insulation.

PREVENTATIVE MAINTENANCE SCHEDULE

- **Annually (every 12 months)**

- ☐ **Test and calibrate the unit's control systems.**

The Thermolator's Test Mode checks the operation of displays, control buttons, inputs and outputs. You can also calibrate the supply and return thermocouples. See *"Performing System Tests"* in this section.



WARNING: Electrical shock and hot surface hazards

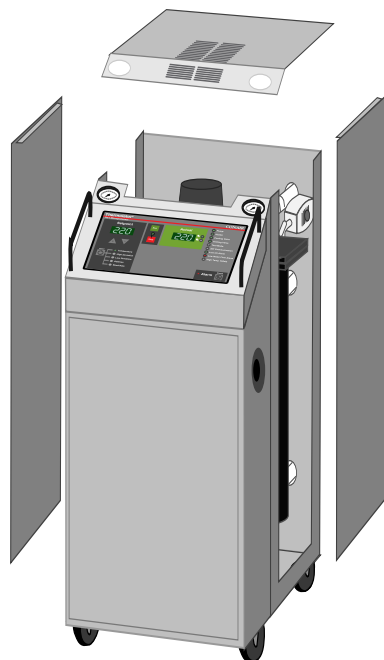
Before attempting maintenance of any kind on the Thermolator, you must stop the unit; disconnect and lockout the main power supply; and allow the unit to cool to less than 100° F (38° C)



ACCESSING THE THERMOLATOR ENCLOSURE

To access the Thermolator enclosure:

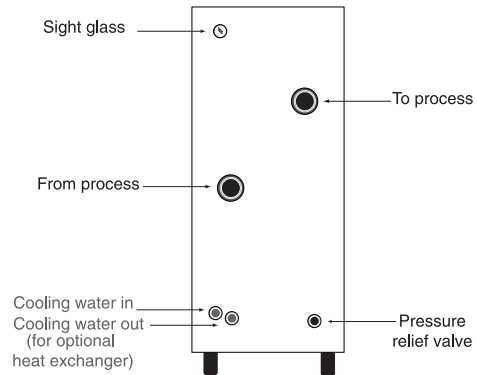
Remove the top access panel by lifting straight up.
Remove the side panels by lifting straight up.



CHECKING THE FLUID LEVEL IN THE RESERVOIR

The heaTrac TH-1 and TH-2 models separate the cooling water from the process fluid, which is held in a reservoir inside the unit. This reservoir should be kept at least three-quarters full of the process fluid.

You can check the fluid level in the reservoir using the sight glass on the back of the Thermolator.



To fill the reservoir:

- 1** Disconnect and lockout power, and remove the top panel of the Thermolator.
- 2** Locate the reservoir near the top of the unit.
- 3** Locate the fill port at the top of the reservoir.
- 4** Refill the reservoir. Monitor the level using the sight glass on the back of the unit.
- 5** Replace the top panel of the Thermolator.

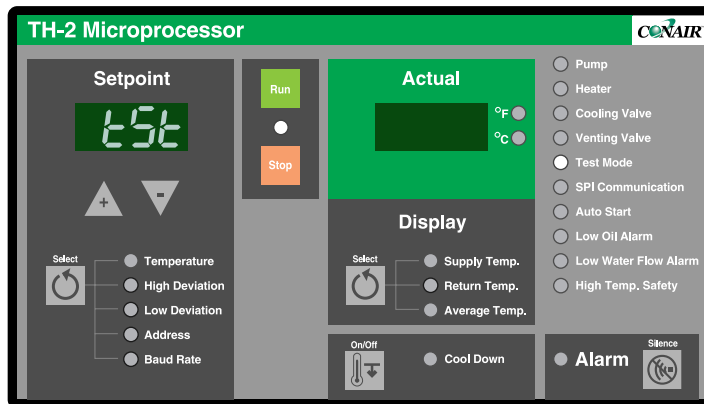
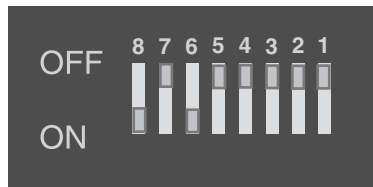
The TH-1 and TH-2 Thermolators provide a Test Mode that tests displays and keys on the control panel, as well as inputs and outputs. The Test Mode also allows calibration of the supply and return line thermocouples.

PERFORMING SYSTEM TESTS

System tests and calibration should be performed annually.

To enable Test Mode:

- 1** Press **Stop** to shut down the Thermolator.
- 2** Disconnect and lock out main power to the unit, then open the electrical enclosure.
- 3** Set dip switches 3 and 5 to OFF.
- 4** Set dip switch 6 to ON.
- 5** Close the electrical enclosure and restore power to the unit.
 - ◆ The control displays “tSt.”
 - ◆ The Test Mode LED lights.



- 6** Press any button to display the first test menu. Test mode provides the following menus:
 - Key/Display Test
 - Input Test
 - Output Test
 - Calibration
 - Total Operating Hours
 - Output Monitor Enable/Disable

- 7** After performing each test, hold the Setpoint  for 3 seconds to index to the next test menu. The procedure for each test is described on the following pages.

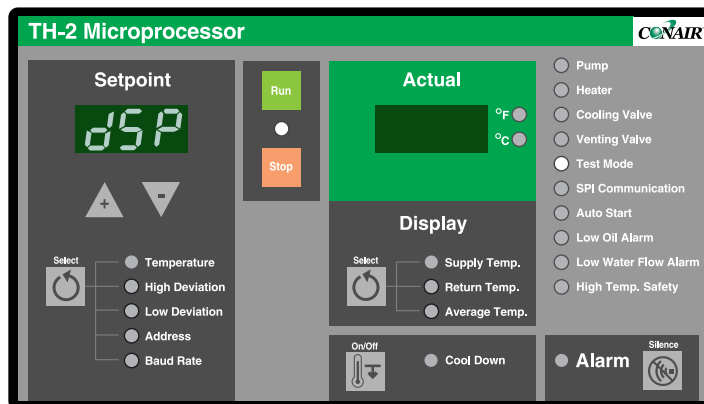
IMPORTANT: All normal operating functions are disabled while Test Mode is enabled. To return to normal operation, you must disable Test Mode.

To disable Test Mode, repeat steps 2 through 5, setting dip switch 6 to OFF instead of ON.

KEY/DISPLAY TEST

The Key/Display Test verifies the function of displays, LEDs and buttons on the control panel.

- 1 Enable Test Mode.**
- 2 Press any key.**
- 3 If necessary, index to the Key/Display menu.**



Press and hold the Setpoint  key for 3 seconds to index to each test menu until the controller displays “dSP”.

- 4 Press any key to clear all displays.**
- 5 Repeatedly press any key to test displays.**

With each key press, a new segment of all six 8-segment LEDs and a select group of LED indicator lights will illuminate.
- 6 Exit the test and enter the next test.**

Press and hold the Setpoint  key for 5 seconds to exit and index to the next test.

INPUT TEST

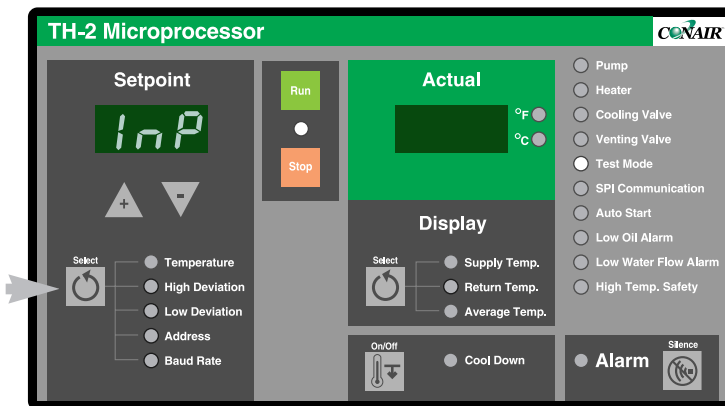
The Input Test verifies the function of inputs available on the various models of TH-1 or TH-2. Not all inputs are used on all models. The performance evaluation of the inputs is based on the voltage sensing device (VSD).

1 Connect all inputs to the system.

2 Press any key to display the first test menus.

3 Select the Input Test menu.

Press and hold the Setpoint  key for 3 seconds to index to each test menu until the controller displays “InP”.



4 Repeatedly press and release any key to test.

With each key press and release, the left display will indicate the number of the input being tested (v1, v2, v3, etc.). The right display indicates either “1” for voltage present or “0” for an absence of voltage.

Only inputs that are actually used by the particular model will be tested.

5 Exit the test and enter the next test.

Press and hold the Setpoint  key for 3 seconds to exit and index to the next test.

OUTPUT TEST

The Output Test verifies the function of outputs available on the various models of TH-1 or TH-2. Not all outputs are used on all models. The performance evaluation of the inputs is based on the output monitors (OM).

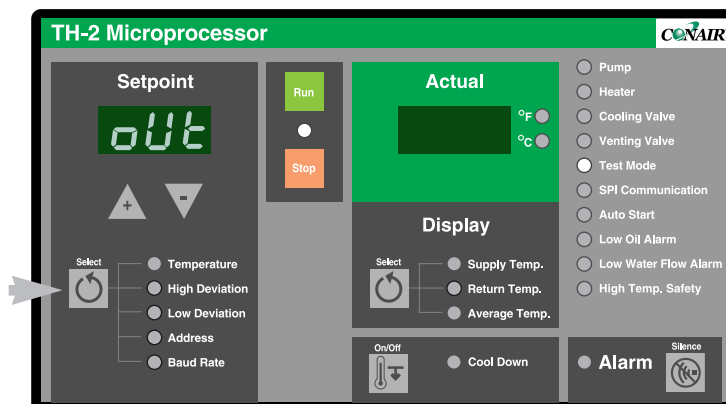
1 Connect all outputs to the system.

IMPORTANT: Testing each output requires the firing of the associated solid state relay. Make sure an output device is connected to the controller, otherwise the test result will be erroneous.

2 Enable Test Mode.

3 Press any key to display the first test menus.

4 Select the Output Test menu.



Press and hold the Setpoint  key for 3 seconds to index to each test menu until the controller displays “oUt”.

5 Repeatedly press and release any key to test.

With each key press and release, the left display will indicate the number of the output being tested (oS1= OM1; oS2 = OM2; etc.). The right display indicates either “1” for a good output or “O” for a failed output.

Only outputs that are actually used by the particular model will be tested.

6 Exit the test and enter the next test.

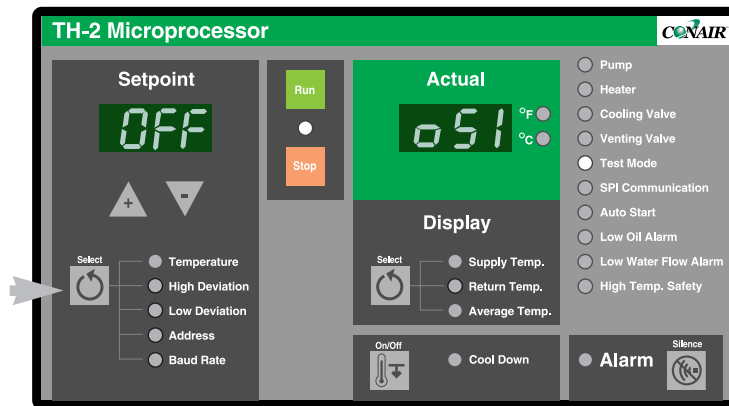
Press and hold the Setpoint  key for 3 seconds to exit and index to the next test.

All output monitors on the Thermolator can be enabled or disabled permanently through the OM Enable/Disable Menu in Test Mode.

You need to use this feature if you have replaced the motherboard, or if dip switches 7 and 8 have been changed erroneously. This will enable any required output monitors that were disabled and give fuse failures.

DISABLING OR ENABLING OUTPUT MONITORS

- 1 Enable Test Mode.**
- 2 Press any key to display the first test menus.**



- 3 Select the OM Enable/Disable menu.**
Press and hold the Setpoint  key for 3 seconds to index to each test menu until the controller indicates “oS1” in the actual display and the status of the selected output in the Select display.
- 4 Press the Setpoint ▲ or ▼ key to change the status.** Each press of the key changes the output status from ON to OFF or OFF to ON.

OUTPUT MONITOR SELECTION GUIDE			
OM1 Pump	ON		
OM2 Heat	ON		
OM3 Cool	ON		
OM4 Vent	ON		

- 5 Press the Setpoint  to select the next output.**
Repeat Step 4 to change the status of the output, or press any key to continue indexing through the outputs.
- 6 Save changes and exit the output menu.**
Press and hold the Select  key for 3 seconds to save the changes and exit.

CALIBRATING TEMPERATURE SENSORS

Special Tools Needed:

□ type K thermocouple calibrator

The TH-1 and TH-2 Thermolators use type “K” thermocouples to sense the temperature in the return and supply process lines. These thermocouples should be calibrated annually, or when a new thermocouple is installed, to ensure correct operation.

The Thermolator’s Calibration Mode provides zero and span calibration of both the supply and return line thermocouples. You access the Calibration Mode while in Test Mode.

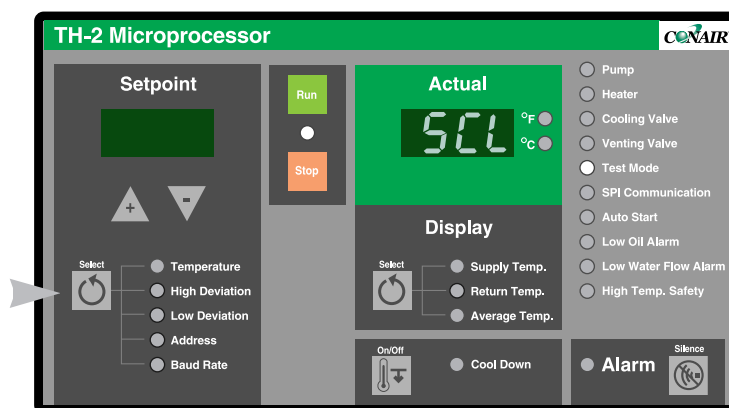
1 Enable Test Mode.

See “Performing System Tests.”

2 Press any button to display the first test menu.

3 Select the Calibration Mode menu.

Press and hold the Setpoint  key for 3 seconds to index to each test menu until the controller indicates “SC.L” in the Actual display.



4 Release the Setpoint key.

You are now in calibration mode. Each press and release of this key will exit the current calibration and start the next calibration. The table below lists the calibrations that will be performed.

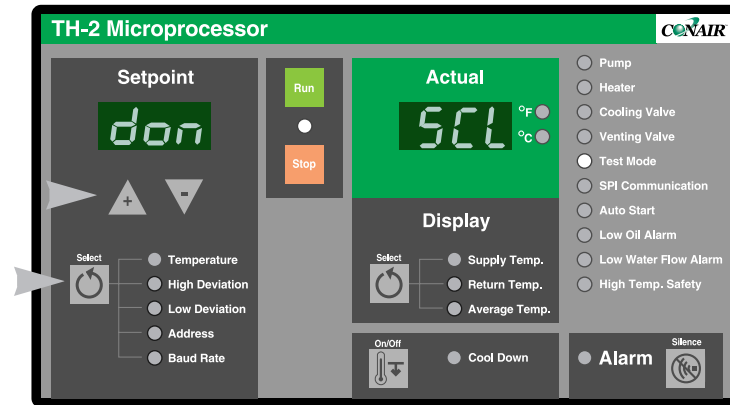
CALIBRATION	SETPOINT DISPLAY	ACTUAL DISPLAY
Zero Calibrate Supply Sensor	32° F (0° C)	SC.L
Zero Calibrate Return Sensor	32° F (0° C)	rC.L
Span Calibrate Supply Sensor	510° F (266° C)	SC.H
Span Calibrate Return Sensor	510° F (266° C)	rC.H

5 Using the thermocouple calibrator, apply the appropriate temperature to the control input.

CALIBRATING TEMPERATURE SENSORS

6 Press the up ▲ key to begin calibrating.

The controller displays the name of the current calibration (examples: 32 SC.L; 32 rC.L; 510 SC.H; or 510 rC.H).



7 Wait until the control displays “don” or “bad.”

A “don” message in the Setpoint display indicates the calibration was successful. A “bad” message in the Setpoint display indicates a bad calibration.

NOTE: The original calibration value stored in EEPROM can be restored for the current calibration by pressing the STOP key at any time.

8 Press Select to start the next calibration.

Pressing and releasing the Select  key at the end of a calibration tells the controller to perform the next calibration.

9 Exit Calibration Mode.

Press and hold the Select  key for 3 seconds to exit the Calibration Mode.

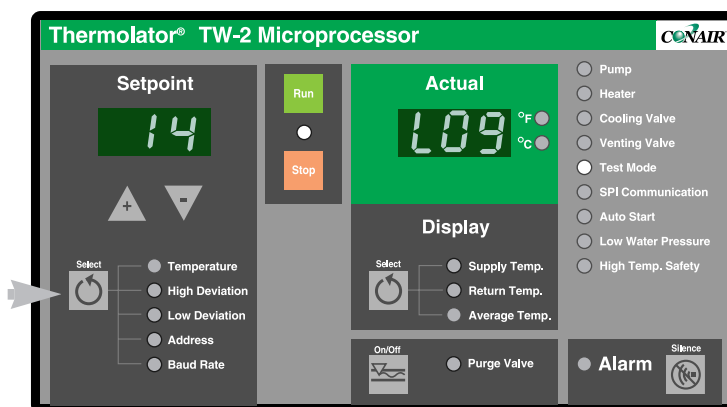
You can now proceed to the next test in Test Mode, or disable Test Mode and resume normal operation.

TO DISABLE TEST MODE, complete steps 2 through 5 in “Performing System Tests”, setting dip switch 6 to OFF instead of ON.

LOGGING OPERATING HOURS

You can see the total numbers of operation by accessing the Total Operating Hours Log in Test Mode.

- 1 Enable Test Mode.**
- 2 Press any key to display the first test menus.**



- 3 Index through test menus to the operating log.**
Press and hold the Setpoint  key for 3 seconds to index to each test menu until the Actual display indicates "Log". The Setpoint display indicates the total number of operating hours in 100-hour units.
- 4 Exit the Operating Hours Log.**
Press and hold the Select  key for 3 seconds to exit and index to the next test.

You can now proceed to another menu in Test Mode, or disable Test Mode and resume normal operation.

TO DISABLE TEST MODE, complete steps 2 through 5 in "Performing System Tests", setting dip switch 6 to OFF instead of ON.

TROUBLESHOOTING

- *Before beginning* 6-2
- *A few words of caution* 6-2
- *How to identify the cause
of a problem* 6-3

DIAGNOSTICS

- *Shut down alarms* 6-4
- *Warning alarms* 6-8
- *System alarms* 6-11
- *Thermolator will not power up* .6-12

REPAIR

- *Checking and replacing fuses* .6-13
- *Resetting overloads* 6-14
- *Replacing the pump overload* .6-14
- *Replacing the motherboard* . . .6-15
- *Replacing the heater
contactor* 6-16
- *Checking and replacing
thermocouples* 6-17
- *Repairing solenoid valves* 6-18
- *Replacing heater elements* . . .6-20
- *Removing the pump* 6-21

BEFORE BEGINNING

You can avoid most problems by following the recommended installation, operation and maintenance procedures outlined in this User Guide. If you do have a problem, this section will help you determine what caused it and tell you how to fix it.

Before you begin troubleshooting:

- ☐ **Find the wiring, plumbing and other diagrams that were shipped with your equipment.** These diagrams are the best reference for correcting a problem. The diagrams also will note any custom features, such as special wiring, control or plumbing options, not covered in this User Guide.
- ☐ **Verify that you have manuals for other equipment in the process line.** Solving problems may require troubleshooting malfunctions or incorrect operating procedures on other pieces of equipment.
- ☐ **If an alarm is present, note any indicator lights and messages shown on the control panel.** These indicators will help you discover the cause of the problem more quickly.

A FEW WORDS OF CAUTION

The Thermolator is equipped with many safety devices. Do not remove or defeat them. Improper corrective action can lead to hazardous conditions, and should never be attempted to sustain production.



WARNING: This machines should be adjusted and serviced only by qualified technical personnel who are familiar with construction and operation of this type of equipment.



WARNING: Hot surfaces and liquids

Allow the Thermolator to cool to below 100° F (38° C) before servicing the unit.



DANGER: Voltage hazard.

Troubleshooting the electrical system of this equipment requires use of precision electronic measuring equipment, and may require access to the electrical enclosure while power is on. Exposure to potentially fatal voltage levels may be unavoidable. These troubleshooting procedures should be performed only by qualified electrical technicians who know how to use this precision electronic equipment and who understand the hazards involved.

Most Thermolator malfunctions are indicated by an illuminated alarm light and error codes displayed on the control panel.

A problem can trigger three types of alarms:

- **Shut Down Alarms:** The Thermolator detected a problem that caused it to shut down automatically to prevent equipment damage or personal injury.
- **Warning Alarms:** The Thermolator continues to operate, but warns of a problem that could lead to a condition that will shut down the unit.
- **System Errors:** The system error codes indicate a non-recoverable problem with the microprocessor control.

When the Thermolator control detects a problem, the red Alarm light is activated and the RUN/STOP light changes from green to flashing red.



When an Alarm condition occurs:

- 1** Press  to silence any optional audible alarm.
 - ◆ The RUN/STOP light changes from flashing red to steady red.
- 2** Note any indicator lights or error messages to help determine the cause of the problem.
- 3** Find the alarm or error code in the diagnostics tables in the TROUBLESHOOTING section of this manual.
- 4** Press  to clear the alarm and shut down the Thermolator to correct the problem.

Press  to resume normal operation after the problem is corrected.

 **WARNING:**
Disconnect and lockout the main power source before opening the Thermolator or its electrical enclosure for servicing. Disconnect oil and water lines as needed.

SHUT DOWN ALARMS

The Thermolator has detected a problem that could lead to equipment damage or personal injury if it is not corrected.

- ◆ The Alarm LED lights and the STOP/RUN LED flashes red.
- ◆ The Thermolator automatically shuts down.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

Alarm	Possible cause	Solution
● Pump The pump motor overload has tripped. The contact is open.  WARNING: Only qualified electrical service personnel should examine and correct problems that require opening the unit's electrical enclosure or checking electrical current to diagnose the cause of a problem.	Is the correct voltage supplied to the pump motor?	Supply voltage should match the rating on the pump name plate. If voltage is correct, check wiring connections.
	Is the required water flow greater than the pump's capacity?	☐ Review pump sizing for the application. ☐ Decrease the water flow from the process.
	Is the motor overload faulty or set incorrectly?	Disconnect the power and open the electrical enclosure. Verify that the overload is set to trip at the proper amperage, which should not exceed the FLA. Manually trip and reset the overload. If the problem continues, replace the overload. See Resetting and Replacing Overloads.
	Is the pump working properly?	Replace the pump if supply voltage, wiring and overload settings are correct, but the pump continues to draw excessive current.

The Thermolator has detected a problem that could lead to equipment damage or personal injury if it is not corrected.

- ◆ The Alarm LED lights and the STOP/RUN LED flashes red.
- ◆ The Thermolator automatically shuts down.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

SHUT DOWN ALARMS

Alarm	Possible cause	Solution
● High Temp. Safety The actual temperature of oil supplied to the process exceeds the 510° F safety switch limit.  WARNING: Only qualified electrical service personnel should examine and correct problems that require opening the unit's electrical enclosure or checking electrical current to diagnose the cause of a problem.	Has oil stopped flowing through the unit or between the supply outlet and return inlet? Is the electro-mechanical safety switch improperly set or defective? Has the heater contactor failed?	☐ Verify that the unit is running and that the pump is working. Verify all process line valves are open. Check the switch setting. A too-low setting will cause nuisance trips. Check the switch and replace if defective. See Checking and Replacing Switches. Replace the contactor if defective. See Replacing the Heater Contactor.
Hi SAF The actual temperature of oil supplied to the process exceeds the programmed 510° F safety limit.  WARNING: Only qualified electrical service personnel should examine and correct problems that require opening the unit's electrical enclosure or checking electrical current to diagnose the cause of a problem.	Has oil stopped flowing through the unit or between the supply outlet and return inlet? Has the heater contactor failed?	☐ Verify that the unit is running and that the pump is working. Verify all process valves are open. Replace the contactor if defective. See Replacing the Heater Contactor.

SHUT DOWN ALARMS

The Thermolator has detected a problem that could lead to equipment damage or personal injury if it is not corrected.

- ◆ The Alarm LED lights and the STOP/RUN LED flashes red.
- ◆ The Thermolator automatically shuts down.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

Alarm	Possible cause	Solution
Lo SAF Actual temperature of oil supplied to the process is below the programmed 50° F safety limit.	Is the cooling valve stuck open?	Disassemble the cooling valve and check for particles blocking the valve seat. Check the valve seat for excessive wear. Replace parts as required using a valve repair kit. See Repairing Solenoid Valves.
	Has the heater failed?	Check for a bad heating element, or a heater contactor that failed in the open position. See Replacing the Heater Contactor and Replacing Heater Elements.
Pbr Err The thermocouple in the process return line failed.	Is the thermocouple loose?	Check for a loose thermocouple or loose wire connections to the thermocouple.
	Has the thermocouple failed?	Check the thermocouple and replace if necessary. See Checking and Replacing Thermocouples.
PbS Err The thermocouple in the process supply line failed.	Is the thermocouple loose?	Check for a loose thermocouple or loose wire connections to the thermocouple.
	Has the thermocouple failed?	Check the thermocouple and replace if necessary. See Checking and Replacing Thermocouples.

The Thermolator has detected a problem that could lead to equipment damage or personal injury if it is not corrected.

- ◆ The Alarm LED lights and the STOP/RUN LED flashes red.
- ◆ The Thermolator automatically shuts down.
- ◆ The control displays a red LED or alarm code indicating the source of the problem..

SHUT DOWN ALARMS

Alarm	Possible cause	Solution
PHS Err The incoming power is out of phase. A leg may have failed or is disconnected. NOTE: This alarm is available only on TH-2 models.	Is the pump rotating in the wrong direction? Has one of the main supply wire leads become disconnected?	Check pump rotation against the arrow stamped on the pump. If the pump is rotating in the wrong direction, disconnect and lockout the main power source. Open the electrical enclosure, and reverse any two leads on the power connection. Disconnect power and open the electrical enclosure. Check for loose connections in main supply and on motherboard.
FUS 002 Pump fuse. FUS 003 Heater fuse. FUS 004 Cooling valve fuse. FUS 005 Vent valve fuse.	Has the indicated device blown a fuse? Is the correct device being used for this fuse location? Has the motherboard output channel at the designated fuse failed?	Disconnect and lockout the main power. Open the electrical enclosure. Check for loose wires and incorrectly installed jumpers or terminal blocks associated with the fuse error. Replace the fuse, if necessary. See Checking and Replacing Fuses. Replace the fuse, then enter Test Mode. Turn off the Output Monitor associated with the fuse location and test outputs. See Performing System Tests and Disabling or Enabling Output Monitors in the <i>MAINTENANCE</i> section. Replace the motherboard. See Checking and Replacing the Motherboard.

WARNING ALARMS

The Thermolator has detected a problem that could lead to a shut down condition if it is not corrected.

- ◆ The Alarm LED lights.
- ◆ The Thermolator continues operating.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

Alarm	Possible cause	Solution
● Low Deviation The Thermolator will not heat to the setpoint temperature, or takes too long to reach the setpoint temperature. The actual temperature of fluid supplied to the process is lower than the setpoint deviation allows.  WARNING: The Thermolator should be tested and repaired only by qualified technicians equipped with the correct tools and trained in the maintenance and repair of electrical systems and industrial appliances.	Is the cooling valve stuck open or leaking water?	Disassemble the cooling valve and check for particles blocking the valve seat. Check the valve seat for excessive wear. Replace as required using a valve repair kit. See Repairing Solenoid Valves .
	Did a heater element fail?	With the unit powered down: Check for loose connections. Check resistance between the phase legs on the output side of the heater contactor. Readings should be within 0.25 ohms of each other. Replace the heater, if necessary. See Replacing Heater Elements .
	Did a heater contactor fail?	With power on and the Heater LED lit: Check the amp draw on each of the three phase legs to the heater. All should match the FLA listed for the heater on the unit nameplate. Replace the heater contactor if there is a voltage imbalance greater than 10%. See Replacing the Heater Contactor .
	Is the low deviation temperature set too low?	Increase the low deviation setting. The recommended setting is 2° F to 10° F below the process setpoint.
	Is the Thermolator correctly sized for the application?	Review specifications and selection guidelines that apply to heater and pump sizes in temperature control units.

The Thermolator has detected a problem that could lead to a shut down condition if it is not corrected.

- ◆ The Alarm LED lights.
- ◆ The Thermolator continues operating.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

WARNING ALARMS

Alarm	Possible cause	Solution
● High Deviation The Thermolator will not cool down, or takes too long to cool down. The actual temperature of fluid supplied to the process is higher than the setpoint deviation allows.  WARNING: The Thermolator should be tested and repaired only by qualified technicians equipped with the correct tools and trained in the maintenance and repair of electrical systems and industrial appliances.	Has oil stopped flowing between supply outlet and return inlet?	Check for a plugged pipe or closed valve.
	Did the cooling valve fail?	Check the cooling valve. See Repairing Solenoid Valves
	Is the temperature difference between the cooling water supply and the setpoint too small?	The temperature difference should be at least 25° F to achieve proper cooling. Increase the process setpoint, decrease the cooling water supply temperature. or increase cooling water supply pressure.
	Did a heater contactor fail?	With power on and the Heater LED lit: Check the amp draw on each of the three phase legs to the heater. All should match the FLA listed for the heater on the unit nameplate. Replace the heater contactor if there is a voltage imbalance greater than 10%. See Replacing the Heater Contactor.
	Is the high deviation temperature set too low?	Increase the high deviation setpoint. The recommended setting is the setpoint + 2° F to 10° F .

WARNING ALARMS

The Thermolator has detected a problem that could lead to a shut down condition if it is not corrected.

- ◆ The Alarm LED lights.
- ◆ The Thermolator continues operating.
- ◆ The control displays a red LED or alarm code indicating the source of the problem.

Alarm	Possible cause	Solution
● SPI Communication The SPI communication link has failed.	Is the unit connected to a host machine?	If the Thermolator is not connected to a host device, set the SPI address to OFF using the Setpoint adjustment buttons on the control panel.
	Are the network address and baud rate correct?	☐ Check the network address. The address may be set to any number from 32 to 254 (a hexadecimal integer between 20 and FE), as long as that number has not been assigned to another machine connected to the same network. ☐ Make sure the baud rate (9600, 4800, 2400, or 1200) matches the host machine.
	Is something wrong with the cable?	Check the communication cable condition and connections. The cable must conform to SPI standards. Check for loose connections on the motherboard.

The Thermolator has detected a non-recoverable error involving the microprocessor control.

- ◆ The Alarm LED lights and the STOP/RUN LED flashes red.
- ◆ The Thermolator shuts down or will not start.
- ◆ The control displays an error code indicating the source of the problem.

SYSTEM ALARMS

Alarm	Cause	Solution
ERR 001 RAM hardware failure.	Electrical noise or failed CPU on the motherboard caused system write tests to fail during power up.	Make sure all connections on the motherboard are solid. Operate unit in a noise free environment. If error persists, contact Conair service.
ERR 002 ROM, checksum failure.	The CPU and/or PROM chip (U1 or U2) is not making good contact with its socket, or the PROM chip has failed.	Make sure the CPU and PROM chips are seated correctly in the sockets. If error persists, contact Conair service.
ERR 003 ERR 004 COP failures.	A failed CPU, failed motherboard, software bug or electrical noise caused an internal software error.	Cycle power to the unit. If the problem persists, contact Conair service technicians. You may need to replace the motherboard.
ERR 005 Illegal Opcode.	The CPU tried to execute an illegal software instruction due to electrical noise or a failed motherboard.	Make sure all connections to the motherboard are solid and that the unit is operating in a noise free environment. If error persists, contact Conair service.
ERR 006 ERR 014 through	A failed CPU, failed motherboard, software bug or electrical noise caused an internal software error.	Cycle power to the unit. If the problem persists, contact Conair service technicians. You may need to replace the motherboard.
ERR 015 ERR 016 Software cannot write to CPU non-volatile memory.	The memory has exceeded its usable life or there is a software bug. This error occurs only after changes have been made to non-volatile memory either through the operator panel or SPI.	Cycle power to the unit. Contact Conair service if an operating parameter such as the setpoint is not being saved or if this error persists.

THERMOLATOR WILL NOT POWER UP

If you apply power to the Thermolator and the control panel does not light, you have a problem with the main power circuit or the unit's microprocessor board.



WARNING: Electrical Shock Hazard
Disconnect and lockout the main power supply before proceeding.

Symptom	Possible cause	Solution
Applying power does not turn on the Thermolator or light the control panel.	Is power reaching the Thermolator?	☐ Verify that the main power supply and any customer-installed electrical disconnect or emergency stop devices are in the ON position. ☐ Verify correct electrical connections between the unit and the control, and between the unit and the power supply. Replace any damaged wires or cables.
	Has the unit blown a fuse?	Check Fuse 1 on the motherboard and any fuses or breakers associated with customer-installed disconnect devices. Replace or reset as required. Identify the cause of the ground fault and correct it. See Checking and Replacing Fuses .
	Is the correct voltage reaching the Thermolator?	Check the electrical requirements on the unit nameplate. Verify correct main supply voltage to the unit and the secondary voltage supply from the transformer to unit components. Replace the transformer, if necessary.
The control panel is lit, but the Thermolator will not operate when RUN is pressed.	Is the unit in Test Mode?	If the Test Mode LED is lit, you must disable Test Mode on the motherboard before resuming operation. See Performing System Tests in the <i>MAINTENANCE</i> section.

This procedure covers the factory-installed fuses on the unit's motherboard. If you have installed an electrical disconnect or emergency stop switch, additional fuses and/or breakers may have been used elsewhere in the in the main power circuit.

To replace a blown fuse:

- 1** **Disconnect and lockout the main power.**
- 2** **Open the electrical enclosure door.** Turn the screw on the front panel counterclockwise to open.
- 3** **Replace the fuse.** The fuses are located on the motherboard and are labeled and identified on the orange shield.
- 4** **Close the electrical enclosure and restart the unit.**

If fuses continue to fail:

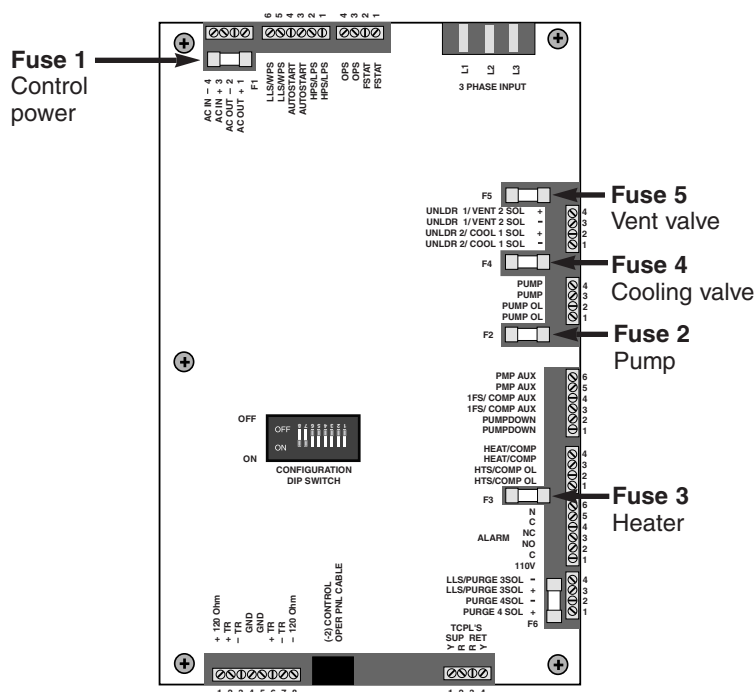
- ☐ Verify that the unit is receiving the correct voltage. Check the voltage, phasing and amperage ratings on the unit's nameplate.
- ☐ Verify that the unit's transformer is operating correctly. Check for proper voltage (120V 10%) to the voltage sensing device for the fuse location.
- ☐ Check all wiring referencing the fusing location for loose connections, damage or improper grounding. Verify that the correct device is being used for this fuse location. See **Disabling or Enabling Output Monitors** in the *MAINTENANCE* section.

CHECKING AND REPLACING FUSES



WARNING: Shock Hazard

Only qualified service personnel familiar with electrical testing and industrial equipment should examine and correct problems that require opening the unit with power on to diagnose the cause of a problem.



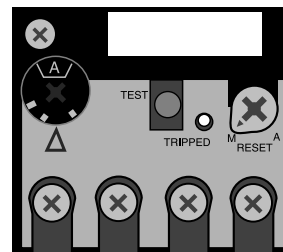
IMPORTANT: Always refer to the wiring diagrams that came with your Thermolator to locate specific electrical components. Illustrations in the User Guide are intended to be representative only.

RESETTING OVERLOADS

The pump motor overload is located inside the unit's electrical enclosure.

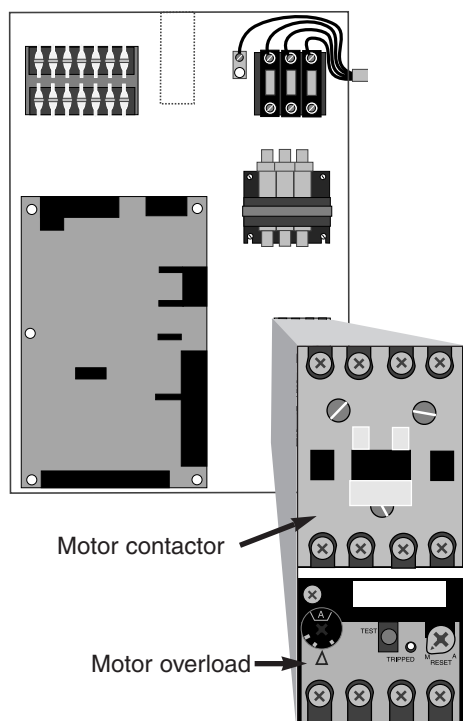
- 1 Disconnect and lockout the main power.**
- 2 Open the electrical enclosure door.** Turn the screw on the front panel counterclockwise to open.
- 3 Check the overload.**

If the yellow button is out, the overload has tripped. Press the blue button to reset the overload. Verify that the overload trip point does not exceed the FLA for the pump.



REPLACING THE PUMP OVERLOAD

- 1 Disconnect and lockout the main power.**
- 2 Open the electrical enclosure door.** Turn the screw on the front panel counterclockwise to open.
- 3 Locate the pump overload module** attached to the pump motor starter.
- 4 Disconnect the three power leads** from the overload module to the pump motor. Note the placement of each lead and label as needed.



- 5 Disconnect auxiliary wiring on the overload module.**
- 6 Remove the overload module.** Loosen the three screws that connect the overload module to the motor contactor. Pull the overload module down to release it from the starter.
- 7 Reverse these steps to install the new overload module.**
- 8 Set the module reset mode to M for manual.**
- 9 Set the proper FLA trip point.** Do not exceed the FLA for the pump motor.

REPLACING THE MOTHERBOARD

1 Disconnect and lockout the main power supply.

2 Open the electrical enclosure door. Turn the screw on the front panel counterclockwise to open.

3 Mark or label each wire connected to the motherboard. The orange shield is labeled with the connection information. You must label the wires to ensure they are connected to the correct terminals on the new motherboard.

4 Disconnect the wires from the motherboard by pulling the terminal blocks up.

5 Loosen the screws holding the orange shield.

6 Remove the motherboard and shield from the electrical enclosure as a unit.

7 Remove the motherboard from the shield and replace with the new motherboard.

8 Reattach the shield and new motherboard in the electrical enclosure. Tighten the screws.

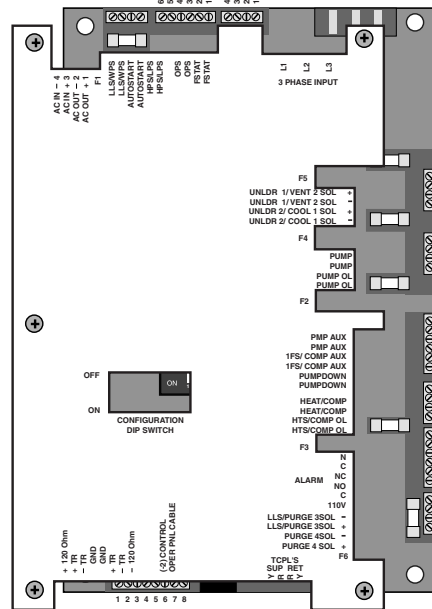
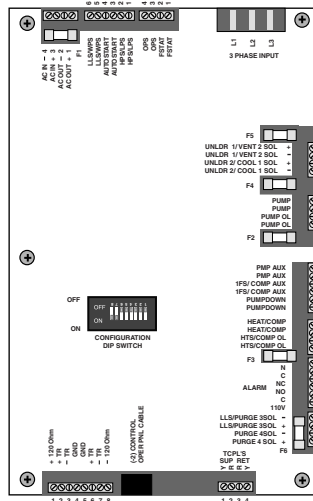
9 Reconnect the terminal blocks and wires to the new board.

Make sure you align the terminal blocks with the correct pins on the board. Push the terminal blocks onto the pins, taking care not to bend any pins.

10 Set dip switches 7 and 8 to the correct unit type. Set Dip switch 7 to OFF and dip switch 8 to ON.

11 Program output monitors on the new board. See **Disabling or Enabling Output Monitors** in the **MAINTENANCE** section.

IMPORTANT: Always refer to the wiring diagrams that came with your Thermolator to locate specific electrical components. Illustrations in the User Guide are intended to be representative only.



REPLACING THE HEATER CONTACTOR

IMPORTANT: Always refer to the wiring diagrams that came with your Thermolator to locate specific electrical components. Illustrations in the User Guide are intended to be representative only.



WARNING: Electrical Shock Hazard

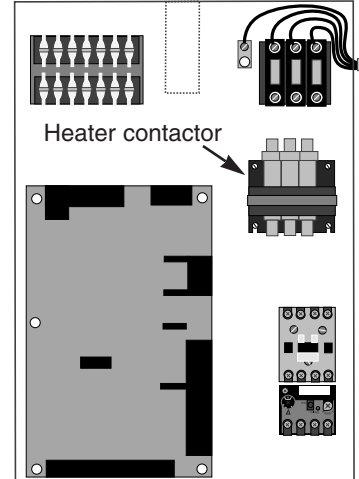
Only qualified service personnel who have been trained on electrical testing and the procedures for avoiding the hazards should diagnose or correct problems that require opening the unit with power on.

Thermolators use mercury displacement heater contactors. The heater contactors should be replaced if:

- You have checked the amp draw on each of the three-phase legs and discovered a voltage imbalance greater than 10%.
- You have checked the continuity and found that ohms at the coil equal zero.

To replace the heater contactor:

- 1 Disconnect and lockout the main power.**
- 2 Open the electrical enclosure door.** Turn the screw on the front panel counterclockwise to open.
- 3 Disconnect the wires from the heater contactor contactor.** Make sure you label the wires to ensure you can connect them correctly to the new contactor.
- 4 Remove the contactor** by removing the screws that hold it in place.
- 5 Discard the old contactor using the proper disposal procedure.** See Material Safety Data Sheet #7439-97 in the *APPENDIX*.
- 6 Reverse this procedure to install the new contactor.** Make sure the wires are connected correctly.



WARNING: Hazardous Substance

Thermolators use mercury displacement contactors. Mercury is considered a hazardous substance and must be dealt with accordingly. See Material Safety Data Sheet #7439-97-6 for information on the how to avoid the potential hazards and how to clean up and dispose of mercury if it spills.

The Thermolator uses two type ‘K’ thermocouples to monitor supply and return process temperatures. One thermocouple is installed in the wall of the heater tank at the “to process” outlet. The other thermocouple is installed in the wall of the cooling tank at the “from process” inlet.

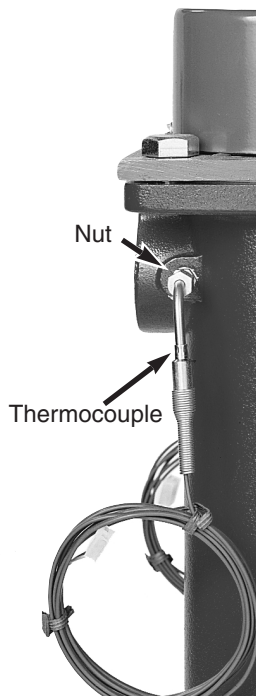
CHECKING THERMOCOUPLES

To check a thermocouple after a probe error:

- 1 Disconnect and lockout the main power.**
- 2 Open the electrical enclosure door.** Turn the screw on the front panel counterclockwise to open.
- 3 Unplug the appropriate thermocouple from the motherboard and install a jumper on the leads.** Refer to the wiring diagrams that came with your unit.
- 4 Restart the Thermolator.**
 - ◆ If error message disappears, replace the thermocouple.
 - ◆ If error message does not disappear, replace the motherboard. See **Replacing the Motherboard**.

To replace a thermocouple:

- 1 Disconnect and lockout the main power.**
- 2 Shut off the process valves (if installed) and drain the unit.** Drain all oil using the drain plugs located the bottom of the unit.
- 3 Remove the unit’s top panel and open the electrical enclosure**
- 4 Remove the thermocouple.** Loosen the compression nut to slide the thermocouple out of the casing. Disconnect the thermocouple wires at the motherboard.
- 5 Install the new thermocouple.** Insert the tip of the new thermocouple at least 1 inch into the tank. Tighten the compression nut. Thread the leads through the raceway leading to the electrical enclosure. Attach the thermocouple leads to the motherboard.



REPLACING THERMOCOUPLES



WARNING: **Hot surfaces**

Allow the Thermolator to cool to below 100° F (38° C) before servicing the unit.

REPAIRING SOLENOID VALVES

Every Thermolator has a solenoid valve assembly that controls the cooling water out flow.

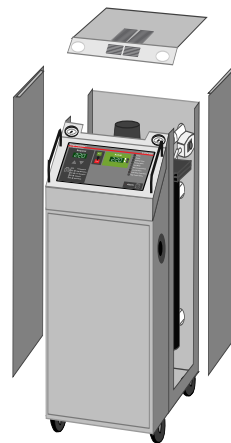


WARNING: Electrical shock and hot surface hazards



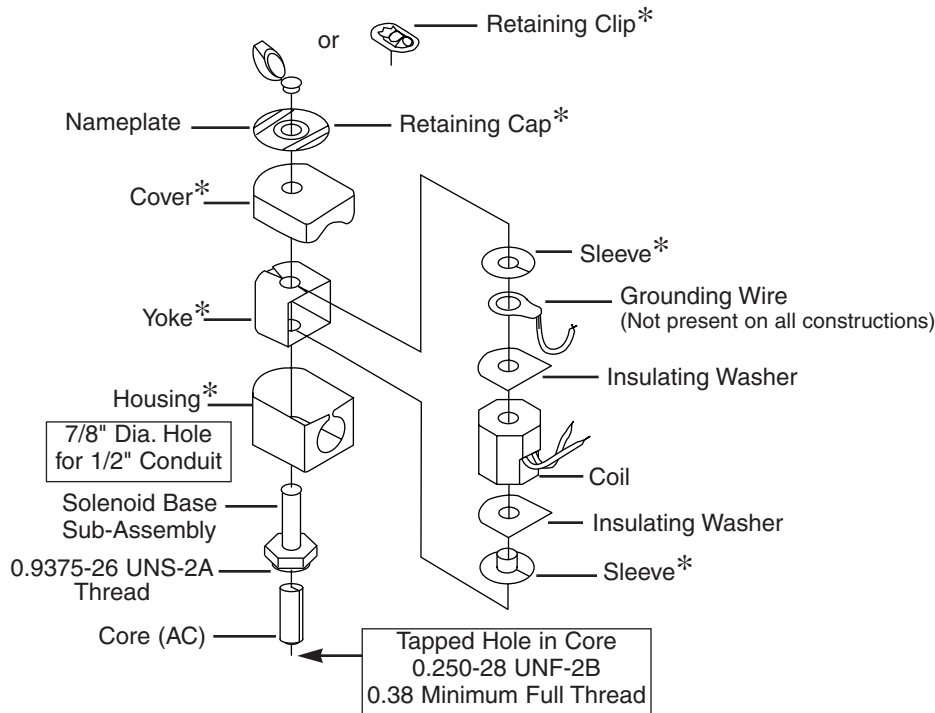
Before attempting maintenance of any kind on the Thermolator, you must stop the unit; disconnect and lockout the main power supply; and allow the unit to cool to 100° F (38° C)

- 1** Shut off the cooling water infeed.
- 2** Drain the unit of all water through the manual lever on the pressure relief valve.
- 3** Remove the cooling water inlet feed.
- 4** Disconnect and lockout main power.
- 5** Remove the top and side panels of the Thermolator. Lift the top panel straight up, then lift the side panels up.
- 6** Remove the solenoid valve from the cooling water inlet line.
- 7** Disassemble the solenoid valve.
(see exploded views on next page.)
- 8** Inspect and clean or repair the valve body assembly.
Remove foreign particles and replace damaged parts as necessary.
- 9** Reassemble the valve and other components.
Reassemble in reverse order. Seal all pipe fittings with pipe sealant. Check that all flows are in the correct direction. Check for leaks before resuming operation.



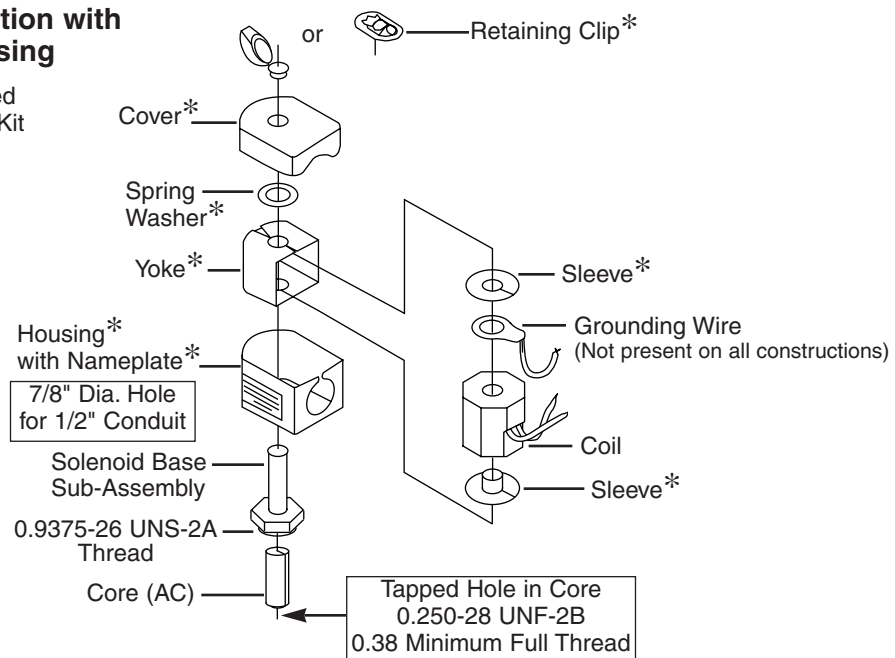
*Indicates Parts Supplied
in Solenoid Enclosure Kit

REPAIRING SOLENOID VALVES



Alternate Construction with Nameplate on Housing

*Indicates Parts Supplied
in Solenoid Enclosure Kit



REPLACING HEATER ELEMENTS



WARNING: Electrical shock and hot surface hazards

Before attempting maintenance of any kind on the Thermolator, you must stop the unit; disconnect and lockout the main power supply; and allow the unit to cool to less than 100° F (38° C)

IMPORTANT: Always refer to the wiring diagrams that came with your Thermolator to locate specific electrical components. Illustrations in the User Guide are intended to be representative only.

1 Disconnect and lockout the main power.

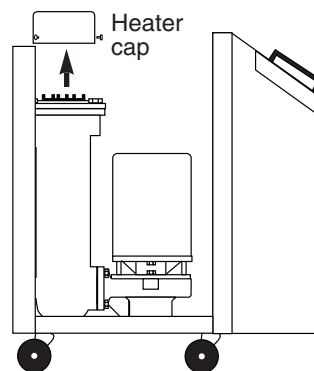
2 Remove the top panel of the Thermolator.

3 Remove the heater cap.

Use a 1/4-inch open-end wrench to remove the three bolts that hold the cap to the heater tank.

4 Remove the heater wiring harness.

Label the wiring layout of the heater terminals; wires are labeled 2T1, 2T2, 2T3 and GND. Then unscrew the locking screws on the wiring harness and remove the wires.



5 Shut off the cooling water in feed.

6 Drain the Thermolator using the drain plugs located at the rear of the unit.

7 Remove the four bolts that hold the heater element in place. Use a 15/16-inch socket with 1/2-inch drive.

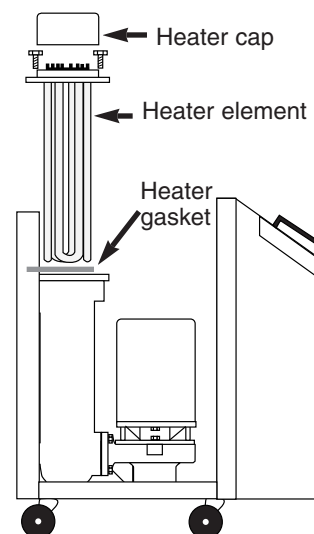
8 Lift the heating element out of the heater tube.

Lift the element straight up.

9 Replace the heater gasket

Use a high temperature Teflon paste to ensure a good seal.

10 Reverse these steps to install the new heater element and reassemble the unit.





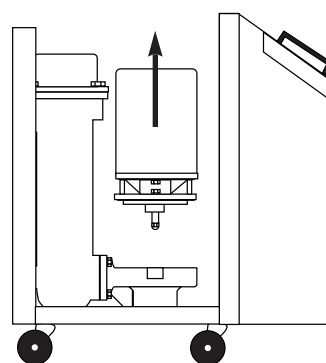
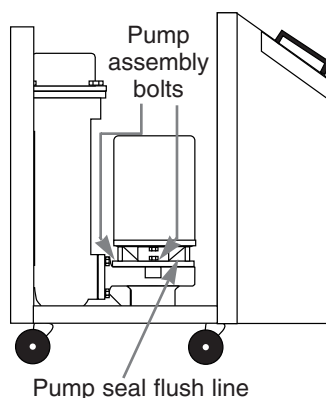
WARNING: Electrical shock and hot surface hazards



Before attempting maintenance of any kind on the Thermolator, you must stop the unit; disconnect and lockout the main power supply; and allow the unit to cool to less than 100° F (38° C)

REMOVING THE PUMP

- 1** Disconnect and lockout the main power.
- 2** Shut off the cooling water in feed.
- 3** Remove the top and side panels of the Thermolator.
- 4** Drain the unit of all fluid. Remove the drain plugs at the rear of the heater casting.
- 5** Remove the seal flush line. Use a 1/2-inch open-end wrench to remove the vent line from the connection on the pump adapter.
- 6** Remove the pump assembly bolts. Use a 9/16-inch open-end box wrench to remove the bolts holding the pump to the volute case. The bolt in the rear will require a 9/16-inch crows foot wrench.
- 7** Lift the pump assembly straight up to remove.
The pump can now be replaced or disassembled for repair.
- 8** Reverse the steps to reassemble the unit.



NOTE: Before restarting, close all drain openings using sealant on the threads and refill the unit with fluid. Do not start the pump when the unit is dry.

Conair has made the largest investment in customer support in the plastics industry. Our service experts are available to help with any problem you might have installing and operating your equipment. Your Conair sales representative also can help analyze the nature of your problem, assuring that it did not result from misapplication or improper use.

To contact Customer Service personnel, call:



From outside the United States, call: 814-437-6861

You can commission Conair service personnel to provide on-site service by contacting the Customer Service Department. Standard rates include an on-site hourly rate, with a one-day minimum plus expenses.

If you do have a problem, please complete the following checklist before calling Conair:

- ☐ Make sure you have all model, serial and parts list numbers for your particular equipment. Service personnel will need this information to assist you.
- ☐ Make sure power is supplied to the equipment.
- ☐ Make sure that all connectors and wires within and between control systems and related components have been installed correctly.
- ☐ Check the troubleshooting guide of this manual for a solution.
- ☐ Thoroughly examine the instruction manual(s) for associated equipment, especially controls. Each manual may have its own troubleshooting guide to help you.
- ☐ Check that the equipment has been operated as described in this manual.
- ☐ Check accompanying schematic drawings for information on special considerations.

WE'RE HERE TO HELP

HOW TO CONTACT CUSTOMER SERVICE

BEFORE YOU CALL ...

Additional manuals and prints for your Conair equipment may be ordered through the Customer Service or Parts Departments for a nominal fee.

EQUIPMENT GUARANTEE

Conair guarantees the machinery and equipment on this order, for a period as defined in the quotation from date of shipment, against defects in material and workmanship under the normal use and service for which it was recommended (except for parts that are typically replaced after normal usage, such as filters, liner plates, etc.). Conair's guarantee is limited to replacing, at our option, the part or parts determined by us to be defective after examination. The customer assumes the cost of transportation of the part or parts to and from the factory.

PERFORMANCE WARRANTY

Conair warrants that this equipment will perform at or above the ratings stated in specific quotations covering the equipment or as detailed in engineering specifications, provided the equipment is applied, installed, operated and maintained in the recommended manner as outlined in our quotation or specifications.

Should performance not meet warranted levels, Conair at its discretion will exercise one of the following options:

- Inspect the equipment and perform alterations or adjustments to satisfy performance claims. (Charges for such inspections and corrections will be waived unless failure to meet warranty is due to misapplication, improper installation, poor maintenance practices or improper operation.)
- Replace the original equipment with other Conair equipment that will meet original performance claims at no extra cost to the customer.
- Refund the invoiced cost to the customer. Credit is subject to prior notice by the customer at which time a Return Goods Authorization Number (RGA) will be issued by Conair's Service Department. Returned equipment must be well crated and in proper operating condition, including all parts. Returns must be prepaid.

Purchaser must notify Conair in writing of any claim and provide a customer receipt and other evidence that a claim is being made.

WARRANTY LIMITATIONS

Except for the Equipment Guarantee and Performance Warranty stated above, Conair disclaims all other warranties with respect to the equipment, express or implied, arising by operation of law, course of dealing, usage of trade or otherwise, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

MP PUMPS HTO SERIES

HTO INSTALLATION AND SERVICE INSTRUCTIONS

This bulletin must be read completely before installing, operating, or servicing the pump.



WARNING:

If any of the items listed below are violated, serious injury or death from burns caused by hot oil may occur.

- **DO NOT** perform service or maintenance when the pumping system is pressurized or hot - serious injury or death from burns caused by hot oil may occur.
- **DO NOT** operate the pump in a manner that it was not intended to be used.
- **DO NOT** install for use in an open environment where people are present.
- **DO NOT** install in a rigid piping system that does not allow the pipe to expand and cause the pump to be strained.
- **DO NOT** continue to operate the pumping system when a known leak exists or the system continues to smoke.
- **DO NOT** continue to operate the pump when unusual noise or vibration occurs.
- **DO NOT** install or use near water where the pumping system may come into contact with water or is splashed by water.
- **DO NOT** operate beyond the pressure or temperature limits stated in the product literature, see form 9001.
- **DO NOT** allow severe temperature changes to occur in a short time period within the pumping system.
- **DO NOT** mix different types or grades of oil within the oil system.
- **DO NOT** use an oil that is not a recommended heat transfer oil by the manufacturer.
- **DO NOT** exceed the maximum oil temperature rated by the oil manufacturer at the hottest point in the pumping system.
- **DO NOT** mount the pump in conditions that high piping loads exist on the pump flanges.



MP PUMPS, INC.
TECUMSEH PRODUCTS COMPANY
34800 BENNETT DRIVE • FRASER, MI 48026-1686
(810) 293-8240 • FAX (810) 293-8469

FORM 3043
PRINTED IN U.S.A.

MP PUMPS HTO SERIES

APPLICATION AND INSTALLATION INSTRUCTIONS

Application assistance and technical information can be obtained by calling MP PUMPS at 810-293-8240.

The HTO pump is designed for pumping high temperature fluids that are non-corrosive, non-volatile and have good lubricating qualities.

The primary application for use is with heat transfer oils.

It is the users' responsibility to determine the pump and product compatibility with the materials of construction.

INSTALLATION AND START-UP

INSTALLATION

1. The pump must be installed in a horizontal shaft position.
2. The housing may be rotated to a horizontal or vertical discharge to fit the particular piping installation.
3. Rigid and supported piping must be used that will not strain the pump housing when temperature changes are made during the use of the pump.
4. The piping system must be free of foreign material and moisture before start-up.
5. Pipe thread sealing compound must be used on the NPT flanges that is compatible with the fluid being pumped and is rated for the temperature requirements.
6. The installation should permit adequate circulation of air to provide proper cooling of the motor and pump seal housing.
7. Do not install in a sealed enclosure or insulate the pump adapter and motor. The motor and/or pump seal may fail from excessive heat.
8. A good installation will have an enclosure that provides adequate air flow of ambient air to the motor of the pump.

START-UP

1. Follow all requirements and recommendations from the heat transfer fluid manufacturer for fill, start-up and use.
2. Check for leaks before insulating the piping system.
3. Check for proper shaft rotation by jogging the power and observing the fan clamp. Rotation arrows are provided on pump housing.
4. The seal cavity inside the pump will internally vent during fill and start-up.
5. A small amount of oil may leak from the seal cavity at the shaft; this is normal for a new installation and will stop after approximately one hour.
6. Do not allow the pump to run dry, or continue to operate the pump when it is noisy, vibrating, or leaks are observed. These noticeable signs give a warning that something is wrong with the equipment and must be investigated to avoid possible damage or injury from burns caused by hot oil.

MP PUMPS HTO SERIES

HTO 80 ASSEMBLY INSTRUCTIONS

1. Assemble drive sleeve #11 (29166), impeller #1 (25910) and nut #3 (22655).
2. Thread pipe plug #16 (21255) into housing #14 (25666).
3. With the housing on the bench, suction down, place the impeller and drive sleeve assembly into the housing.
4. Assemble the adaptor #9 (29160) to the housing with gasket #15 (25662) between them. Use six 3/8-16 bolts #18 (21950) and washers #17 (21266).
5. Install three gaskets #6 (29165), two carbon isolators #10 (29158) and one O-ring #8 (29230) onto drive sleeve. The O-ring and one gasket go between the two carbon isolators. The second gasket goes between the carbon isolators and the adaptor. The third gasket goes between the carbon isolator and the seal housing.
6. Assemble seal #2 (29168) onto the drive sleeve with a liberal amount of grease to prevent the seal from being damaged.
7. Press the ceramic seal seat into the seal housing #12 (29162). Turn the seal housing over and press the lipseal #13 (29167) into the other side of the seal housing.
8. Assemble the seal housing #12 (29162) to the adaptor #9 (29160) with three 5/16-18 screws #5 (29178). As steady pressure is applied to the seal housing to hold it in place, thread the three 5/16-18 screws in and torque them to 25 inch-lbs. each. Working around the bolt circle tighten the screws in 25 inch-lbs. increments until each screw is tightened to 150 inch-lbs.
9. Assemble fan clamp #4 (29164) to drive sleeve.
10. Assemble the pump to the motor. Slide the motor onto the pump. Install and tighten the four mounting screws. Push the impeller towards the motor until it stops (contact with the impeller and isolater). Tighten the drive clamp screw to 70/90 inch-lbs. and install piping.

**NOTE:**

Follow oil manufacturers guide for fill and start-up. The seal cavity will vent internally during start-up.

**MP PUMPS, INC.**

TECUMSEH PRODUCTS COMPANY
34800 BENNETT DRIVE • FRASER, MI 48026-1686
(810) 293-8240 • FAX (810) 293-8469

FORM 3043

PRINTED IN U.S.A.

MP PUMPS HTO SERIES

OPERATION AND MAINTENANCE

Thermal oil vapors leaking from a system can be highly flammable.

Any system leak should be repaired immediately.

Do not insulate the pump or system piping with porous flammable insulation. Fluid may wick, decompose and spontaneously ignite.

Ideal mechanical seal life is 20,000 hours.

Reduced seal life may be experienced from extreme conditions.

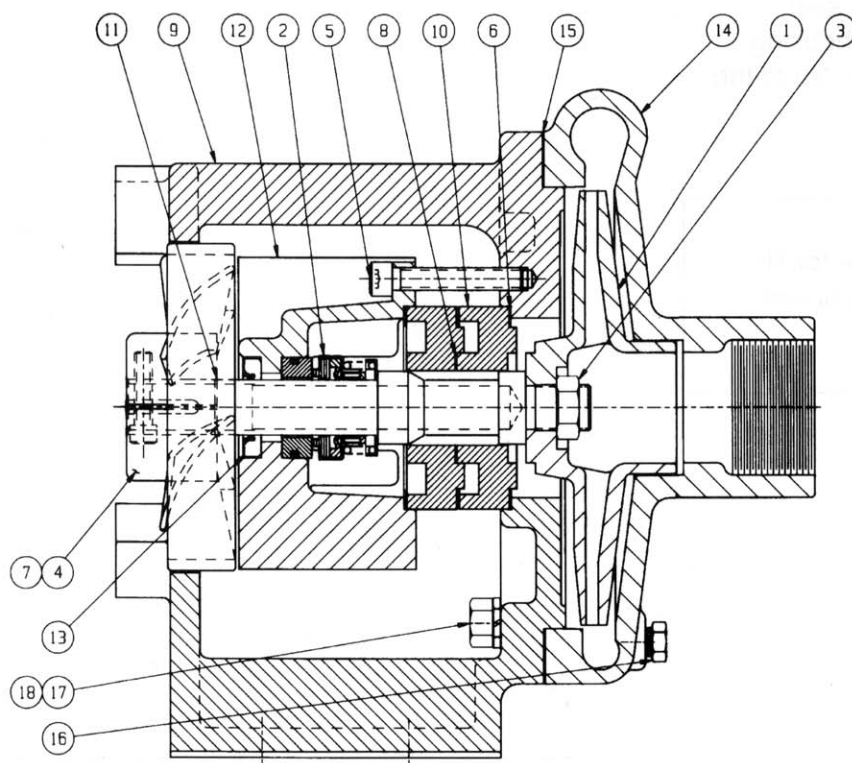
Recommended spare parts and service parts to rebuild the HTO-80 are:

At disassembly, check the impeller and other wear items for unusual wear. Replace if necessary.

When servicing the pump, care should be taken that the pump has cooled to a sufficient temperature to permit disassembly. The product should be drained from the pump housing and disposed in accordance with the fluid manufacturer's recommendations. Operating personnel should be warned to exercise care and utilize eye and skin protection when servicing the pump.

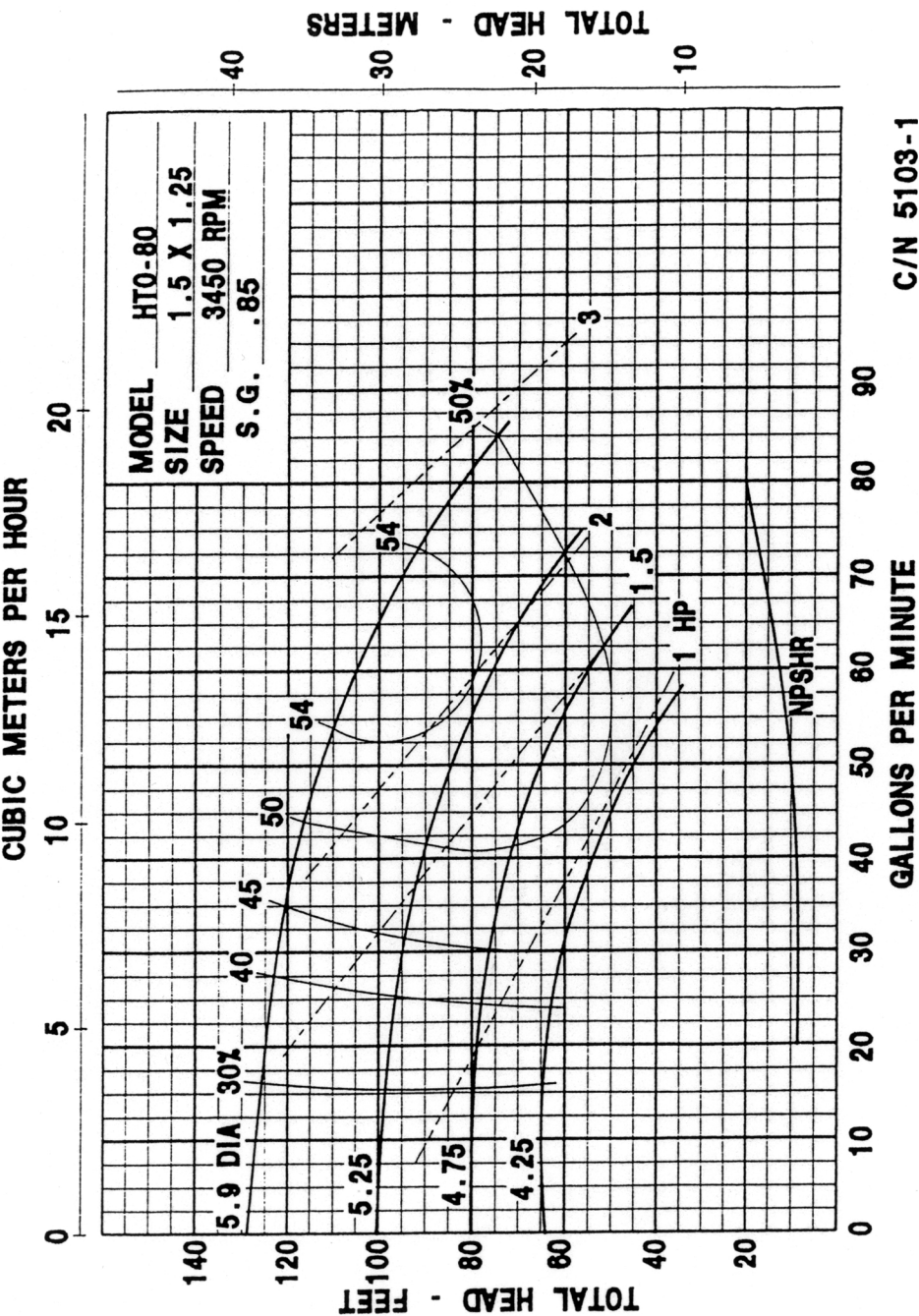
PART NO.	DESCRIPTION	QTY.
29166	DRIVE SLEEVE	1
25662	GASKET	1
29158	ISOLATOR	2
29167	LIP SEAL	1
29168	SEAL ASSEMBLY	1
29165	GASKET	3
29230	O-RING	1

HTO PUMP CROSS-SECTION AND DETAIL



DET.	DESCRIPTION
1	IMPELLER - CAST IRON
2	SEAL ASSEMBLY
3	HEX JAM NUT - S.S.
4	COOLING FAN CLAMP - ALUMINUM
5	CAPSCREW
6	GASKET
7	CAPSCREW
8	O-RING - VITON
9	ADAPTOR - DUCTILE IRON
10	ISOLATOR - CARBON GRAPHITE
11	DRIVE SLEEVE - STAINLESS STEEL
12	SEAL HOUSING - DUCTILE IRON
13	LIP SEAL - VITON
14	HOUSING - DUCTILE IRON
15	GASKET
16	PIPE PLUG S.S.
17	LOCKWASHER S.S.
18	CAPSCREW CPS

PUMP CURVES





Fluid Fouling Problems in Closed-Loop Temperature Control Systems

Thermal-liquid temperature control systems provide major advantages over other methods of heating and cooling. Among them are efficiency, low maintenance, lack of hot or cool spots and the absolute control of temperature. One problem, system fouling, can reduce equipment performance and product output — and lead to increased downtime and unacceptable product quality.

Fouling can occur when the heat transfer fluid is degraded. And the "bruised" fluid can no longer transfer the same amount of heat or flow as quickly.

Fluid Damage

There are three ways the fluid can be bruised: contamination, oxidation or overheating.

Contamination results from foreign matter in the system. In new systems, incomplete cleaning can leave weld slag, spatter and flux, dust and dirt, and quench oils and protective lacquers to mix with the fluid. In existing systems, dirty bruised fluid may remain, or a non-compatible fluid may have been added.

Oxidation occurs when hot fluid comes in contact with the oxygen found in air. The fluid will start to smoke (like overheated cooking oil) and will become acidic and corrosive. And as the fluid oxidizes, it becomes less efficient—and less resistant to heat.

Note: We strongly recommend that copper or copper-bearing materials **not** be used in hot oil systems. Copper, when in contact with hot fluid and air, will act as a catalyst causing the fluid to oxidize **much** more quickly.

Overheating occurs as the fluid's film temperature rises above its recommended maximum. The fluid will first start to distill, with the smaller molecules beginning to boil and vaporize. Viscosity (thickness) increases,

causing flows to decrease. This allows the fluid to linger in contact with the heated surface and pick up too much heat. As temperatures continue to rise, chemical bonds begin to break, and the fluid releases sooty carbon. Allowed to continue unchecked, the process repeats itself until all the fluid has been carbonized.

System Problems

Overheating, the most serious type of bruising, is caused by loss of input heat control or a decrease in fluid velocity.

Input Heat Control

Problems with the equipment include improper flame propagation in fossil-fired heaters, and controller glitches or human failure in electrically heated systems. Power failures and "bumps" can drop the pump motor out. The fluid, standing stagnant in the tubing of fossil-fired heaters, absorbs heat radiating and convecting from the refractory and starts to boil*.

Flow

A reduction in (or loss of) flow is the most common cause of overheating. As flows decrease, fluid velocity and turbulence also decrease, and the heat transfer fluid remains in prolonged contact with the heated surface. Even though the system's bulk fluid temperature may not change much, the film temperature can rise dramatically—and quickly. This extra heat is no longer transferred as rapidly to the bulk of the fluid, and the fluid distills and then "cracks" at the heated surface.

As molecules at the film layer crack, carbon can be formed. This carbon adheres to the heated surface, and much of it bakes on—thickening as the process repeats itself and successive layers are added. Difficult to remove, the carbon coating acts as an insulator both in heater tubing and on electrical heater elements, and can severely affect

flows. The carbon that escapes or breaks away from the heated surface is carried throughout the system, and can lodge in restrictions, clog small channels and hang up control valves—further contributing to the problem.

In addition, the fluid is now more viscous. Not flowing as well, it remains in contact with the heated surface longer, picking up even more heat and continuing to overheat, degrade and foul.

Flows may decrease for a variety of reasons—contaminants lodged in valves, lines or strainers, bypass valves hanging up, pump problems, out-of-spec components or the wrong valves mistakenly closed.

Solutions

Never exceed the maximum film or bulk temperature of any heat transfer fluid. This is possible, but in practice not very easy or inexpensive (power failures alone can victimize even the most fail-safe system—not to mention operator error or worn components). And system contamination is difficult to totally prevent.

Specify a heat transfer fluid that does not foul when severely overheated.

Paratherm NF®

The Paratherm **NF** won't carbon-coat a system's internal surfaces when severely overheated. Formulated for service to 600°F, the odorless, crystal clear **NF** fluid provides excellent heat transfer and is low in viscosity. It is exceedingly reliable, cost-effective and **totally non-toxic**. The **NF** fluid can be safely combined with used lube oils and recycled locally, or burned for BTU value.

If severely overheated, the Paratherm **NF** evolves carbon granules. Remaining in suspension, they cannot adhere to the system's internal surfaces and can be easily filtered out.

*In fossil-fired systems, the circulating pump should be allowed to run until the excess heat stored in the heater's refractory and structural members has safely exited the firebox.

Note: The information and recommendations in this literature are made in good faith and are believed to be correct as of the below date. You, the user or specifier, should independently determine the suitability and fitness of Paratherm heat transfer fluids for use in your specific application. We warrant that the fluids conform to the specifications in Paratherm literature. Because our assistance is furnished without charge, and because we have no control over the fluid's end use or the conditions under which it will be used, we make no other warranties—expressed or implied, including the warranties of mer-

chantability or fitness for a particular use or purpose (recommendations in this bulletin are not intended nor should be construed as approval to infringe on any existing patent). The user's exclusive remedy, and Paratherm's sole liability is limited to refund of the purchase price or replacement of any product proven to be otherwise than as warranted. Paratherm Corporation will not be liable for incidental or consequential damages of any kind. Some product names of companies found in Paratherm literature are registered trademarks. This statement is in lieu of individually noting each.



The SPI commands supported by Conair Thermolator® mold temperature controllers are listed in the following tables.

The standard required commands and three optional commands are listed in the SPI Command Pairs table, along with the Select and Poll command pairs in hexadecimal format. Select commands set or change Thermolator functions. Poll commands retrieve information from the Thermolator.

SPI COMMANDS SUPPORTED BY THE CONAIR THERMOLATOR®

SPI Command Pairs		
Mold temperature controllers		Device ID: hex 20
Commands	Select	Poll
Echo - Select stores 4 bytes of information at the Thermolator; Poll retrieves it.	0x20 0x21	0x20 0x20
Setpoint Process Temperature - Sets and retrieves the process temperature setpoint.	0x20 0x31	0x20 0x30
Alarm, High Temperature Deviation* - Sets the alarm band temperature; retrieves setpoint + alarm band value.	0x20 0x33	0x20 0x32
Alarm, Low Temperature Deviation* - Sets the alarm band temperature; retrieves setpoint + alarm band value.	0x20 0x35	0x20 0x34
Mode, Machine - Start/stops the Thermolator; acknowledges alarms; retrieves run status	0x20 0x49	0x20 0x48
Version - Retrieves 4 bytes of SPI version information.		0x20 0x22
Process Status - Retrieves run status and alarm conditions.		0x20 0x40
Status, Machine 1 - Retrieves run status and alarm conditions.		0x20 0x42
Status, Machine 2 - Retrieves run status and alarm conditions.		0x20 0x44
Temperature, from Process - Retrieves the actual temperature of fluid returning to the Thermolator.		0x20 0x72
* NOTE: Both High and Low Temperature Deviation commands set the same variable. Use only one of these commands to avoid problems.		

See the tables on the following pages for the SPI status words and BIT positions for Process Status, Machine 1 Status and Machine 2 status.

For more information on the SPI protocol, you can obtain the SPI Communication Protocol Manual by contacting:

The Society of the Plastics Industry, Inc.
1801 K Street, NW
Suite 600K
Washington DC 20006
(202) 974-5200 Fax: (202) 296-7005
www.plasticsindustry.org

SPI STATUS WORDS

Status, Process

Poll: 0x20 0x40

SPI STATUS WORD	Open	Open	Reserved	Reserved	Reserved	Reserved	Alarm, Low flow	Reserved	Alarm, Low pressure condition	Alarm, High pressure condition	Alarm, Low temperature deviation	Alarm, High temperature deviation	Alarm, Machine	Alarm, Process	Alarm, System	Processing
Word BIT position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
EEPROM error														SET	SET	*
A/D converter error														SET	SET	*
CJC Error														SET	SET	*
RAM hardware														SET	SET	*
ROM checksum														SET	SET	*
Probe Failure													SET		SET	*
E/M Hi temp safety																*
Prog. Hi temp safety																*
Output monitor failure													SET		SET	*
Low water pressure									SET				SET		SET	*
High deviation alarm												SET		SET	SET	*
Low deviation alarm											SET			SET	SET	*
Prog. Lo temp safety																*
Pump overload													SET		SET	*
Low water level													SET		SET	*
Test Mode																*
Phase error																*

NOTES:

* The SPI I/O list defines the Processing bit as being cleared if the unit is not processing; otherwise it is SET.

Elsewhere on the chart:

- If a bit is not shown to be SET, it is cleared.
- The System Alarm bit is SET if an alarm is present. It is the logical OR of Process alarm and Machine alarm.
- Processing, System Alarm, Process Alarm and Machine Alarm bits are repeated for Process Status, Machine 1 Status and Machine 2 Status.

SPI STATUS WORDS

Status, Machine 1

Poll: 0x20 0x42

SPI STATUS WORD	Open	Alarm, Phase	Alarm, Low current	Alarm, High current	Alarm, Low volts	Alarm, High volts	Reserved	Reserved	Alarm, Low pressure safety limit	Alarm, High pressure safety limit	Alarm, Low temperature safety limit	Alarm, High temperature safety limit	Alarm, Machine	Alarm, Process	Alarm, System	Processing
Word BIT position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
EEPROM error														SET	SET	*
A/D converter error														SET	SET	*
CJC Error														SET	SET	*
RAM hardware														SET	SET	*
ROM checksum														SET	SET	*
Probe Failure																*
E/M Hi temp safety												SET	SET		SET	*
Prog. Hi temp safety												SET		SET	SET	*
Output monitor failure													SET		SET	*
Low water pressure									SET				SET		SET	*
High deviation alarm																*
Low deviation alarm																*
Prog. Lo temp safety											SET			SET	SET	*
Pump overload													SET		SET	*
Low water flow													SET		SET	*
Low water level													SET		SET	*
Test Mode																*
Phase error		SET											SET		SET	*

NOTES:

* The SPI I/O list defines the Processing bit as being cleared if the unit is not processing; otherwise it is SET.

Elsewhere on the chart:

- If a bit is not shown to be SET, it is cleared.
- The System Alarm bit is SET if an alarm is present. It is the logical OR of Process alarm and Machine alarm.
- Processing, System Alarm, Process Alarm and Machine Alarm bits are repeated for Process Status, Machine 1 Status and Machine 2 Status.

SPI STATUS WORDS

Status, Machine 2

Poll: 0x20 0x44

SPI STATUS WORD	Open	Open	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Fault, CAL	Fault, Sensor	Alarm, Machine	Alarm, Process	Alarm, System	Processing
Word BIT position	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
EEprom error														SET	SET	*
A/D converter error														SET	SET	*
CJC Error														SET	SET	*
RAM hardware														SET	SET	*
ROM checksum														SET	SET	*
Probe Failure												SET		SET	SET	*
E/M Hi temp safety																*
Prog. Hi temp safety																*
Output monitor failure													SET		SET	*
Low water pressure																*
High deviation alarm																*
Low deviation alarm																*
Prog. Lo temp safety																*
Pump overload													SET		SET	*
Low water level													SET		SET	*
Test Mode																*
Phase error																*

NOTES:

* The SPI I/O list defines the Processing bit as being cleared if the unit is not processing; otherwise it is SET.

Elsewhere on the chart:

- If a bit is not shown to be SET, it is cleared.
- The System Alarm bit is SET if an alarm is present. It is the logical OR of Process alarm and Machine alarm.
- Processing, System Alarm, Process Alarm and Machine Alarm bits are repeated for Process Status, Machine 1 Status and Machine 2 Status.

Material Safety Data Sheet

An explanation of the terms used in this document may be found in OSHA 29 CFR 1910.1200, which is available from OSHA regional or area offices.

MSDS: 7439-97-6 MERCURY

1. Chemical Identification

Substance: Mercury	CAS-Number: 7439-97-6
Chemical name: Mercury	Synonyms: Quicksilver; Liquid silver
Formula: HG	Molecular weight: 200.59
Trade name: Not applicable	Chemical family: Metal
Supplier of MSDS information: The Conair Group Inc. One Conair Drive Pittsburgh, PA 15202 412-312-6000	Emergency contact: For CHEMTREC assistance call 800-424-9300 (in the U.S.) 703-527-3887 (international)

2. Composition and Exposure Limits

Material	Weight (%)	Exposure Limits
Mercury	100	0.05 mg/m ³ Threshold Limit Value(skin)/TWA
		0.1 mg/m ³ Permissible Exposure Limit (PEL)

3. Hazards Identification

Hazard Ratings (0 = no hazard; 4 = extreme hazard):		
Health	- 4 Extreme (Poison)	Carcinogenic: NTP – No
Flammability	- 0 None	IARC – No
Reactivity	- 1 Slight	Z List – No
Contact	- 3 Severe (Life)	OSHA Reg – No

Personal Health Effects:

WARNING Mercury is a dangerous poison and an extreme contact hazard. Mercury may be absorbed by the skin or through the eyes. It may be fatal if swallowed or inhaled. It emits toxic vapors, especially when heated. Do not get mercury in your eyes, on your skin or on your clothing. Do not breathe mercury dust. Keep mercury in a tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.

Effects of overexposure Mercury causes skin, digestive tract and severe respiratory tract irritation. It may affect the central nervous system and cause severe eye irritation. Inhalation of vapors may cause coughing, chest pains, nausea and vomiting. Chronic effects of overexposure may include kidney and/or liver damage, and central nervous system depression. Chronic effects of mercury poisoning include a buildup of the metal in the brain, liver and kidneys. Symptoms include headache, tremors, loose teeth, loss of appetite, blisters on the skin and impaired memory. This substance has caused adverse reproductive and fetal effects in animals.

Target organs Eyes, skin, respiratory system, central nervous system, kidneys and liver.

Routes of entry Inhalation, absorption, eye contact, skin contact.

4. Emergency and First Aid Measures

Call a physician immediately.

If swallowed:	Immediately induce vomiting, if person is conscious.
If inhaled:	Immediately remove exposed person to fresh air. If the person is not breathing, give artificial respiration. If breathing is difficult, give oxygen.
In case of contact:	Immediately flush eyes or skin with plenty of water for at least 15 minutes, while removing contaminated clothing and shoes. Wash clothing before using again.

MSDS:

7439-97-6

MERCURY

5. Fire and Explosion Data	
Fire and explosion hazards:	Mercury presents a slight fire and explosion hazard when exposed to heat or flame. Mercury vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back.
Firefighting media:	Dry chemical, carbon dioxide, water spray or foam. For larger fires, use water spray, fog or alcohol foam. (1984 Emergency Response Guidebook, DOT P 5800.3).
Firefighting procedures:	Use agents suitable for type of fire. Use water in flooding amounts as a fog. Avoid breathing corrosive and poisonous vapors. Keep upwind. Move containers from the fire area if possible. Cool containers exposed to flames with water from side until well after fire is out. (1984 Emergency Response Guidebook, DOT P 5800.3).
6. Spill and Disposal Procedures	
EPA Hazardous Waste Number: U151 (Toxic Waste)	
If spilled or discharged:	Wear self-contained breathing apparatus and full protective clothing. Clean up the spill immediately. Collect and store using a suction pump with a capillary tube. Calcium polysulfide with excess sulfur should be sprinkled into cracks or inaccessible sites. Keep collected mercury in a tightly closed bottle for recovery or disposal.
Disposal procedure:	Dispose in accordance with all applicable federal, state, and local environmental regulations.
7. Storage and Handling Precautions	
Mercury should be stored in a secure poison area inside a tightly closed container.	
8. Exposure Control and Protective Equipment	
Ventilation:	Use general or local exhaust ventilation to meet TLV requirements.
Respiratory protection:	None required where appropriate ventilation conditions exist. If the TLV is exceeded, a self-breathing apparatus is advised.
Eye/skin protection:	Safety goggles and face shield, uniform, protective suit and rubber gloves are recommended.
9. Physical and Chemical Properties	
Appearance and odor: Silver-white, heavy, mobile liquid metal; odorless	
Boiling point: 675° F (357° C)	Melting point: -38° F (-39° C)
Specific gravity: 13.5	Vapor pressure: 0.002 mm HG
Vapor density: 1.01	Solubility in H₂O: negligible, less than 0.1%
Solubility in solvents: Sulfuric acid, nitric acid, lipids	
10. Stability and Reactivity Data	
Stability: Stable	Hazardous polymerization: Will not occur
Conditions to avoid:	Heat
Incompatibles:	Strong acids

IMPORTANT: Users of this equipment should study this MSDS carefully to become aware of and understand the hazards associated with the product. If necessary or appropriate, the reader should consider consulting reference works or individuals who are experts in ventilation, toxicology and fire prevention to use and understand the data in this MSDS. To promote safe handling, the reader should furnish this information to anyone whom he or she knows or believes will use this equipment.

Material Safety Data Sheet



Paratherm Corporation
NF® Heat Transfer Fluid

I. PRODUCT IDENTIFICATION

Manufacturer's Name Paratherm Corporation
Address 1050 Colwell Road
 Conshohocken, PA 19428

Emergency Telephone No. (610) 941-4900
Trade Name **Paratherm NF®**
Revision Date April 3, 1996

CAS Number: 8042-47-5
TSCA Inventory Status: Included

NFPA Hazard Identification	
Degree of Hazard	Hazard Ratings
Health: 0	0—Least
Fire: 1	1—Slight
Reactivity: 0	2—Moderate
	3—High
	4—Extreme

II. INGREDIENTS

COMPONENT NAME	CAS NUMBER	HAZARDOUS IN BLEND	PERCENTAGE Min. Max.	COMPONENT EXPOSURE LIMITS	UNITS
Hydrotreated Natural Hydrocarbon	8042-47-5	No	100.00	OSHA PEL ACGIH TLV	None established (see item III below) None established (see item III below)

III. HEALTH EFFECT INFORMATION

ACUTE EFFECTS

EYE CONTACT

Paratherm NF® is non-irritating to the eyes upon direct contact.

SKIN CONTACT

Paratherm NF® is not expected to cause any skin irritation upon direct single or repeated and prolonged contact; however, similar chemical composition products applied to the skin of laboratory animals resulted in minimal to slight dermal irritation.

INHALATION

Paratherm NF® has a low vapor pressure and is not expected to present an inhalation hazard at ambient conditions. Caution should be taken to prevent aerosolization or misting. The permissible exposure limit (PEL) and threshold limit value (TLV) for the fluid as oil mist is 5 mg/m³. Exposures below 5 mg/m³ appear to be without significant health risk.

INGESTION

Ingestion is relatively non-toxic unless aspiration occurs. Paratherm NF® has laxative properties and may result in abdominal cramps and diarrhea. See Personal Health Protection section below.

CHRONIC EFFECTS

On rare occasions, prolonged and repeated exposure to oil mist poses a risk of pulmonary disease such as chronic lung inflammation. This condition is usually asymptomatic as a result of repeated small aspirations. Shortness of breath and cough are the most common symptoms. Aspiration may lead to chemical pneumonitis which is characterized by pulmonary edema and hemorrhage, and may be fatal. Signs of lung involvement include increased respiration rate, increased heart rate, and a bluish discoloration of the skin. Coughing, choking, and gagging are often noted at the time of aspiration. Gastrointestinal discomfort may develop, followed by vomiting, with a further risk of aspiration.

CARCINOGENICITY

NTP: No
IARC: No
OSHA: No

IV. EMERGENCY & FIRST AID PROCEDURES

EYE CONTACT

Immediately flush eyes with large amounts of water and continue flushing for 15 minutes. If fluid is hot, treat for thermal burns and take victim to hospital immediately.

SKIN CONTACT

Remove contaminated clothing. If fluid is hot, submerge injured area in cold water. If victim is severely burned, take to a hospital immediately.

INHALATION

Paratherm NF® has a low vapor pressure and is not expected to present

an inhalation hazard at ambient conditions. If vapor or mist is generated when the fluid is heated or handled, remove victim from exposure. If breathing has stopped or is irregular, administer artificial respiration and supply oxygen if it is available. If victim is unconscious, remove to fresh air and seek medical attention. **Do not use compressed oxygen in hydrocarbon atmospheres.**

INGESTION

May act as a laxative. Do not induce vomiting due to possible aspiration. If vomiting occurs, lower head below knees to avoid aspiration. Seek immediate medical attention.

V. PERSONAL HEALTH PROTECTION INFORMATION

EYE PROTECTION

Eye protection is not required under conditions of normal use. If the fluid is handled such that it could be splashed into eyes, wear plastic face shield or splash-proof safety goggles.

SKIN PROTECTION

No skin protection is required for single, short duration exposures. For prolonged or repeated exposures, use impervious synthetic rubber clothing (boots, gloves, aprons, etc.) over parts of the body subject to exposure. If handling hot fluid, use insulated protective clothing (boots, gloves, aprons, etc.)

RESPIRATORY PROTECTION

Respiratory protection is not required under conditions of normal use. If vapor or mist is generated when the fluid is heated or handled, use an

organic vapor respirator with a dust and mist filter. All respirators must be NIOSH certified. **Do not use compressed oxygen in hydrocarbon atmospheres.**

VENTILATION

If vapor or mist is generated when the fluid is heated or handled, adequate ventilation in accordance with good engineering practice must be provided to maintain concentrations below the specified exposure or flammable limits.

OTHER

Consumption of food and beverages should be avoided in work areas where hydrocarbons are present. Always wash hands and face with soap and water before eating, drinking or smoking.

VI. FIRE PROTECTION INFORMATION

FLASH POINT	345°F (174°C)
FLASH POINT	335°F (169°C)
FIRE POINT	385°F (196°C)
AUTOIGNITION TEMPERATURE	690°F (366°C)
AUTOIGNITION TEMPERATURE	691°F (367°C)

TEST METHOD	ASTM D-92 (COC)
TEST METHOD	ASTM D-93 (PMCC)
TEST METHOD	ASTM D-92 (COC)
TEST METHOD	ASTM D-2155
TEST METHOD	ASTM E-659-78

FLAMMABLE LIMITS IN AIR % BY VOL.

LOWER: No data

UPPER: No data

EXTINGUISHING MEDIA

Use dry chemical, foam, water fog, or carbon dioxide.

SPECIAL FIRE FIGHTING PROCEDURES

Water may be ineffective but can be used to cool containers exposed to heat or flame. Caution should be exercised when using water or foam

as frothing may occur, especially if sprayed into containers of hot, burning liquid.

UNUSUAL FIRE AND EXPLOSIVE CONDITIONS

Dense smoke may be generated while burning. Carbon monoxide, carbon dioxide, and other oxides may be generated as products of combustion.

VII. REACTIVITY DATA

STABILITY (THERMAL, LIGHT, ETC.): Stable

HAZARDOUS POLYMERIZATION: Will not occur

CONDITIONS TO AVOID: None

INCOMPATIBILITY (MATERIALS TO AVOID): May react with strong oxidizing agents

HAZARDOUS DECOMPOSITION PRODUCTS: If burned, will produce carbon dioxide and carbon monoxide

VIII. ENVIRONMENTAL PRECAUTIONS

STEPS TO BE TAKEN IF FLUID IS RELEASED OR SPILLED

Consult health effect information in Section III, Personal Health Protection Information in Section V, Fire Protection Information in Section VI, and Reactivity Data in Section VII. Notify appropriate authorities of spill. Contain spill immediately. Do not allow spill to enter sewers or watercourses; remove all sources of ignition. Absorb with appropriate inert materials such as sand, clay, etc. Large spills may be picked up using vacuum pumps, shovels, buckets or other means and placed in drums or other suitable containers.

WASTE DISPOSAL METHOD

All disposals must comply with federal, state and local regulations. The fluid, if spilled or discarded, may be a regulated waste. Refer to state and local regulations. **Caution:** If regulated solvents are used to clean up spilled fluid, the resulting waste mixture may be regulated. Department of Transportation (DOT) regulations may apply for transporting this material when spilled. Waste material may be landfilled or incinerated at an approved facility. Materials should be recycled if possible. This material, as supplied, is not regulated by RCRA as hazardous waste.

IX. MISCELLANEOUS

HANDLING AND STORAGE REQUIREMENTS

Do not transfer to unmarked containers. Store in closed containers away from heat, sparks, open flame, or oxidizing materials. Paratherm NF® is not classified as hazardous under DOT regulations. Fire extinguishers should be kept readily available. See NFPA 30 and OSHA 1910.106—Flammable and combustible liquids.

ADDITIONAL INFORMATION

SARA Title III: Paratherm NF® is not subject to the reporting requirements of section 313 of Title III of the Superfund Amendment & Reauthorization Act of 1986, and 40 C.F.R. part 372.

X. PHYSICAL PROPERTIES

BOILING POINT	646°F, 347°C (10% fraction)
MELTING POINT	Not applicable
APPEARANCE	Clear liquid
ODOR	Odorless
VAPOR PRESSURE	<1 mm Hg @ 70°F
SOLUBILITY	Negligible in water. Soluble in hydrocarbons.

PERCENT VOLATILE	Nil @ Ambient Temperature
VAPOR DENSITY (AIR=1)	>1
EVAPORATION RATE (EE=1)	<1
TYPICAL SPECIFIC GRAVITY	Approx. 0.8734 @ 25/25 C
MOLECULAR WEIGHT	Average Molecular Weight = 350

XI. SHIPPING INFORMATION

Not regulated by D.O.T., no placarding required.

NOTE: We present the information and recommendations in this bulletin in good faith and believe them to be correct, however, Paratherm Corporation makes no representations as to accuracy or completeness. We supply this information on the condition that the user determine suitability of product

for each specific application. We warrant that the heat transfer fluid conforms to the specifications in this bulletin, but make no further warranty, expressed or implied, including the warranties of merchantability or fitness for a particular purpose.

PARTS/DIAGRAMS

- *Spare Parts Lists* PD-1
- *TH-1 Wiring* PD-5
- *TH-2 Wiring* PD-7

TH-1 and TH-2 Thermolators

208-230/460V 9kW & 12kW units
1 HP through 3 HP

PD-2

RECOMMENDED SPARE PARTS

UGH002/0514

RECOMMENDED SPARE PARTS

SPARE PARTS

REPLACEMENT HEATERS	
Part No.	Description
09002018	6 KW 208V/3/60 MS
09001579	6 KW 230/460V/3/60 MS
09002019	12 KW 208V/3/60 MS
09002017	12 KW 230/460V/3/60 MS
25917401	Heater flange gasket
COOLING SOLENOID OVERHAUL KITS	
Part No.	Description
09004614	1/2 inch solenoid overhaul kit, 4.0 CV
09004554	3/4 inch solenoid overhaul kit, 5.0 CV
COOLING SOLENOID VALVES	
Part No.	Description
09002969	1/2 inch solenoid valve, 4.0 CV
09004510V	3/4 inch solenoid valve, 5.0 CV

Description

09002018	6 KW 208V/3/60 MS
09001579	6 KW 230/460V/3/60 MS
09002019	12 KW 208V/3/60 MS
09002017	12 KW 230/460V/3/60 MS
25917401	Heater flange gasket

Part No.	Description
09004614	1/2 inch solenoid overhaul kit, 4.0 CV
09004554	3/4 inch solenoid overhaul kit, 5.0 CV

Description

09004614	1/2 inch solenoid overhaul kit, 4.0 CV
09004554	3/4 inch solenoid overhaul kit, 5.0 CV

Part No.	Description
09002969	1/2 inch solenoid valve, 4.0 CV
09004510V	3/4 inch solenoid valve, 5.0 CV

Description

09002969	1/2 inch solenoid valve, 4.0 CV
09004510V	3/4 inch solenoid valve, 5.0 CV

RECOMMENDED SPARE PARTS

TH-1 and TH-2 Thermolators

208-230/460V, 6kW ,12kW & 18kW units, 1 HP through 3 HP

HEATER CONTACTORS	
Part No.	Description
20004401	Heater contactor for 6kW 208/230/460V
20004401	Heater contactor for 12kW 230/460V
09000417	Heater contactor for 12kW 208V
REPLACEMENT BOARDS for TH-1 , TH-2	
Part No.	Description
09003732	TH1 operator board
09003731	TH1 motherboard
09003735	TH1 flat ribbon cable
09003734	TH2 operator board
09003733	TH2 motherboard
09003737	15 feet coiled control cable - TH-2
02001186PH	30 feet coiled control cable - TH-2
02001187	50 feet coiled control cable - TH-2
PUMP OVERLOADS	
Part No.	Description
20003909	Pump overload for: 1 HP 460V
20003910	Pump overload for: 1 HP 230V and 2 HP 460V
20003911	Pump overload for: 1 HP 208/230V
20003912	Pump overload for: 3 HP 460V
20003913	Pump overload for: 2 HP 208/230V
20003914	Pump overload for: 3 HP 208/230V
PUMP CONTACTORS	
Part No.	Description
20003801	Pump contactor for: 3 HP 208/230/460V
MISCELLANEOUS	
Part No.	Description
11001213	Thermolator transformer
11000400	Thermocouple, standard temp unit, 6 feet
09002602	Process pressure gauge 0-60PSI
09000328	Water pressure relief valve, 150 PSI
09040000	Caster
09000686	Handle
09002254	Level Switch 500 Deg F rated
MANUALS	
Part No.	Description
UGH002/0514	User Guide, Thermolator TH-1 Series
QCH003/1197	Quick Card, Thermolator TH-1
QCH004/1197	Quick Card, Thermolator TH-2

