



\$30.<sup>00</sup>

Operation and Installation Manual

# Royal Series Open Reservoir Water Temperature Control Units

***Important!*** Read Carefully Before Attempting to Install or Operate Equipment



Part No. 682.89515.00

Revision C

Bulletin No. SC1-640.3

Write down your unit serial number(s) \_\_\_\_\_  
here for future reference \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Sterling/Sterlco is committed  
to a continuing program of product improvement.  
Specifications, appearance, and dimensions described in this manual  
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Part No. 682.89515.00	Revision C	Bulletin No. SC1-640.3

# Safety Considerations

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Sterling Royal Series temperature control units are designed to provide safe and reliable operation when installed and operated within design specifications, following national and local safety codes.

To avoid possible personnel injury or equipment damage when installing, operating, or maintaining this equipment, use good judgment and follow these safe practices:

- ☑ Only **PROPERLY TRAINED** personnel familiar with the information within this manual should work on this equipment.
- ☑ Follow all local **SAFETY CODES**.
- ☑ Royal Series cabinets and piping are hot and are a **BURN HAZARD**.
- ☑ Do not operate a Royal Series system without all outer panels installed. Pressurized hot water leaks can cause serious injury.
- ☑ Wear **SAFETY GLASSES** and **WORK GLOVES**.
- ☑ Use care when **LOADING, UNLOADING, RIGGING, or MOVING** this equipment.
- ☑ Operate this equipment within design specifications.
- ☑ **OPEN, TAG, and LOCK ALL DISCONNECTS** before working on equipment. Sterling recommends following OSHA Lock-Out/Tag-Out Standard 29 CFR 1910.147.
- ☑ Make sure the unit is properly **GROUND**ED before switching power on.
- ☑ When welding or brazing in or around this equipment, be sure **VENTILATION** is **ADEQUATE**. **PROTECT** adjacent materials from flame or sparks by shielding with sheet metal. An approved **FIRE EXTINGUISHER** should be close at hand and ready for use if needed.
- ☑ Do not jump or bypass any electrical safety control.
- ☑ Do not restore power until all tools, test equipment, etc. have been removed and the panels replaced.

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## 1-1 Introduction

Sterling/Sterlco Royal Series water temperature control units are reliable, accurate, and easy-to-use process temperature control units. They are self-contained, portable, and shipped ready to use.

The Royal Series water temperature control unit is designed to circulate water through your process and to precisely, automatically, and reliably maintain it at a specified temperature. Standard unit operating range is from 0°F (-17°C) to 180°F (82°C). The unit is suited for use with city water, water from portable or central chillers or towers, or well water.

These units are designed for rapid recirculation of a relatively small amount of water to provide close and uniform temperature relation between delivery and return lines. This performance, of course, depends on the configuration of your process and any restrictions within the process. The recirculation, combined with the large immersion heater and cooling capability, gives fast and accurate response to bring the water up to temperature or to changes in the settings when needed.

The 2600/2700 Series water temperature control unit is a self-contained system consisting of a centrifugal pump, electric immersion heater, heat exchanger, cool solenoid valve, and electrical control, including a PID microprocessor controller and sensing probe. It is designed for use in process temperature control applications using water or a water/corrosion inhibitor mix. Any other use or fluid **is prohibited**.

Some standard safety devices include a mechanical overtemperature safety thermostat, a pressure relief valve, motor overcurrent and overload protection, low level control, and non-fused lockable rotary disconnect.

A properly installed, operated, and maintained Royal Series system provides years of reliable operation. Please read and follow the instructions in this manual to get the most satisfaction from your Royal Series system.

## 1-2 Necessary Documents

The following documents are necessary for the operation, installation, and maintenance of Sterling/Sterlco Royal Series water temperature control units. Additional copies are available from Sterling.

Familiarize the appropriate personnel with these documents:

- This manual.
- The controller operation manual.
- The electrical schematic and connection diagram placed inside the control enclosure.
- The operation and installation manuals for accessories and options selected by the customer.
- The Customer Parts List included in the information packet.

## 1-3 Models Covered

This manual provides operation, installation, and maintenance instructions for the Royal Series water temperature control unit.

Model numbers are listed on the serial tag. A model number followed by **Q** indicates a specially constructed unit, and not all information in this manual may apply. Make sure that you know the model number, serial number, and operating voltage of your temperature control unit if you contact Sterling.

## 1-4 Standard Royal Series Features

- Compact, rugged cabinet with easy-access side panels
- Cast-and-flange design to reduce connection points
- Half- and full-heat automatic switching capability
- Dual stage Incoloy™ immersion heater with IEC contactors
- NEMA 12 electrical enclosure
- M2B microprocessor controller with fuzzy logic; includes diagnostics features with indicator and warning status lights; CE and cUL



- Forward-facing liquid-filled To Process pressure gauges
- Independent high temperature safety thermostat
- Non-fused lockable rotary disconnect
- Integral Motor Circuit Protector
- Transformer fusing
- EPDM/NI-Resist pump seal
- 150 psig (1,034 kPa/10.3 bars) pressure relief valve
- Choice of 230 or 460 operating voltages
- ¾" water supply and drain connections; 1½" process connections
- Automatic water level control
- 3" (76 mm) casters
- Operating range of 0°F to 180°F (-17°C to 82°C)
- One (1) -year parts and labor warranty at the factory; five (5) -year controller warranty

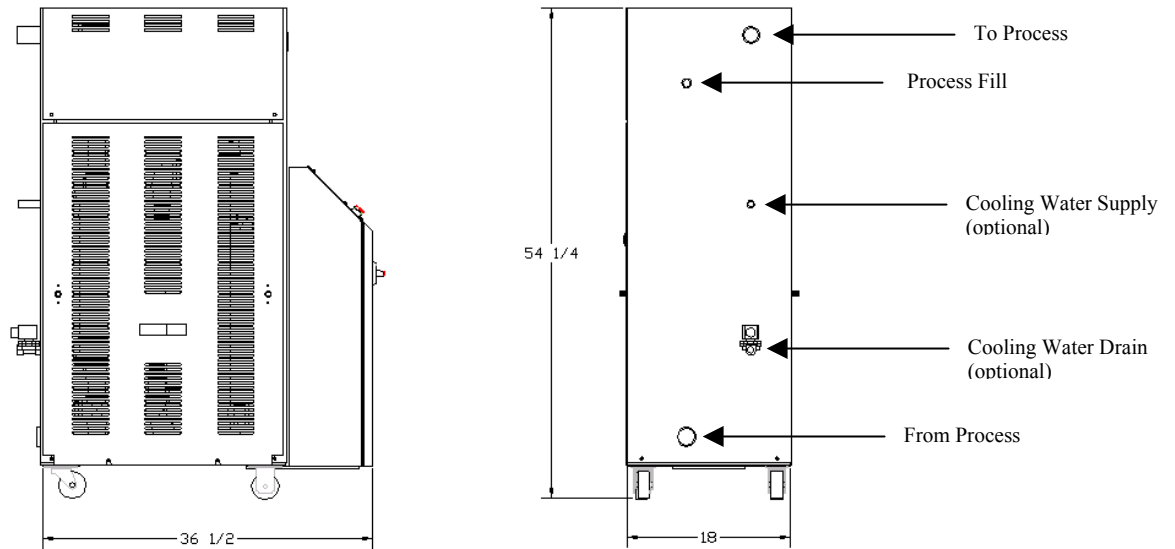
## 1-5 Available Options

Royal Series systems are available with options to tailor the unit to your requirements. Some are factory installed; some can be retro-fitted in the field. Consult your Sterling sales representative for more information. Available Royal Series options include:

- M2B controller with integral flow meter; with:
  - Up to 30 gpm (114 lpm) flow indicator
  - or -
  - 30 to 75 gpm (114 to 284 lpm) flow indicator
  - 0-20 mA and 4-20 mA current control output

- Remote set point and retransmission; 0-20 mA and 4-20 mA
  - RS-232 or RS-485 communications, and RS485 SPI
  - Remote sensor; 10 ft. (3 m)
- Remote controller enclosure
- Heaters available in 12 kW, 18 kW, 24 kW
- Closed-loop heat exchanger available in 3.7, 7.4, 11.2, 18.1, and 27.0 sq. ft. (0.135, 0.688, 1.042, 1.683, and 2.511 sq. m)
- Quick Cool function
- Auto system water purge (process purge)
- Y-strainer
- Hammer arrestor (water hammer shock stop)
- Remote start/stop control
- Rubber feet; available in lieu of casters
- Non-ferrous brass construction
- Slow-close cooling solenoid valves available in 1/2" x 9/16" (C<sub>V</sub> = 3.5) and 3/4" x 3/4" (C<sub>V</sub> = 5.5)
- Modulating valves available in 1/2" (C<sub>V</sub> = 0.4, 1.3, 2.2, or 4.4), 3/4" (C<sub>V</sub> = 5.5 or 7.5), 1" (C<sub>V</sub> = 10 or 14), and 1 1/4" (C<sub>V</sub> = 20)
- Audible and visual general fault alarm
- Electrical operation available in 208, 230, 460, and 575 volts, 60 Hz; 200, 380, and 415 volts, 50 Hz
- UL/cUL-listed electrical subpanel

**Figure 1**  
**Typical Royal Series Open Reservoir Water Temperature Control Unit and Specifications**



Model number	Pump						Dimensions						Shipping weight	
	hp	kW	gpm	lpm	psig	kPa	H		W		D		lbs.	Kg
460 / 230							in.	cm	in.	cm	in.	cm		
2600/2700, 9 kW heater	3/4	0.56	30	114	15	103	54	138	18	46	36.5	93	310/ 340	141/ 155
	1	0.75	35	133	22	152								
	2	1.50	50	189	40	276								
	3	2.25	60	227	45	310								
	5	3.75	75	284	52	359							340/ 370	155/ 168
	7 1/2	5.63	90	341	61	421								

**Figure 2**  
**Royal Series Unit Full-Load Amps**

Model		Full-load amps at 460 volts			
hp	kW	9 kW heater	12 kW heater	18 kW heater	24 kW heater
0.75 hp	0.56 kW	12.7 amps	16.5 amps	24.0 amps	31.6 amps
1.00 hp	0.75 kW	13.1 amps	16.9 amps	24.4 amps	32.0 amps
2.00 hp	1.50 kW	14.7 amps	18.5 amps	26.0 amps	33.6 amps
3.00 hp	2.24 kW	16.1 amps	19.9 amps	27.4 amps	35.0 amps
5.00 hp	3.73 kW	18.9 amps	22.7 amps	30.2 amps	37.8 amps
7.50 hp	5.60 kW	22.3 amps	26.1 amps	33.6 amps	41.2 amps

**-Notes-**

## 2-1 Unpacking and Inspection

You should inspect your Sterling/Sterlco Royal Series temperature control unit for possible shipping damage. If the container and packing materials are in re-usable condition, save them for reshipment if necessary.

Thoroughly check the equipment for any damage that might have occurred in transit, such as broken or loose wiring and components, loose hardware and mounting screws, etc. In case of breakage, damage, shortage, or incorrect shipment, refer to the following sections.

## 2-2 In the Event of Shipping Damages

### Important!

**According to the contract terms and conditions of the Carrier, the responsibility of the Shipper ends at the time and place of shipment.**

- ☑ Notify the transportation company's local agent if you discover damage.
- ☑ Hold the damaged goods and packing material for the examining agent's inspection. **Do not return any goods to Sterling before the transportation company inspection and authorization.**
- ☑ File a claim against the transportation company. Substantiate the claim by referring to the agent's report. A certified copy of our invoice is available upon request. The original Bill of Lading is attached to our original invoice. If the shipment was prepaid, contact Sterling at (414) 354-0970 for a receipted transportation bill.
- ☑ **Advise Sterling regarding your request for assistance and to obtain an RGA (return goods authorization) number.**

## 2-3 If the Shipment is Not Complete

Check the packing list. The apparent shortage may be intentional. Back-ordered items are noted on the packing list. You should have:

- Sterling/Sterlco Royal Series water temperature control unit
- Bill of lading
- Packing list
- Operating and Installation packet
- Electrical schematic and panel layout drawings
- Component instruction manuals

Re-inspect the container and packing material to see if you missed any smaller items during unpacking. Determine that the item was not inadvertently taken from the area before you checked in the shipment. Notify Sterling immediately of the shortage.

## 2-4 If the Shipment is Not Correct

If the shipment is not what you ordered, **contact Sterling immediately**. Include the order number and item. *Hold the items until you receive shipping instructions.*

## 2-5 Returns

### **Important!**

**Do not return any damaged or incorrect items until you receive shipping instructions from Sterling.**

## 2-6 Uncrating Your New Royal Series System

- ☑ Royal Series water temperature control units are shipped fastened to a skid and covered with a cardboard box.
- ☑ Carefully remove the staples on the bottom of the box, lift off the box, and remove the bolts holding the unit to the skid.

### **Caution!**

**Be careful when cutting straps.**

**Straps may spring back and cause injury!**

- ☑ From the side, slip two lifting straps between the skid and temperature control unit. Spread the straps from the center line so it is balanced.
- ☑ Loop the straps over a fork truck fork. Lift slowly and only high enough to clear the skid. Use a pry bar if necessary to remove the skid from the unit.
- ☑ Carefully slide the skid from beneath the unit and lower the unit. Lower slowly. The unit should land on its casters and can be rolled into position.
- ☑ Retain the crating in case reshipment is necessary due to hidden shipping damage.

**- Notes -**



### 3-1 Installation Location Considerations

Royal Series systems are portable and can be installed almost anywhere. As with all equipment installations, follow all applicable codes and regulations.

- ☑ The recommended ambient temperature range for Royal Series installations is from +14°F (-10°C) to a maximum operating ambient temperature of 131°F (55°C). Recommended ambient storage temperature range is from -13°F to 149°F (-25°C to 65°C). If storing the unit below freezing temperatures, make sure the unit has an antifreeze mixture circulated inside.
- ☑ Provide a minimum of twelve inches (12" or about 30 cm) clearance on all sides of the cabinet to allow circulation of cooling air.
- ☑ Locate the unit as close to the process as is practical.

### 3-2 Process Approach Temperature Considerations

If the differential ( $\Delta$ ) between **COOLING WATER IN** and **TO PROCESS** temperatures is less than 10°F (7°C), consult our Sales Department for advice on how to control low approach applications.

### 3-3 External Piping Sizing Considerations

- ☑ All external hose and piping should be adequately sized to assure minimum external pressure drop.
- ☑ Low external piping pressure drop is needed for best operation.

*Note:* Use a backup wrench to support Royal Series system piping when making process piping connections.

**⚠ CAUTION**

**All external valves, fittings, and hoses must be rated at a minimum of 150 psig and 180°F (1,034.25 kPa/10.34 bars and 82°C).**

### 3-4 Piping Considerations for Permanent Installations

Sterling recommends an optional (or customer-installed) strainer on the **COOLING WATER IN** inlet.

Keep restrictions to a minimum by using proper inlet pipe sizing. If the water supply piping is larger than ¾", reduce the size at the unit. The table below contains the pipe sizes that are used in the unit.

Pipe sizes for ¾ hp to 7.5 hp (0.56 kW to 5.59 kW) units	
Location	Size in inches NPT
Process delivery	1½"
Process return	1½"
Water supply	¾"
Drain	- depends on solenoid used -

Common black pipe is recommended for permanent installations. Royal Series water circuit piping is primarily ferrous (iron) and reacts electro-chemically with non-ferrous metallic materials such as copper. Some water contains dissolved minerals that greatly accelerates the reaction between dissimilar metals.

Ferrous piping is recommended to minimize galvanic action. If piping must be copper, use dielectric unions at the unit.

## 3-5 Piping Considerations for High Mobility Installations

Mobile Royal Series systems must use high quality hose rated for **at least** 150 psig and 180°F (1,034.25 kPa/10.34 bars and 82°C).

Quick disconnects may be used for mobility, although **they cause a drop in pressure**. If used, they must be sized carefully to minimize pressure drop. Don't use quick disconnects with check valves *unless absolutely necessary*.

### CAUTION

**Non-relieving quick connect fittings or check valves on the water supply must have a pressure relief piped to the drain.**

***Failure to do so could result in a dangerous over-pressure condition!***

## 3-6 Process Water Considerations

### Raw Water

Water treatment is vital in any piping system. In some cases, raw water may be used in the system without problems; in other cases, it can result in large deposits of scale and corrosion.

Sterling offers a complete line of water treatment equipment. Contact your Sterling sales representative for water testing and treatment options.

### Distilled Water

Non-ferrous (brass, copper, or high-temperature plastic) piping is recommended for distilled water processes.

## Deionized Water

Stainless steel (316 SS minimum) or PVC plastic components must be used with deionized water. Sterling recommends stainless steel because of the temperature constraints with plastic.

## 3-7 Making Process Water Connections

### Closed Circuit/Direct Injection

For both types of systems, the connections are basically the same. On the back of each unit, the connections are labeled appropriately. Connect the **TO PROCESS** hookup to the entrance of the process and the **FROM PROCESS** hookup to the exit of the process. Connect the **PROCESS WATER SUPPLY** to your plant water supply. Connect the **PROCESS WATER DRAIN** line to an open drain, or to the return line of your central water system.

**Make sure you carefully select the connecting lines and connectors between the temperature control unit and the process to suit the needs and requirements of your application.**

**If your unit has a maximum operating temperature of 180°F (82°C), the connecting lines and connectors should have a service rating of at least 180°F (82°C) and 150 psig (1,034.25 kPa/10.34 bars).**

### **TO PROCESS — 1½" NPT**

This is the outlet for the tempered water leading to the process being controlled.

### **FROM PROCESS — 1½" NPT**

Water from the process re-enters the Royal Series system to be tempered and re-circulated back into the process.

## 3-8 Making Cooling Water Connections

### WATER IN — 3/4"

The cooling water supply inlet from a cooling tower, a chiller, or a city water supply.

### Water Out

#### *Size Depends on Solenoid Used*

The cooling water return outlet leading back to the cooling tower, chiller, or drain.

### PRESSURE RELIEF — 3/4"

The pressure relief valve is located inside the cabinetry. This piping reduces the chance of scalding nearby personnel if the relief valve should trip.

## 3-9 Making System Purge Connections

Royal Series systems equipped with the System Purge option have a compressed air inlet marked **MOLD PURGE**. Connect to a clean, dry 100 psig (689.50 kPa/6.90 bars) air line. Install your own shutoff valve to prevent process liquid from backing up into the plant air piping if the compressed air is turned off and the check valve fails. **Don't depend on the solenoid valve to hold water pressure in the temperature control unit.**

Figure 3  
Typical Piping Schematic

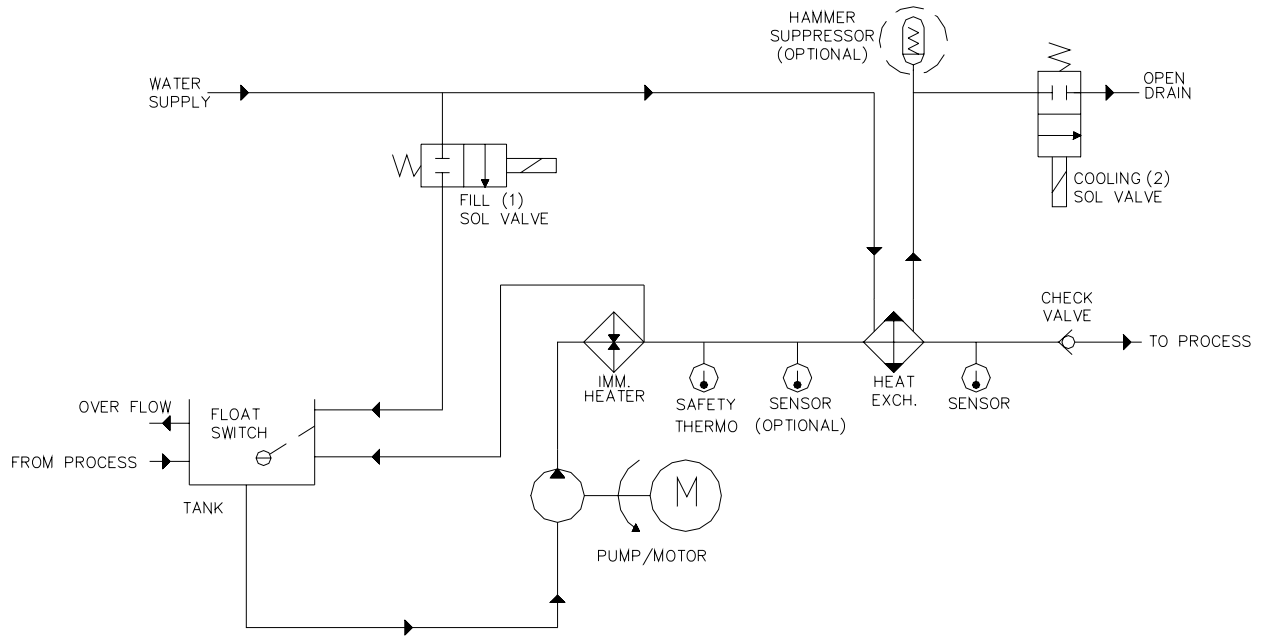


Figure 4  
Pump Curves; 60 Hz

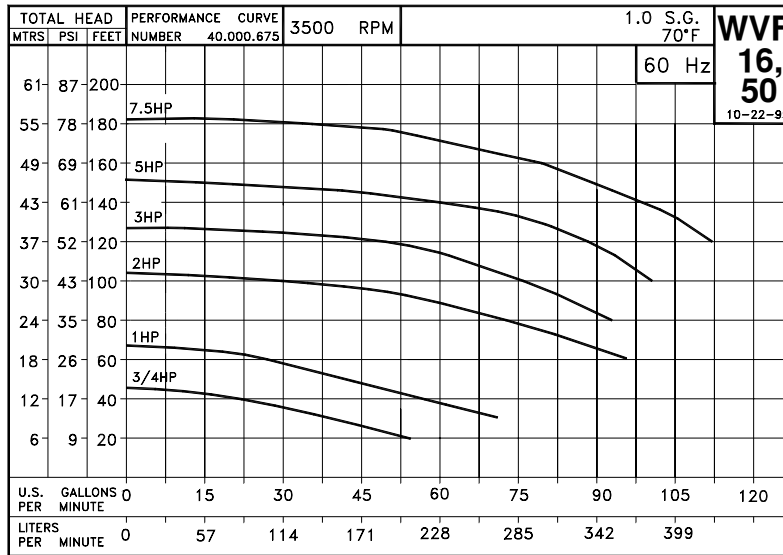


Figure 5  
Pressure Drops

Model		Pressure drop flow and loss				
hp	kW	9 kW htr	flow gpm	flow lpm	loss psi	loss kPa
0.75 hp	0.56 kW	12.7 amps	30	114	0.0 psi	0.0 kPa
1.00 hp	0.75 kW	13.1 amps	35	133	1.0 psi	6.9 kPa
2.00 hp	1.50 kW	14.7 amps	50	190	1.5 psi	10.3 kPa
3.00 hp	2.24 kW	16.1 amps	60	227	2.0 psi	13.8 kPa
5.00 hp	3.73 kW	18.9 amps	75	284	2.5 psi	17.2 kPa
7.50 hp	5.60 kW	22.3 amps	90	341	5.0 psi	34.4 kPa

## 3-10 Making Electrical Connections

Royal Series systems are designed for three-phase voltage operation. Refer to the unit nameplate for proper voltage and amperage requirements.

*Make sure you provide a correctly sized and protected supply of electrical power to the unit.*

### **Important!**

**Refer to National Electric Code (NEC) Article 430-24 through 430-26 for proper feeder conductor and supply disconnect sizing.**

*Maintain a safe ground and disconnect the power supply before servicing the unit. A qualified electrician should make electrical connections, and disconnect and lock out electricity using OSHA 29CFR 1910.147 standards when you need a service call.*

Check serial tag voltage and amperage requirements and make sure your electrical service conforms *before* making any electrical connections. Total running amps for Royal Series systems are listed on the nameplate. Customer connections can be run to the supply terminals from either side of the unit. Make sure that all three phases are wired correctly. If not wired properly, the unit will run *backwards*. **Again, check the unit nameplate for correct voltage and amperage.**

 **DANGER**



**Improper electrical connections can damage the unit and cause serious operator injury or death!**



Bring properly sized power leads and ground from a fused disconnect (installed by your electrician) to the unit. Provide external overcurrent protection to the unit, using circuit breakers or fuses. If you use fuses, make sure that they are dual-element time-delay fuses, sized according to your electrical code. Make sure that **all** electrical connections are *tight*.

**Important!**

- 1. Electrical connections must comply with all applicable electrical codes.**
- 2. The temperature control unit must be grounded in accordance with NEC Article 250.**
- 3. Voltage must be within plus or minus ten percent ( $\pm 10\%$ ) of the nameplate rating.**
- 4. Make sure your installer provides external protection.**

Figure 6  
Typical Electrical Wiring Schematic

**Please Refer to the Electrical Schematics  
Supplied in Your Customer Information Packet.**

**-Notes-**

# **4      *Identifying Controls and Features***

---

## **4-1    Identifying Mechanical Controls and Features**

### **To and From Process Probes**

Two (2) 1,000-ohm (1 K $\Omega$ ) platinum RTD probes are included with your Royal temperature control unit. One is located downstream from the heater to sense To Process temperature; the other probe is located in the tank to sense From Process temperature.

### **Safety Thermostat**

The safety thermostat mounted on the side of the heater tank protects against thermal runaway. The thermostat guards against the unlikely event of “runaway” heating. If overheating occurs, the safety thermostat shuts down heater outputs. The unit continues to pump water through the system to prevent heater damage. Sterling recommends that you install an audible or visual alarm to the terminals provided. Factory installed alarms are available; see the electrical schematics in Your Information Packet for more information.

### **Pressure Relief Valve**

If the system pressure exceeds 150 psig (1,034.25 kPa/10.34 bars), the pressure relief valve opens and relieves the pressure. This is a non-adjustable ASME construction valve with a stainless steel spring.

#### **Important!**

**Route a pipe from the pressure relief valve  
to a suitable drain to reduce potential scalding hazard.**

**The drain line must not have any restrictions or back pressure.**

## Low Level Cutout Switch

This level switch shuts down the unit if the water level in the tank drops below the conductive rod. This shuts down the unit until the high level probe is satisfied.

## Pumps

Pumps range in power from  $\frac{3}{4}$  hp to 7.5 hp (0.56 kW to 5.6 kW) and are equipped with 3-phase ODP motors and seal flush lines as standard.

The pump is a bronze-fitted close-coupled centrifugal type. It features a split case design to facilitate replacement of the seal. It has a high output capacity with excellent discharge pressure helping it facilitate turbulence to maximize heat transfer, and is well suited for the conditions under which it was designed to operate.

## Heaters

The specially designed 9 kW three-phase low watt density electrical immersion heater heats the water, and the controller regulates the temperature. The standard heater has an incolloy sheath for best heat transfer and low fouling properties.

Low watt density immersion heaters at 12 kW, 18, and 24 kW are available options for these models, depending upon the heating needs of the process. All models are built to provide full or partial heat as required by the process and determined by the controller, providing more precise temperature control.

## Solenoid Valves

If the unit is equipped with a heat exchanger for cooling, the solenoid ( $\frac{1}{2}$ " slow-closing type) allows the cooling water to pass through the tubes of the heat exchanger.

## **Water Hammer Arrestor (Shock Stop)**

### **Optional**

Shock waves from fast-operating solenoid valves may damage some process systems. For these applications, a welded metal bellows-type shock stop with a pre-charged and sealed nitrogen blanket can be installed in the cooling piping.

## **Pump Starter**

Royal Series high quality IEC-rated self-protected pump motor combination starters are industrial grade motor controls with overload and short-circuit protection per NEC Article 430-52 and manual reset.

## **Transformer**

High quality industrial design transformers are specified to suit incoming voltage on the application and provide 115 VAC control voltage. The 115 VAC circuit is protected by primary fusing and secondary grounding.

## **Heater Contactor**

Your Royal Series unit uses high-quality IEC-rated industrial-grade electromechanical contactors for heater controls.

## Cooling

The controller automatically regulates cooling by opening and closing the solenoid valve or modulating valve.

For closed circuit operation, the unit cools by automatically releasing cooling water through the tubes of the specially designed tube bundle heat exchanger in each zone. The process fluid is circulated through the shell of the heat exchanger.

*Note:* The plant water supply temperature governs the minimum operating temperature of the unit.

## Electricals

The pump motor and the immersion heater operate on three-phase 50/60 cycle nominal voltages with the control circuit operating at 115V single phase. The control circuit voltage is provided by a single phase machine tool transformer with a grounded secondary.

The 115V control circuit is fuse protected. The pump motor is controlled by a full voltage magnetic non-reversing motor starter, with overcurrent and modular overload protection.

## Level Switches

This unit utilizes three conductive level rods in conjunction with a differential relay to control the water level in the open reservoir. The three levels are low, mid, and high which control the pump, the fill solenoid valve, and the controller operation, respectively.

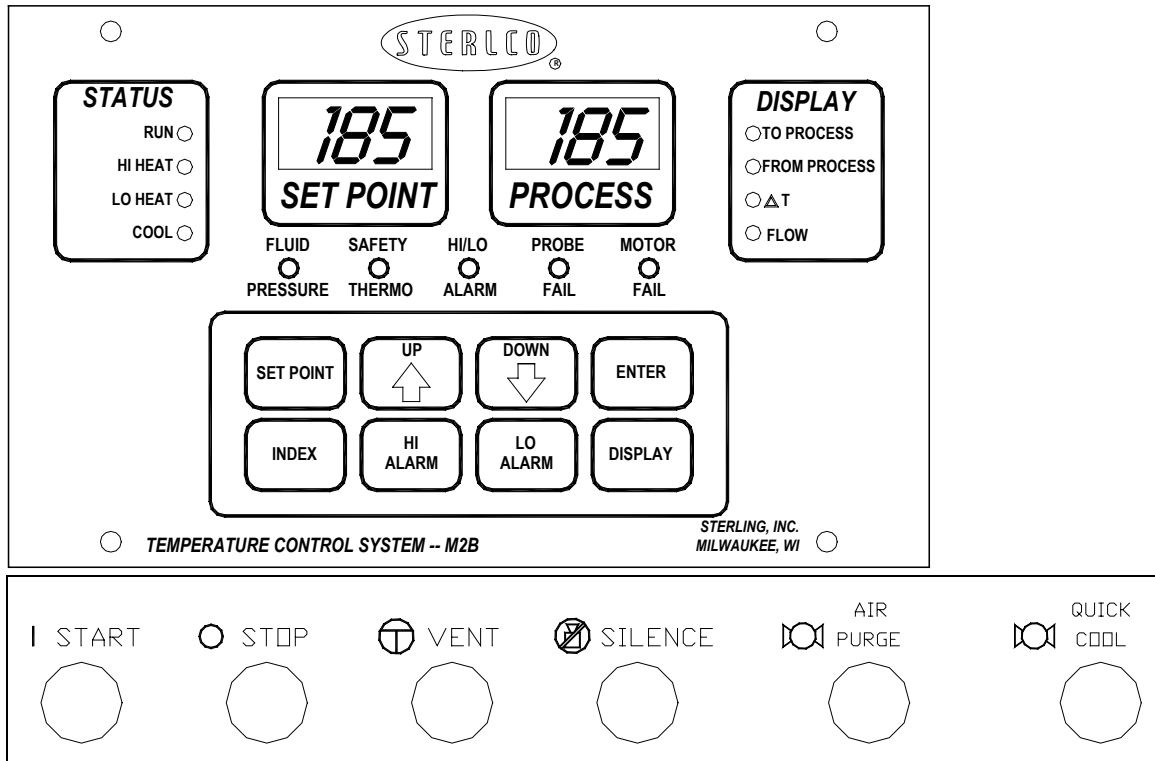
## 4-2 The Microprocessor Controller

The M2B controller is an easy-to-operate microprocessor-based PID control device. When the process reaches the set point, the PID control cycles the cooling valve and/or immersion heater to maintain the proper leaving water temperature.

The controller is fully factory tested. Set the process temperature set point you want and the controller does the rest.

Built-in range of operation on the controller is 0°F to 180°F (-18°C to 82°C).

Figure 7  
Typical M2B Graphic and Button Control Panels



## 4-3 Identifying M2B Controller Panel Components

### Screen Displays

#### SET POINT Numeric LED

During normal operation, the **SET POINT** LED on the controller displays the process set point you want the unit to maintain. It also displays parameter and pre-set function values during setup.

#### PROCESS Numeric LED

During normal operation, the **PROCESS** LED on the controller displays the actual process temperature at the To Process thermocouple. It also lists parameter symbols during setup and error messages if an error occurs.

### Status Indicators

#### RUN Indicator

The **RUN** indicator is on during normal operation and flashes during the auto-tuning sequence.

#### HI HEAT Indicator

The **HI HEAT** indicator is on when fluid heaters are at 100% capacity to rapidly raise fluid temperature.

#### LO HEAT Indicator

The **LO HEAT** indicator is on when fluid heaters are at 50 percent capacity.

#### COOL Indicator

The **COOL** indicator is on when fluid temperature is above the set point and is being cooled.

### Display Indicators

#### TO PROCESS Indicator

The **TO PROCESS** indicator is on when the **PROCESS** LED screen on the controller displays the temperature of the outgoing fluid.



### **FROM PROCESS Indicator**

The **FROM PROCESS** indicator is on when the **PROCESS** LED screen on the controller displays the temperature of the incoming fluid.

### **$\Delta T$ Indicator**

The  **$\Delta T$**  indicator is on when the **PROCESS** LED screen on the controller displays the difference in temperature between outgoing Delivery fluid and incoming Return fluid.

### **FLOW Indicator**

The **FLOW** indicator is on when the **PROCESS** LED screen on the controller displays the flow of fluid in liters per minute; this function requires the optional flow sensor.

## **Alarm Indicators**

### **FLUID PRESSURE Indicator**

The **FLUID PRESSURE** indicator goes on when fluid pressure is low. The TCU shuts down and resumes operation only when a proper level of fluid pressure is restored. (Available only on water units with pressure switches.)

### **SAFETY THERMO Indicator**

The **SAFETY THERMO** indicator is on when an over-temperature condition occurs. The heater outputs are then disabled, the pump continues to operate, and the **COOL** solenoid energizes. This is a **fatal fault condition**, requiring that main power be disconnected to reset the M2B controller.

### **HI/LO ALARM Indicator**

The **HI/LO ALARM** indicator is on when an individually-set alarm condition occurs. The **HI** deviation is +200°F (about +93°C) above the set point. The **LO** deviation is -100°F (about -37°C) below the set point. **Alarms reset automatically.**

### **PROBE FAIL Indicator**

The **PROBE FAIL** indicator is on when a temperature sensing probe fails. A delivery probe failure displays **DEL** on the screen, and a return probe failure displays **RET** on the screen. The alarm resets after the failed probe is replaced.

## MOTOR FAIL Indicator


The **MOTOR FAIL** indicator is on during improper pump rotation, motor out of phase, or thermal motor overload conditions. This is a **fatal fault condition**, requiring that main power be disconnected to reset the M2B controller.

## 4-4 Using M2B Controller Keys




### SET POINT Key

Press and hold the  **SET POINT** key, then press the 

**UP Arrow** key to increase the set point value or press the  **DOWN Arrow** key to decrease the set point value displayed on the **SET POINT** LED screen.




### UP Arrow Key

Press the  **UP Arrow** key to increment or advance the values or settings on the LED screens.



### DOWN Arrow Key

Press the  **DOWN Arrow** key to decrement or reduce the values or settings on the LED screens.



### Important!

**Do not change any of the control settings  
without consulting the Sterling/Sterlco Service Department.**

***The Sterling warranty does not cover TCU failures  
from tampering with controller settings!***



### ENTER Key

The  **ENTER** key is used with the  **INDEX** key menu to store the value or the item that was changed. If this key is not pressed, the previously-stored value or item is retained.



### INDEX Key



Each press of the **INDEX** key advances the screen to the next menu item. Refer to your Sterling/Sterlco M2B Temperature Control Owner's Manual for a list of functions available using this key.



### HI ALARM Key



Press and hold the **HI ALARM** key, then press the **UP Arrow** key to increase the alarm high limit value or press the



**DOWN Arrow** key to decrease the alarm high limit value on the **SET POINT LED** screen. Refer to your Sterling/Sterlco M2B Temperature Control Owner's Manual for a list of functions available using this key.



### LO ALARM Key



Press and hold the **LO ALARM** key, then press the **UP Arrow** key to increase the alarm low limit value or press the



**DOWN Arrow** key to decrease the alarm low limit value on the **SET POINT LED** screen. Refer to your Sterling/Sterlco M2B Temperature Control Owner's Manual for a list of functions available using this key.



### DISPLAY Key



Press the **DISPLAY** key to advance through the display menu. Each key press increments to the next available function. The screen returns to delivery temperature after thirty (30) seconds of inactivity. Refer to your Sterling/Sterlco M2B Temperature Control Owner's Manual for a list of menus available using this key.

## Digital Flow Screen

### Optional

The optional digital flow screen displays process flow in gallons per minute (gpm). No customer-usable control is necessary. Depending on option level and setup, flows can be measured at rates reaching and exceeding 75 gallons per minute (284 lpm).

## 4-5 Using Graphic Panel Buttons

### Figure 7

#### START Button

Push the **START** button to energize the unit and begin the temperature control cycle.

#### STOP Button

Push the **STOP** button to de-energize the unit and stop the temperature control cycle.



#### ALARM SILENCE Button

##### Optional

Push the **ALARM SILENCE** button to silence the alarm. You should investigate the alarm condition and restore the unit to normal operation before continuing with the temperature control cycle.

#### AIR PURGE

##### Optional

Press the  **UP Arrow** key and the  **DOWN Arrow** key on the M2B controller to purge the system of air. The **PURGE VALVE ON** indicator lights during the air purge cycle.

#### QUICK COOL Button

##### Optional

Press the **QUICK COOL** button to open the cooling valve and quickly cool the process.

## LOCAL/REMOTE Switch

### Optional

Press the **LOCAL/REMOTE** switch to toggle between local and remote temperature sensor probe operation.

## 4-6 Alarms

### Audible/Visual General Fault Alarm

#### Optional

The audible/visual general fault alarm sounds if any fault triggers, such as low water pressure, over-temperature, or pump overload. A signal from any of the safety devices activates a horn and flashing strobe.

- Push the **ALARM SILENCE** button to silence the alarm.

The mechanical high temperature safety alarm is interlocked with the heater. When triggered, the heater cuts out and the pump continues to run.

## 4-7 Controller Factory Setup

The controller is set up and tested at the factory for optimum operation, and doesn't need to be adjusted. If the controller does not work properly, or you suspect someone has accidentally changed some settings, you can do two things. First, perform the Auto-Tune Procedure described in the following section. If that doesn't work, restore the controller to the original factory settings as described in your Sterling/Sterlco M2B Temperature Control Owner's Manual.



## 4-8 Auto-Tuning the M2B Controller

The Auto-Tune function lets you fine-tune the M2B controller to process requirements. Activate the Auto-Tune function whenever the process under control changes. The controller automatically evaluates the process, and selects the **P**, **I**, **D**, and fuzzy logic values. It's best to do auto-tuning *before* you run any product.

For best results, start this procedure with a stabilized process temperature, with no rapid rises or drops in temperature.


To auto-tune the M2B controller:



- Switch on the controller.

- Press and hold the  **SET POINT** key, then press the  **UP Arrow** key to **increase** the set point value

- or -

- Press and hold the  **SET POINT** key, then press the  **DOWN Arrow** key to *decrease* the set point value.

- Repeatedly press the  **INDEX** key until the screen displays the *TUN* message.

- Press the  **UP Arrow** key or the  **DOWN Arrow** key until the screen displays the *SLF* message.

- Press the  **ENTER** key.





The Auto-Tune cycle executes.

The **RUN** indicator flashes during the Auto-Tune cycle.

Do not attempt to reprogram the M2B controller or press any keys while the **RUN** indicator flashes during the Auto-Tune cycle. Doing so cancels the Auto-Tune cycle.

## 4-9 Operating the Unit with the Controller

To change the process temperature set point:

- Press and hold the  **SET POINT** key, then press the  **UP Arrow** key to increase the set point value of the temperature you want.
- Press and hold the  **SET POINT** key, then press the  **DOWN Arrow** key to decrease the set point value of the temperature you want.

The set point automatically updates.

## 4-10 Communications

A connection port on the electrical cabinet permits easy hook-up to the host computer for RS-232C and RS-485 communications. The connection port is a direct pin-to-pin extension from the back of the controller. For pin outs, consult the Sterling/Sterlco M2B Temperature Control Owner's Manual.

**-Notes-**



## 5-1 Introduction

The checklist below outlines start-up procedures for Royal Series water temperature control units. This list assumes that installation information located in this manual has been read and followed.

## 5-2 Startup Checklist

- ☑ Check the shipping papers against the serial tag to make sure that system size, type, and voltage is correct for the process under control.
- ☑ Check the transformer primary voltage connections to be sure they are configured for the electrical power you are using. The voltage at the main power connection must be within plus or minus ten percent ( $\pm 10\%$ ) of the voltage listed on the serial tag. Electrical connections must conform to all applicable codes. Make sure that a qualified electrician checks all electrical connections.
- ☑ The safety thermostat is preset at the factory to 180°F (82°C). It trips at 195°F (91°C).
- ☑ The relief valve should be piped to an open, unrestricted drain.
- ☑ **TO PROCESS, FROM PROCESS, WATER IN, WATER OUT, and MOLD PURGE** connections should be complete.




### CAUTION

**Only use components rated at a minimum of 150 psig and 180°F (1,034.25 kPa/10.34 bars and 82°C).**

- ☑ **All outer panels must be in place.**
- ☑ All external process valving should be set for proper operation of the unit.

- ☑ Connect the main power to the unit disconnect switch, and press the **START** switch to check for proper pump rotation direction as described in Section 5-6 on Page 45. Pump rotation should be clockwise, viewed from the **motor** end.
- ☑ Check your work and proceed to the **Startup Procedure** section on the following page.

## 5-3 Starting the Temperature Control Unit

- ☑ Turn **ON** the water supply, turn the rotary disconnect to the **ON** position, and press the **START** switch.
- ☑ The fill solenoid will automatically energize, filling the reservoir tank until the High Level Probe is satisfied.
- ☑ After the tank is filled, the motor and heater circuitry will be enabled, permitting the unit to operate. During normal operation, water level will be maintained via the fill solenoid. The fill solenoid will open when the water level falls below the Mid Level Probe and close when High Level is reached.
- ☑ If for any reason the water level falls below the Low Level Probe the unit will not restart until the High Level Probe is satisfied. The tank will fill automatically via the fill solenoid.
- ☑ Set the microprocessor controller to the process temperature you want by pressing and holding the  **SET POINT** key, then pressing the  **UP Arrow** key or the  **DOWN Arrow** key until the **SET POINT** screen displays the set point temperature you want.
- ☑ Before your process reaches the set point temperature, then auto-tune the controller. See Section 4-8 on Pages 38-39 for more information.
- ☑ Operate the unit, checking for anything unusual that could indicate improper operation.





**Note:** You can stop the Royal Series temperature control unit at any time by pressing the **STOP** button.

## CAUTION

- 1) Your Royal Series system operates with hot water under pressure. To reduce the risk of scalding:
  - Always wear work gloves and safety glasses when operating the unit.
  - Never operate the unit with panels or shields removed.
  - Pipe the relief valve to an open drain.
  - Never install a fitting or hose that is rated less than 150 psig and 180°F (1,034.25 kPa/10.34 bars and 82°C).
- 2) To reduce the risk of electrical shock:
  - All electrical installation and repairs should be done by a qualified electrician.
  - Ground the unit in accordance with electrical codes.
  - Never attempt any repairs without first opening and locking out the main disconnect.
  - Never deactivate or neutralize any safety device.

## 5-4 Operating the Unit with the M2B Controller

To change the process temperature set point:

- Press and hold the  **SET POINT** key, then press the  **UP Arrow** key to **increase** the set point value of the temperature you want.
- Press and hold the  **SET POINT** key, then press the  **DOWN Arrow** key to *decrease* the set point value of the temperature you want.

The set point automatically updates.

## 5-5 Sequence of Operation

The simplicity of design and the highly engineered controller make this unit almost self-operating. The **START** and **STOP** buttons and the temperature controller buttons are all that is required to operate this unit.

After you complete all connections, turn the water supply **ON**, then turn control power **ON**. The unit automatically fills the reservoir tank.

As the water comes in the reservoir tank, the water must enter the pump, up through the tank and out through the **TO PROCESS** line, through the process, and back through the **FROM PROCESS** line to the reservoir tank.

- ☑ TCU systems provide temperature control on processes by directly heating the process water and injecting cooling water into the heat exchanger (if option was selected).
- ☑ When the unit is energized, reservoir will be filled through the auto-fill solenoid valve.
- ☑ After filling, the microprocessor controller monitors the **TO PROCESS** RTD probe, cycling open the cooling valve on the optional heat exchanger or energizing the immersion heater to maintain the process set temperature.

## 5-6 Checking Motor Rotation Direction

Check for correct pump rotation direction by looking at the top of the motor. Press the **START** button and the **STOP** button, and note the direction that the motor turns. Rotation should be **clockwise** when viewed from the motor end.

*Note:* Make sure that a qualified electrician performs the following steps.

To change rotation direction:

1. Disconnect and lock out power at the fused disconnect.
2. Reverse any two incoming leads at the power terminal blocks.
3. Do not switch leads at the motor or motor starters.

## 5-7 Shutting Down the Temperature Control Unit

Cool the unit down by selecting a set point of zero (0). Let the unit stabilize at one temperature close to the incoming water temperature, then press the **STOP** button. Now rotate the disconnect switch to the **OFF** position.

**- Notes -**

## ⚠ CAUTION



Never attempt to service a unit until a qualified electrician has opened and locked out the main disconnect using OSHA 1910.147 standards.

The water supply should be turned off and internal pressure should be relieved before you remove panels.

All electrical connections must be done by a qualified electrician.

## ⚠ WARNING



Disconnect all power to the unit, let the unit cool down, and turn off the water *prior to any servicing*.

*Failure to do so can result in SERIOUS INJURY OR DEATH!*

## 6-1 Preventive Maintenance

### Draining

Drain the unit thoroughly if you are taking it out of service for a long period of time, or you expose it to freezing. Drain plugs are provided at the base of the heater tank and at the base of the pump.

## Periodic Checks

### Every Six Months

Inspect all electrical connections for secure attachment and for safe and secure ground connections. Inspect the power cable, especially at the entrance point to the unit. Also inspect the heater contactors for loose wire connections and unusual wear or debris, as this may be a sign of premature failure. This inspection should be made by a qualified electrician. Check for leaks, especially under the pump, as it may indicate a worn pump seal.

## 6-2 Corrective Maintenance

### Pumps and Seals

Before leaving our factory, we test each unit extensively, then we calibrate each unit. Afterwards, the unit is drained and blown out with air to remove water from piping systems. If the unit is allowed to stand idle for a long time before being installed in your factory, the housing gasket at the pump can dry out and can possibly leak when the unit is started. In most cases these gaskets will soon swell and form a tight seal. In other cases, it may be necessary for you to tighten the pump bolts to stop a leaking condition.

Pump seal surfaces can separate slightly because of rough handling or from vibration during transit. This could cause a leak at the pump seal when the pump is started, but in most cases the surfaces will mate again after the pump is allowed to run for a short period of time. If they do not reseal, you may need to open the pump and free the seal by hand. It is seldom necessary to install a replacement seal in a new unit unless the seal has been damaged because the unit was started without water.

Our pump seals have a long period of service life. Some conditions, of course, can shorten seal life, including the presence of grit, operation of the unit without water, sustained high water temperature, or presence of certain chemicals in the water. Our pump seal assembly has been developed to resist abrasive particles that are present in many water systems. This is done by a special flushing system that uses water exiting the pump to constantly wash the seal area.



It is also fitted with high temperature flexible components for maximum heat resistance. These same components remain flexible even at low temperatures. Thus, the standard seal is a fine combination of heat resistant and wear resistant components. Unfortunately, even under normal use, the seal will eventually wear and require replacement.

A small puddle underneath the unit is a sign of rotary seal wear, and if investigation confirms the pump as the source, the seal should be replaced as soon as practical. The water slinger is intended to provide temporary protection against this, but a continued and substantial leak will ruin the motor bearing and cause further damage.

After the unit has been in service for a period of years where abrasive conditions are present, you may find that the pump bracket (the top half of the pump casting), can be eroded away in the area around the seat of the rotary seal. This area should provide a straight, smooth bearing surface for the cup seal. Should your casting show signs of erosion in this area, the casting needs to be replaced. The replacement cost of the casting is very modest compared to the down time and maintenance cost for frequently replacing the seal.

Under some conditions, the pump may not start. After turning off the power supply, check the motor shaft to be certain it is free to turn. By removing the drip cover on top of the motor, you'll have access to the end of the shaft. It has been slotted to make it easy to turn with a screwdriver. If the shaft is free to turn, next check that the motor overloads are set, check for blown fuses, and finally check the power supply on each leg to the motor. A qualified electrician should check the motor and its circuit.

### **Important!**

**If the pump motor wiring is disconnected for removal from the unit, make sure that you check the actual rotation direction when the motor is rewired to the unit.**

**A phase sensor does not always indicate proper rotation if motor wire leads are reversed at installation.**

**Consult the elementary wiring diagram for more information.**

## Heaters

Heaters may need to be cleaned chemically or mechanically to remove deposits and dirt that reduce heat transfer and cause hot spots. Hot spots cause premature heater failure. Install a new gasket when reassembling. Make sure a qualified electrician disconnects and reconnects heater wires.

## Solenoid Valves

- ☑ Clean annually, more often if using high mineral content water or on high service level units.
- ☑ Sluggish operation, excessive leakage, and/or noise indicate cleaning is necessary. Inspect the components for excessive wear while the valve is disassembled.
- ☑ Rebuild kits are available from the Sterling Parts Department.

## 6-3 Restoring the Controller to Factory Setup

If the preset parameters on the controller have been tampered with and it no longer properly controls temperature, you can restore the controller to factory setup parameters. For more information on controller restoration, consult the Sterling/Sterlco M2B Temperature Control Owner's Manual.

## 6-4 Electrical Connections

Make sure that a qualified electrician inspects all electrical components and connections every six (6) months for secure attachment and ground connections. Inspect all wiring for fraying or damage, especially power lines where they enter the unit. **All wiring connections must be *tight*.**

## 6-5 Safety Devices

### Caution!

**Make sure that only qualified electricians test safety devices!**

Safety devices should be tested for function **every six (6) months**. Perform the following procedures for testing:

### Motor Overload

Turn off the door disconnect switch to disconnect main power. Open the electrical enclosure and depress the manual **TEST** button on the circuit protector. Close the enclosure and turn on the disconnect. Push the **START** button. The unit should **not** start and the **Pump Overload** indicator should illuminate.

Turn the **RESET** switch. The unit is now ready for operation.

### CAUTION



**HAZARDOUS ELECTRICAL CURRENT PRESENT.**

**Maintain a safe ground and disconnect the power supply before servicing the unit.**

**Make sure a qualified electrician makes electrical connections; disconnect/lock out electricity using OSHA 20CFR 1910.147 standards when servicing the unit.**

## Safety Thermostat

Disconnect main power. Open the electrical enclosure and disconnect the neutral lead on the safety thermostat from the terminal strip. Protect the stripped lead to prevent short circuits. Close the enclosure, reconnect main power, and push the **START** button. The heater should **not** turn on and the **Over Temperature** indicator should illuminate. **Disconnect main power before reconnecting the thermostat lead.**

## 6-6 Cleaning and Storage

- **Inspect the unit daily for leaks.** Wipe down the unit periodically to remove dirt and dust buildup, especially the motor casing.
- Drain and flush the unit every six (6) months to remove sediment buildup.
- Completely drain the unit and **carefully** blow out the piping with pressurized air before placing the unit in storage.

<b>Condition</b>	<b>Possible cause</b>	<b>Solution</b>
Unit does not turn on.	No power.	Check main disconnect, fuses, wiring, and power lead to unit.
	Wrong voltage supplied to unit.	Voltage must be within plus or minus 10% of nameplate rating.
	Defective on/off switch.	Replace.
	Control circuit fuse blown.	Replace.
	Defective control transformer.	Check transformer.
Unit does not run.	Broken or loose wire in pump motor control circuit.	Locate and repair.
	Pump motor contactor holding coil is open.	Repair or replace.
	Pump overload light on.	Reset and test each leg for balanced amp draws.
	Low water level in tank.	Check water connection to fill solenoid valve. Check reference and low-level probes both at tank and at the associated relay on panel.
Low pump pressure.	Pump running in reverse.	Verify proper rotation. If not clockwise, reverse any two incoming power leads.
	Foreign matter in the system.	Clean the system.
	System has minimal back pressure, and is operating at the far end of the pump curve.	As long as there is satisfactory process temperature control there is no problem.
High pump pressure.	Foreign matter obstructing system.	Clean the system.
	Restricted water flow.	Check for closed valves etc. Be sure all lines are properly sized.
	System has high back pressure, and is operating at the near end of the pump curve; a low flow condition.	As long as there is satisfactory process temperature control there is no problem.

Condition	Possible cause	Solution
Temperature fluctuations/ rapid cycling from hot to cold.	Undersized connectors/ water lines.	Increase size of connectors/ water lines.
	Long connecting lines between unit and process.	Move the unit closer to the process and shorten connecting lines.
	Serpentine flow through process.	Connect lines for parallel flow instead of series flow.
	Blocked water line in process.	Check process for metal chips or lime buildup. Clean process.
	Quick disconnect fitting with check valve.	Remove and replace fitting or valve.
	Lime buildup in unit piping.	Clean or replace.
	Faulty TCU.	Check unit by connecting 3/4" line directly from delivery to return line. Run unit to determine if TCU controls set point temperature.
	Reversed probes.	Switch delivery and return probes.
Unit overheats or does not cool.	Drain is plugged or excessive back pressure is in drain line.	Clear drain line or eliminate back pressure condition.
	Faulty solenoid valve.	Test solenoid valve by pressing <b>VENT</b> button and listen for valve operation. Replace if faulty.
	Controller Cool output relay open.	Replace output relay.
	Solenoid valve is not operating, but <b>COOL</b> LED is on.	Set process temperature to minimum and check for magnetism on solenoid coil top.
	Solenoid coil circuit is open.	Check coil resistance. If MΩ range, replace solenoid coil.
	Modulating valve is not operating, but <b>OUT2</b> LED is on.	Set process temperature to minimum and check for complete travel of valve.
	Insufficient pressure differential between cooling <b>WATER IN</b> and <b>OUT</b> lines.	Find a means to get less back pressure in the <b>WATER OUT</b> line.
	Cooling valve is undersize.	Replace cooling valve with a larger valve.
	Heater contactor(s) welded closed.	Replace Contactors.
Relief valve leaks.	Foreign material under valve seat.	Manually open valve to clear seat of material.
	High system pressure.	Reduce <b>WATER IN</b> or <b>MAKEUP</b> water pressure.
Unit runs continuously cooling or heating, and cannot attain set point.	Unit under-sized for application.	Call sales representative.

Condition	Possible cause	Solution
Unit does not heat/cannot achieve set point.	Defective heater contactor.	Visually inspect coil and contacts; repair/replace defective contactors.
	Defective immersion heater.	Check resistance on all three (3) legs of the heater with an ohm meter. If not all equal, contact factory for replacement heater.
	Controller heat output open.	Check the heater output with an ohm meter to ground. It should read in the mega-ohm range. Infinite or zero readings indicate a defective output.
	Heater contactor is not energizing, but <b>HEAT</b> LED is on.	Set process temperature to maximum and check for control voltage at heater contactor.
	Immersion heater elements dirty.	Remove heater and clean elements.
	Immersion heater element is burned out.	Check heater tank for scorched/discolored paint. Check resistance on all three (3) legs of the heater with an ohm meter. Replace heater as required.
		Check for balanced amp draws, and supply voltage. If not present replace immersion heater.
	<b>OUT1</b> indicator is on, but no voltage on heater contact.	Replace relay board on controller.
	Cooling valve is leaking.	Dismantle valve and clean out.
	Solenoid valve is not operating, but <b>COOL</b> LED is on.	Set process temperature to minimum and check for magnetism on top of solenoid coil.
Magnetism on coil.	Clean coil.	
Faulty/dirty solenoid valve.	Press <b>VENT</b> button several times to flush the valve.	







- △T indicator, 31
- Air Purge button, 34
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**Sterling** warrants all equipment manufactured by it to be free from defects in workmanship and material when used under recommended conditions. The Company's obligation is limited to repair or replace FOB the factory any parts that are returned prepaid within one (1) year of equipment shipment to the original purchaser, and which, in the Company's opinion, are defective. Any replacement part assumes the unused portion of this warranty. Your Sterling unit is also provided with a five (5) year controller warranty.

This warranty does not apply to any equipment which, in the Company's opinion, has been subjected to misuse, negligence, or operation in excess of recommended limits or which has been repaired or altered without the Company's express authorization. If the serial number has been defaced or removed from the component, the warranty on that component is void. Defective parts become the property of the warrantor and are to be returned.

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