

## Operators Manual

### Circulating Bath with Digital Controller



# Table of Contents

## Section 1 - General Information

- 1.1 Unpacking
- 1.2 Contents
- 1.3 General Description
- 1.4 Circulator Pump
- 1.5 Pump Inlet and Outlet Connections
- 1.6 Closed Loop Circulation
- 1.7 Reservoir Purge
- 1.8 Ambient and Cooling Coil

## Section 2 - Standard Controller Information

- 2.1 Front and Rear Panels
- 2.2 Heater/Pump Assembly

## Section 3 - Operation

- 3.1 Circulator Location
- 3.2 Filling the Reservoir
- 3.3 Power
- 3.4 Setting the Safety Set Point
- 3.5 Selecting Temperature Units
- 3.6 Setting the High Limit
- 3.7 Setting the Set Point Temperature
- 3.8 User-Defined Preset Temperatures
- 3.9 Local Lockout Feature
- 3.10 Stick-on Strips for Preset Buttons
- 3.11 Auto-Refrigeration Operation
- 3.12 Controller Display Messages

## Section 4 - Calibration and Maintenance

- 4.1 Calibration
- 4.2 Heater
- 4.3 Pump Motor
- 4.4 Cleaning
- 4.5 Maintaining Clear Bath Water
- 4.6 Condenser, Air Vents, and Reusable Filter  
(Refrigerating/Heating Circulators Only)

## Section 5 - Troubleshooting

- 5.1 Unit Will Not Operate (no heat, cooling, or pumping)
- 5.2 No Pumping
- 5.3 Slow or Insufficient Pumping
- 5.4 No Heating
- 5.5 Insufficient Heating
- 5.6 No Cooling or Insufficient Cooling
- 5.7 Triac Failure

## Section 6 - Reservoir Fluids

## Section 7 - Service and Technical Support

- 7.1 Replacement Parts

## Section 8 - After-sale Support

## Section 9 - Warranty

## Section 10 - EC Declaration of Conformity



This symbol marks chapters and sections of this instruction manual which are particularly relevant to safety. When attached to the unit, this symbol draws attention to the relevant section of the instruction manual.



This symbol indicates that hazardous voltages may be present.

Read all instructions pertaining to safety, set-up, and operation.  
Proper operation is the users' responsibility.

## Section 1 - General Information

### 1.1 Unpacking

Your circulator is shipped in a special carton. Retain the carton and all packing materials until the unit is completely assembled and working properly. Set up and run the unit immediately to confirm proper operation. Beyond one week, your unit may be warranty repaired, but not replaced. If the unit is damaged or does not operate properly, contact the transportation company, file a damage claim and immediately contact the company where your unit was purchased.

Remove any loose packing material that may have fallen into the reservoir during shipping. Before powering up, check that nothing remains around the heater or circulator pump.

The instructions in this manual pertain to circulating baths, both refrigerated and cooling coil types. Read the section pertaining to the special instructions for your model.

### 1.2 Contents

Circulator Bath	TC-102D	TC-202D	TC-502D	TC-602D
Operators Manual, warranty card	110-241			
3/16 in., 1/4 in., and 3/8 in. Nylon Barbed Tubing Adapters	510-011			
6 ft. of 1/4 in. ID Latex Tubing	HT-Tubing			
Adapter Fittings*	1/4 in. NPT – M16, Male (qty 2)			
Beaker Platform(s) for Bath Reservoir				
— 600 ml	701-402	701-402 (qty 2)	701-402	701-402
— 1000ml		701-403		
Deck Lid(s)				
— Solid	510-209		510-290	510-246
— w/Beaker Holes	510-211	510-210	510-293	
Blue Hole Plugs				
— 3-1/2 inch	TBPS300-295	TBPS300-295 (qty 2)	TBPS300-295	
— 4-1/4 inch		TBPS300-296		
<b>Note: Do NOT Use Above 120°C</b>				
Stick-on Strips for Preset Buttons	(qty 2)			
IEC Power Cord	(qty 1)			
<p>Note: Work area "opening" is designed to measure samples directly in the bath. If additional viscometer height is required (spindle/guard clearance), either a 4 inch rod extension (part number BLM-4E) used with type A lab stand or an 18 inch rod replacement (part number VS-38) used with type S lab stand are available from Brookfield or an authorized dealer.</p> <p>*Included with 50Hz Models only.</p>				

### 1.3 General Description

Refrigerating/Heating and Heat Only Circulating Baths with the Digital Controller are designed for use as stand-alone baths or to provide precise temperature control of fluids for closed loop circulation to external equipment.

All Circulating Bath models feature a reservoir which may be used for immersing samples while the unit is connected to an external device. Circulating bath models are equipped with either 6 or 10 liter reservoirs. All wetted parts are corrosion resistant 300 series stainless steel.

Refrigeration is normally required for operation at temperatures below 40°C. However, refrigeration should not be used when the fluid temperature is above 55°C. Refrigeration should not be turned on when the ambient air temperature is above 32°C.

Model Specifications	TC-102D	TC-202D	TC-502D	TC-602D
Temperature Range	Ambient +5° to 150°C	Ambient +5° to 150°C	-20° to 150°C	-20° to 150°C
Temperature Stability	± 0.05°C			
Readout Accuracy	± 0.5°C			
Heater	1100 Watts for 115V models, 1600 Watts for 240V models			
Reservoir Volumes	6 liters	10 liters	6 liters	6 liters
Pump Speeds	2-speed - 9 liters per minute or 15 liters per minute			
Over-Temp Protection	Yes, user-adjustable			
Dimensions l x w x h	14¼ x 8¼ x 14 in. 37.5 x 13.3 x 35.6 cm	13¼ x 14¼ x 13¼ in. 33.7 x 36.2 x 33.7 cm	15¼ x 18¼ x 17 in. 40 x 47.6 x 43.2 cm	15¼ x 8¼ x 22½ in. 40 x 21 x 57.1
Unit Weights	22 lbs (10.0 kg)	28 lbs (12.7 kg)	63 lbs (28.6 kg)	62 lbs (28 kg)
Power Requirement 60Hz	9A @ 115V / 1 / 60Hz (105V - 125V)	9A @ 115V / 1 / 60Hz (105V - 125V)	10A @ 115V / 1 / 60Hz (105V - 125V)	10A @ 115V / 1 / 60Hz (105V - 125V)
Power Requirement 50Hz	4.5A @ 240V / 1 / 50Hz (200V - 260V)	4.5A @ 240V / 1 / 50Hz (200V - 260V)	5A @ 240V / 1 / 50Hz (200V - 260V)	5A @ 240V / 1 / 50Hz (200V - 260V)

#### Environmental Conditions:

- Indoor Use Only
- Maximum Altitude: 2000 meters
- Relative Humidity: 80% for temperatures to 30°C
- Class 1: Residential, Commercial, Light Industrial
- Over Voltage: Category II
- Operating Ambient: 5° to 30°C
- Pollution Degree: 2
- Class 2: Heavy Industrial

### 1.4 Circulator Pump

The two-speed simplex (pressure) pump may be used for tempering of samples in the reservoir or for circulation in closed loops. It is not designed for pumping from the circulator's reservoir into and out of a second open reservoir.

The HIGH or LOW Speed Selection Switch on the rear of the Controller is used to select pump speed. LOW is adequate for most applications and provides quieter pumping. HIGH is recommended where temperature varies frequently and there is a need for fast recovery or when pumping to multiple external units.

Speed Selection	Maximum Pump Outlet Ratings Line Frequency = 50/60Hz
HIGH	15 LPM / 2.6 PSI
LOW	9 LPM / 1.5 PSI

The data in the table above are based on the following criteria:

1. Maximum pump outlet flow rate is measured in liters per minute (LPM) with no restriction on the pump outlet.
2. Maximum pump outlet pressure is measured in pounds per square inch (PSI) at no flow.
3. Water was used as the circulation fluid. Water has a viscosity of one centistoke. High viscosity or low-density fluids will change these figures.

## 1.5 Pump Inlet and Outlet Connections

The pump inlet and outlet ports are female ¼ inch NPT connections that permit use of barbed tubing adapters or hard plumbing fittings. ½ inch (13mm) ID tubing may also be slid over these connections and held in place with a hose clamp. If the pump inlet and outlet are not used for external circulation, they should be connected using the tubing provided with the unit in order to optimize fluid mixing within the reservoir.



**Picture 1:** Inlet to Outlet Connection. When bath is not circulating with an external device, the tubing provided with the unit should be used as shown above.

The nylon barbed tubing adapter fittings supplied with the unit are intended for temperature control from -40°C to 93°C. For controlling temperature above 93°C, brass, stainless steel, or Teflon® fittings are recommended. ¼ inch NPT to M16 stainless steel male adapter fittings are provided with all 50Hz models.

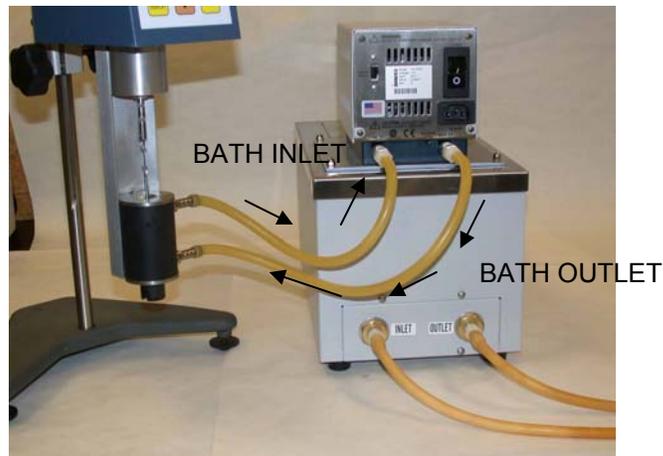


**IT IS THE USER'S RESPONSIBILITY TO ENSURE THAT THE TUBING AND FITTINGS CONNECTED TO THE CIRCULATOR ARE COMPATIBLE WITH THE BATH FLUID AND TEMPERATURE RANGE BEING USED.**

NOTE: The use of quick-connect fittings will restrict flow rate. Therefore a high or maximum pump speed should be used.

## 1.6 Closed Loop Circulation

Connect the pump inlet and outlet to the external apparatus (See Picture 2 below). To maintain adequate flow, avoid restrictions in the tubing. When connecting the Circulator to more than two closed loops, the use of a manifold made of "Y" adapters to divide the fluid into multiple banks is recommended. After setting up multiple closed loops, check for adequate flow at the return manifold of each loop and check that the bath fluid is at an adequate level. A booster pump may be added to closed loops without damaging the Circulator's bath pump.



**Picture 2:** Flow connections. Small Sample Adapter (shown), DIN and UL Adapters, or Cone and Plate Viscometers.

The temperature control stability of a closed loop system is better at the external apparatus than in the Circulator reservoir (provided the control point of the apparatus represents a constant load and is well insulated). For example, if you circulate fluid through a viscometer at 50°C, the temperature variation observed in the Circulator reservoir may be  $\pm 0.2^\circ\text{C}$  while the temperature variation in the viscometer may be only  $\pm 0.1^\circ\text{C}$ .

Although temperature stability is generally better at the external apparatus control point, depending on the length of tubing used and the efficiency of the insulation, the actual temperature reading at the external apparatus may be slightly different than the temperature reading at the Circulator reservoir.

#### 1.7 Reservoir Purge

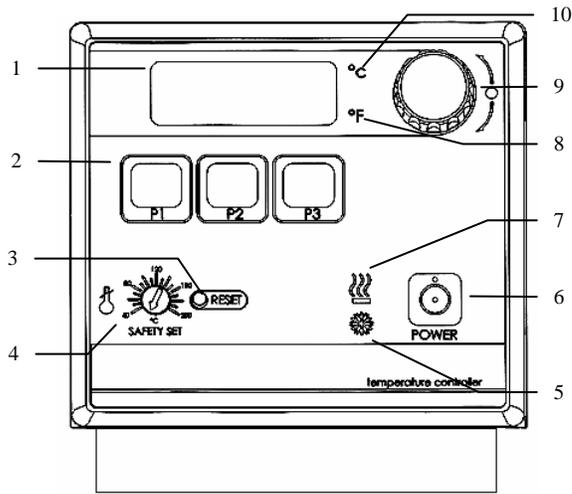
When operating at low temperatures, atmospheric moisture tends to migrate into the reservoir and condense. The 1/8 inch OD Reservoir Purge tube allows you to inject inert gas into the Circulating bath to prevent the build-up of condensation.

#### 1.8 Ambient and Cooling Coil (Non-refrigerated Models)

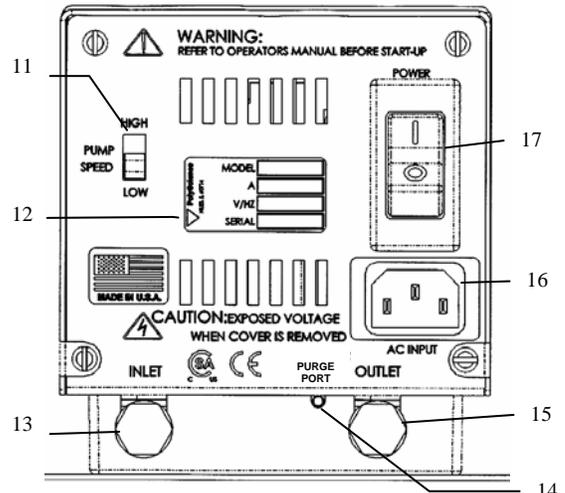
Used when auxiliary cooling of circulator coil is needed. Use of cooling coil is recommended when the bath is operated at  $24^\circ - 35^\circ\text{C}$  temperatures. When connected to a water source, the stainless steel coil permits more rapid cooling from high temperatures and will ensure more precise temperature control and faster response when operating close to ambient temperatures. The cooling coil inlet and outlet ports are located on the rear of the bath, near the bottom of the reservoir.

## Section 2 - Standard Controller Information

### 2.1 Front and Rear Panels



Front View



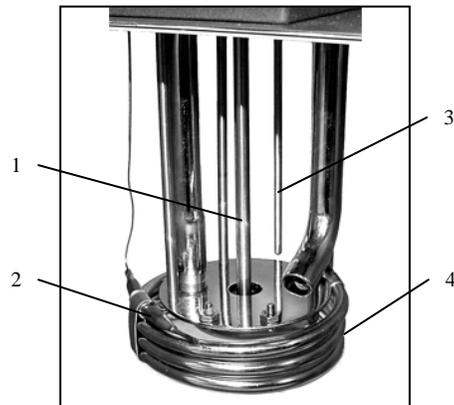
Rear View

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>1. Display</li> <li>2. Preset Temperature Buttons</li> <li>3. Safety Set Reset Button</li> <li>4. Safety Set Indicator Knob</li> <li>5. Cooling Light <sup>1</sup></li> <li>6. Power ON / OFF Button</li> <li>7. Heating Light</li> <li>8. °F Light</li> <li>9. Select/Set Knob (Push to set, turn to adjust)</li> <li>10. °C Light</li> </ul> | <ul style="list-style-type: none"> <li>11. Pump Speed Switch</li> <li>12. Identification Label</li> <li>13. Pump Inlet</li> <li>14. Reservoir Purge</li> <li>15. Pump Outlet</li> <li>16. AC Input</li> <li>17. Circuit Breaker / AC Power Switch</li> </ul> |
|---|--|

<sup>1</sup>. Present on Refrigerating/Heating models only

### 2.2 Heater/Pump Assembly

- 1. Pump Shaft and Impeller
- 2. Over-Temperature Sensor
- 3. Temperature Sensor
- 4. Heater Coils



## Section 3 – Operation

### 3.1 Circulator Location

Locate the Circulator on a level surface, free from drafts and out of direct sunlight. Do not place it where there are corrosive fumes, excessive moisture, high room temperatures, or excessive dust is present.

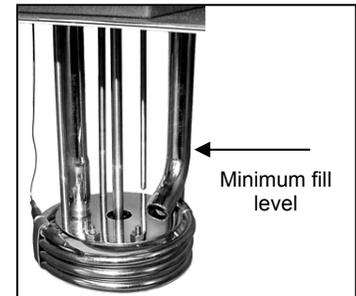
Refrigerating/Heating Circulators must be a minimum of four inches (102mm) away from walls or vertical surfaces so air flow around the unit is not restricted.

To help prevent voltage drops, position the Circulator as close as possible to the power distribution panel and a properly grounded outlet. The use of an extension cord is not recommended.

### 3.2 Filling the Reservoir

The maximum fill level for the Circulating bath is one inch (25mm) below the top of the reservoir. A liquid level that fully covers the heater coil, pump, over-temperature sensor, and at least one inch (25mm) of the temperature sensor must be maintained. For optimum cooling efficiency, the bath fluid level in Refrigerating/Heating Circulators should be kept above the cooling coils at all times.

Upon start-up, it may be necessary to add fluid to compensate for the fluid required for external circulation. If the proper fluid level is not maintained, the heater coil may become exposed and possibly damaged.



	<p><b>Warning:</b> These units are equipped with over-temperature protection (Safety Set). A low-liquid level or failure to set the Safety Set and properly immerse the heater may result in heater burnout and triac failure. While operating, do not allow the heater to contact any potentially flammable materials, such as plastic trays or the sides of plastic tanks, as a fire hazard may result.</p>
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### 3.3 Power

An IEC power cord is provided with the Circulator. This power cord should be plugged into the IEC receptacle on the rear of the Controller and then plugged into a properly grounded outlet. Make sure that the power outlet is the same voltage and frequency indicated on the identification label on the back of the Controller.

The use of an extension cord is not recommended. However, if one is necessary, it must be properly grounded and capable of handling the total wattage of the unit. The extension cord must not cause more than a 10% drop in voltage to the Circulator.

Once the unit has been connected to an appropriate electrical outlet, place the Circuit Breaker/Power Switch on the rear of the Controller in the ON position. Four decimal points (...) will appear on the digital display. DO NOT place the Power Switch on the front of the Controller ON until the Safety Set has been adjusted to the desired temperature (see 3.4 below).

	<p>After filling the reservoir with fluid, you must set the Safety Set and the High Limit as well as your desired control set point temperature.</p>
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### 3.4 Setting the Safety Set Point

The Safety Set feature automatically disconnects Controller power to the heater and pump in the event that the reservoir liquid level drops too low or the Controller fails. The Safety Set is user-adjustable between approximately 40° and 210°C. It should be set at least 5°C higher than the High Limit temperature.

Use a flat blade screwdriver to rotate the Safety Set Indicator Knob to the desired temperature. Do not force the knob beyond the stops at either end of the temperature value range.

Once the Safety Set temperature has been set, turn power to the Controller ON by pressing the Power Switch on the front of the Controller. The pump will begin operating, the display will flash the current temperature set point (tx.xx), the °C LED will light, and the current bath temperature will appear on this display. Pump speed selection is made using the Pump Speed Selection Switch on the rear of the Controller (see Section 1.4).

If power is disrupted because the Safety Set temperature was exceeded, place the Circuit Breaker/Power Switch in the OFF position, press the Safety Set Reset Button, correct the problem (low liquid level, incorrect Safety Set temperature, etc.), and then restore power.

Activation of the Safety Set during normal operation will display a fault (FLt 3) on the readout.

### 3.5 Selecting Temperature Units

The control set point and actual bath temperatures may be displayed in either °C or °F. The factory-default is °C.

To change from °C to °F, place the Circuit Breaker/Power Switch on the rear of the Controller in the OFF position and then press and hold the P2 Button while turning the power back ON.

To change from °F to °C, place the Circuit Breaker/Power Switch in the OFF position and then press and hold the P3 Button while turning the power back ON.

NOTE: When the temperature display units are changed, the High Limit value and all temperature presets revert to the factory-default values. If a calibration value has been entered, the value will be retained.

### 3.6 Setting the High Limit

This feature provides additional safety and protection by allowing a selectable upper temperature limit set point. To avoid an unwanted shutdown during regular operation, the high limit value should be set at least 5°C higher than the selected control temperature

To set the High Limit temperature set point, press the P2 and P3 keys simultaneously and repeat until (Hxxx) appears on the display. This is the current High Limit value. It is factory set at 152°C.

To change the displayed value, press and turn the Select/Set Knob until the desired High Limit set point value is displayed. A clockwise rotation increases the value; a counterclockwise rotation decreases the value. Press the Select/Set Knob a second time to accept the new value and return to normal operation.

If the High Limit value meets or exceeds the control temperature set point, (E-H1) will flash on the display. If this occurs, enter a higher value for the High Limit or reduce the control temperature set point.

If the actual bath temperature reaches the High Limit setpoint, (FLt 1) will flash on the display. Should this occur the Controller will automatically remove power from the heater and, in Refrigerating/Heating units, the compressor as well. The pump will continue to operate.

Once the problem is corrected (bath temperature reduced or High Limit value increased), press the Power button to clear the message.

### 3.7 Setting the Set Point Temperature

Press and release the Select/Set Knob. The decimal point flashes to indicate that the set point temperature can be changed.

Turn the Select/Set Knob until the desired temperature set point is displayed. A clockwise rotation increases the setting; a counterclockwise rotation decreases the setting. Press the Select/Set Knob a second time to accept the displayed value. The decimal point stops flashing and the display will indicate the actual bath temperature. Allow sufficient time for the bath to stabilize at the desired temperature before making any adjustments to set point temperature.

NOTE: The unit will automatically accept the displayed set point after approximately 10 seconds of inactivity, even if the Select/Set Knob was not pressed.

The set point temperature may be checked at any time by pressing the Select/Set Knob.

If the set point temperature cannot be raised, it is possible that the High Limit value is set lower than the desired control temperature set point. Reset the High Limit value to 5°C or more above the desired set point temperature.

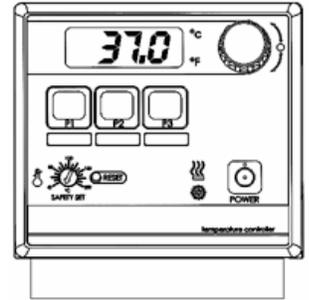
### 3.8 User-Defined Preset Temperatures

With the unit on, press the desired Preset Button — P1, P2, or P3. The LED associated with the selected Preset Button will begin to flash.

Rotate the Select/Set Knob to the desired temperature set point.

Press the selected Preset Button a second time to enter the new set point. The new set point temperature will not be saved unless the Preset Button is pressed.

The LED associated with Preset Button lights continuously whenever that preset value is controlling bath temperature. If more than one Preset Button is set at a given temperature set point, the LED associated with all Preset Buttons with that set point will light.



### 3.9 Local Lockout Feature

This feature enables the user to lock all controls on the controller. While the feature is activated, the unit will remain running at the current settings.

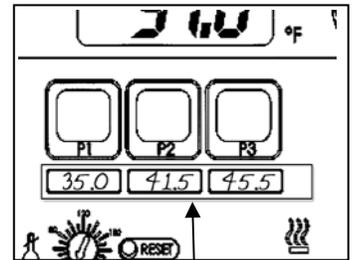
To activate the local lockout feature, press and hold the Select/Set Knob for 10 seconds. Once locked, the screen will read LLo. When locked, the setpoint decimal point will not flash as usual.

Press and hold the Select/Set Knob again for 10 seconds to unlock the controls. Once unlocked, the screen will read CAn.

### 3.10 Stick-on Strips for Preset Buttons

The Standard Controller is supplied with two stick-on strips that can be applied beneath the Preset Buttons. These strips are removable and can be reapplied.

The user can write the set point temperature associated with each Preset Button on this strip. The use of an erasable medium, such as dry erase marker or flair tip pen is recommended. The former can be wiped off with a dry cloth or tissue; the later can usually be removed with simple glass cleaner and a cloth or tissue. Do not use a permanent marker or ballpoint pen. Do an ink test before writing on these strips.



The stick-on strip fits beneath the controller's Preset Buttons. It is removable and reapplicable.

### 3.11 Auto-Refrigeration Operation

Auto-Refrigeration selects the temperature at which refrigeration is activated. For most applications, a set point 15°C above room temperature is recommended.

The Auto-Refrigeration control range on these is from +20°C to 70°C. The refrigeration system will turn on when the bath fluid temperature is at or above the Auto-Refrigeration set point (70°C maximum).

#### Setting the Auto-Refrigeration Temperature:

Press the P2 and P3 Buttons simultaneously and repeat until the current Auto-Refrigeration set point temperature appears on the display (Axxx).

To change the displayed value, press and turn the Select/Set Knob until the desired temperature is displayed. Press the Select/Set Knob a second time to enter the value and return to normal operation.

The factory default Auto-Refrigeration value is 40°C.

Display	Description	Action Required
....	Standby mode	Normal — Indicates that the Circuit Breaker/Power Switch is ON and the Controller Power Switch is OFF
tx.xx	Power up self-test	Normal — Appears momentarily at startup
oCx.x	Calibration offset value	Normal — Current calibration offset value; refer to section 4.1
Hxxx	High Limit value	Normal — Current High Limit value; refer to section 3.6
Axxx	Auto-Refrigeration set point value	Normal — Current Auto-Refrigeration set point; refer to section 3.10 (Appears only on Refrigerating/Heating Circulators)
E-H1	High Limit set point too low	Error — The value entered is below the control temperature set point. Refer to Setting High Limit, section 3.6
FLt 1	High Limit value exceeded	Error — Set a High Limit value higher, then turn main power to the unit OFF and back ON; refer to section 3.6
FLt 2	EEPROM reset	Error — Turn Circuit Breaker/Power Switch OFF, hold P3 Button, and then turn the Circuit Breaker/Power Switch back ON
FLt 3	Safety Set temperature exceeded	Error — Turn Circuit Breaker/Power Switch OFF, press Safety Set Reset Button, and then turn the Circuit Breaker/Power Switch back ON
FLt 4	Heating Triac failure	Error — Service required
FLt 5	Probe failure	Error — Service required
FLt 6	i2c error — Communication failure to modulation board	Error — Service required (Appears only on Refrigerating/Heating Circulators)

## Section 4 - Calibration and Maintenance

### 4.1 Calibration

Calibration allows the user to match the Controller's bath temperature display to an external certified reference thermometer. Calibration is performed as follows:

Set the desired operating fluid temperature set point and allow temperature to stabilize.

Press the P2 and P3 simultaneously and release and repeat until the display reads (oCx.x). Press P1 and hold until (Cal) is displayed. This will take about 2 seconds.

At one second intervals, the displayed value will alternate between the actual bath fluid temperature and the current offset value, which is the difference between the factory calibration setting and the user's reference temperature sensor. The maximum offset is  $\pm 0.9^{\circ}\text{C}$  from factory calibration.

To change the calibration offset value, rotate the Select/Set Knob until the display matches the reading on the reference temperature sensor. The display will continue to alternate between the offset value and the calibrated display temperature.

Press the Select/Set Knob or the P1 Button to accept the entered value. When the new calibration is stored and the mode is exited, (dONE) will appear on the display.

NOTE: The displayed offset value will also be accepted if there is no activity for 20 seconds.

### 4.2 Heater

The heater should be kept clean. If deposits build up on the heater, they may be removed by scrubbing with a non-metallic (plastic) abrasive pad. Do not use steel wool.

#### 4.3 Pump Motor

The pump bearings are permanently lubricated with high-temperature silicone grease and do not require additional lubrication. Should the bearings become noisy, replacement of the entire pump motor is recommended. This will reduce repair labor costs and retain fluid pumping reliability.

#### 4.4 Cleaning

Only mild detergents and water or an approved cleaner should be used on the painted and stainless steel surfaces of the Circulator. Do not allow cleaning liquids or sprays to enter the Controller vents.

A concentrated bath cleaner (TC-Fluid 6) is available that can be used to remove mineral deposits from the reservoir. See Replacement Parts Section 7.1.

#### 4.5 Maintaining Clear Bath Water

When water is used as the bath fluid, optimal conditions are present for algae growth. To prevent algae contamination and minimize the need for draining the reservoir, an algaecide (TC-Fluid 1) should be used. See Replacement Parts Section 7.1.

Do NOT use chlorine bleach in the reservoir or on any pump parts.

#### 4.6 Condenser, Air Vents, and Reusable Filter (Refrigerating/Heating Circulators Only)

To keep the refrigeration system operating at optimum cooling capacity, the condenser, the front and back air vents, and reusable filter should be kept free of dust and dirt. They should be checked on a scheduled basis and cleaned as required.

The reusable filter (see Replacement Parts Section 7.1) is easily accessed from the bottom/front of the unit. Turn the filter-retaining clip away from the filter cutout and remove the filter as shown by photo 4.6. Use a mild detergent and water solution to wash off any accumulated dust and dirt and then rinse thoroughly and dry before reinstalling.



Photo 4.6

## Section 5 - Troubleshooting

#### 5.1 Unit Will Not Operate (no heat, cooling, or pumping)

- Check that the power cord is plugged in to an operating electrical outlet.
- Check that the Circuit Breaker/Power Switch is ON.
- Check that the Controller Power Switch is ON.
- Check that the Safety Set temperature is higher than the control temperature set point.
- Turn power off, press the Safety Set Reset button, and restore power.

#### 5.2 No Pumping

- Check the fluid level of the bath to be sure the pump head is covered with fluid.
- If the pump motor does not spin, verify that the Pump Speed Switch is either in the HIGH or LOW position. If it is in the middle, the pump will not receive power.
- Check the pump impeller for obstructions (it should turn freely).

#### 5.3 Slow or Insufficient Pumping

- Check for low line voltage, particularly when the heater is on.
- Check for a kink in the hose or too small of a hose diameter (closed loop applications).
- Check for too high of a fluid viscosity.

- 5.4 No Heating
- Verify that the unit is pumping properly.
  - If the heat light is not lit, check the control temperature set point and bath temperature to verify that heating is required.
  - Verify that the liquid in the bath covers the heater coils.
  - Check that the High Limit value has not been exceeded (FLt 1 appears on the display).
- 5.5 Insufficient Heating
- Verify that the unit is pumping properly.
  - Check for proper line voltage.
  - Check for excessive external cooling load on unit.
  - At higher temperatures, insufficient heating could be due to excessive heat loss from tanks, hoses, or vapor from the tank.
  - Check that the heat demand from connected devices or experiments does not exceed the heating capabilities of the unit.
  - Allow sufficient time for bath temperature to stabilize when changes in heat load or set point are made.
- 5.6 No Cooling or Insufficient Cooling
- Check that the Cooling switch is ON.
  - If the cooling light is not lit, check the control temperature set point and bath temperature to verify that cooling is required.
  - Check for low or high line voltage.
  - Check for blocked airflow through ventilation screens.
  - Check ambient air temperature. Refrigeration unit should not be operated above 32°C ambient temperature as high air temperature may cause the refrigeration compressor to temporarily shut down.
  - Check for excessive heat being transferred to the bath liquid as this may exceed the cooling capacity of the refrigeration system. Refrigeration should not be used for fluid temperatures above 55°C.
  - Check cooling coil supply to be sure sufficient tap water is flowing through the hose (non-refrigerated units).
- 5.7 Triac Failure
- (FLt 4) appears on the display, indicating that the heater triac has failed or line supply voltage has a source of extreme interference from other equipment. Plug the unit into another power source. If it still displays triac failure, a triac or triac driver needs replacement. If problem persists, contact supplier.

## Section 6 - Reservoir Fluids

Depending on your needs, a variety of fluids can be used with your Circulator. No matter what bath medium is selected, it must be chemically compatible with the reservoir and with the 300 series stainless steel in the pump and heater. It must also be suitable for the desired temperature range. Always use fluids that satisfy safety, health, and equipment compatibility requirements

For optimum temperature stability, the fluid's viscosity should be 50 centistokes or less at its lowest operating temperature. This permits good fluid circulation and minimizes heating from the pump.

For temperatures from 10°C to 90°C, distilled water is recommended. For temperatures below 10°C, use TC-FLUID 2. Do not use deionized water. See Replacement Parts Section 7.1.

The following chart is intended to serve as a guide in selecting a bath fluid for your application. For optimum temperature stability and low vaporization, be sure to stay within the fluid's normal temperature range.

**You are responsible for proper selection and use of the fluids.**

**Avoid extreme range operation.**

FLUID DESCRIPTION	SPECIFIC HEAT @25°C	NORMAL RANGE	EXTREME RANGE
Distilled Water	1.00	10° — 90°C	2° — 100°C
TC-Fluid 2	.82	-20° — 100°C	-30° — 100°C
TC-Fluid 3	.39	50° — 150°C	5° — 270°C*
TC-Fluid 4	.42	100° — 200°C	80° — 232°C*
TC-Fluid 5	.76	-50° — 60°C	-62° — 60°C

**\*WARNING - Fluid's flash point temperature**

Contact supplier for replacement fluids.

**DO NOT USE the following fluids:**

1. Automotive antifreeze with additives\*\*
2. Hard tap water\*\*
3. Deionized water with a specific resistance > 1 meg ohm
4. Any flammable fluids
5. Concentrations of acids or bases
6. Solutions with halides: chlorides, fluorides, bromides, iodides or sulfur
7. Bleach (Sodium Hypochlorite)
8. Solutions with chromates or chromium salts

\*\* At temperatures above 40°C, additives or mineral deposits can adhere to the heater. If deposits are allowed to build up, the heater may overheat and fail. Higher temperatures and higher concentrations of additives will hasten deposit build up



**Warning:** Do not use a flammable liquid as a bath medium as a fire hazard may result. Be aware of the flash point temperatures for the fluids used.

### Application Notes

At a fluid's low temperature extreme:

1. The presence of ice or slush adversely affects temperature stability.
2. A viscosity above 10 centistokes adversely affects temperature uniformity.
3. A high fluid viscosity and high pump speed adds heat to the fluid being pumped.

At a fluid's temperature above ambient without refrigeration:

1. To avoid friction heating of the fluid, the viscosity of the fluid should be 10 centistokes or less and within 15°C of room temperature.
2. Heat loss should be encouraged by uncovering the fluid and lowering the pump speed.

At fluid's high temperature extreme:

1. Heat loss from vapor adversely affects temperature stability.
2. To prevent the accumulation of vapors inside the room, the reservoir may need to be placed in a fume hood.
3. Use a cover and/or floating hollow balls to help prevent heat and vapor loss.
4. Replenish fluid lost from vapor frequently.

## Section 7 - Service and Technical Support

If you have followed the troubleshooting steps and your circulator fails to operate properly, contact the distributor or manufacturer from whom the unit was purchased (see Section 8 – After-sale Support). Have the following information available for the customer service person:

- Model and Serial Number
- Voltage (from back panel label)
- Date of purchase and your purchase order number
- Suppliers' order number or invoice number
- A summary of your problem

### 7.1

#### Replacement Parts

<b>Description</b>	<b>Part #</b>
<u>Lab Algicide, concentrate, 8 oz.</u>	<u>TC-Fluid 1</u>
<u>Bath Cleaner, concentrate, 8 oz.</u>	<u>TC-Fluid 6</u>
<u>Reservoir Fluid (Ethylene Glycol 50% / Water 50%)</u>	<u>TC-Fluid 2</u>
<u>Reservoir Fluid (High Temp)</u>	<u>TC-Fluid 3</u>
<u>Reservoir Fluid (High Temp)</u>	<u>TC-Fluid 4</u>
<u>Reservoir Fluid (Low Temp)</u>	<u>TC-Fluid 5</u>
<u>Tubing, Rubber 10 ft.</u>	<u>Ex-Tubing</u>
<u>Tubing, Rubber 6 ft.</u>	<u>HT-Tubing</u>
<u>Tubing, High Temperature (Fluran) 6 ft.</u>	<u>ULA-45</u>
<u>Tubing, Insulated 6 ft.</u>	<u>TC-Tubing</u>
<u>Air Filter for TC-502D</u>	<u>TBPS400-9</u>
<u>Air Filter for TC-602D</u>	<u>TBPS400-5</u>
<u>IEC Power Cord, 115V models</u>	<u>225-227</u>
<u>IEC Power Cord, 230V models</u>	<u>225-228</u>
<u>Adapter Fittings (qty 2) - ¼ in. NPT X M16, SS (50Hz models)</u>	<u>TC-55</u>

## Section 8 - After-sale Support

All instruments requiring warranty service must be returned to Brookfield Engineering Laboratories, Inc. or the Brookfield dealer from whom it was purchased. Obtain return authorization number prior to returning bath for service. Transportation is at the purchaser's expense. See Section 9 – Warranty, below.

**For questions, repair or service in the United States, e-mail or return to:**

Brookfield Engineering Labs., Inc.  
11 Commerce Boulevard  
Middleboro, MA 02346 USA

Telephone: 508-946-6200, Fax: 508-946-6262, E-mail: [service@brookfieldengineering.com](mailto:service@brookfieldengineering.com)  
Website: [www.brookfieldengineering.com](http://www.brookfieldengineering.com)

For repair or service outside the United States, consult Brookfield Engineering Laboratories, Inc. or the dealer from whom you purchased the instrument.

**For questions, repair or service in the United Kingdom, e-mail or return to:**

Brookfield Viscometers Limited  
1 Whitehall Estate  
Flex Meadow  
Pinnacles West  
Harlow, Essex CM19 5TJ, United Kingdom

Telephone (44) 27/945-1774, Fax: (44) 27/945-1775, E-mail: [service@brookfield.co.uk](mailto:service@brookfield.co.uk)  
Website: [www.brookfield.co.uk](http://www.brookfield.co.uk)

**For questions, repair or service in Germany, e-mail or return to:**

Brookfield Engineering Labs. Vertriebs GmbH  
Hauptstrasse 18  
D-73547 Lorch, Germany

Telephone: (49) 7172/927100, Fax: (49) 7172/927105, E-mail: [info@brookfield-gmbh.de](mailto:info@brookfield-gmbh.de)  
Website: [www.brookfield-gmbh.de](http://www.brookfield-gmbh.de)

## Section 9 - Warranty

Thank you for your purchase. We are confident it will serve you for a long time. Our warranty to you is as follows:

The manufacturer agrees to correct for the original user of this product, either by repair, or at the manufacturer's election, by replacement, any defect that develops after delivery of this product within the period as stated on the warranty card. In the event of replacement, the replacement unit will be warranted for 90 days or warranted for the remainder of the original unit's parts or labor warranty period, whichever is longer.

If this product should require service, contact the manufacturer/suppliers' office for instructions. When return of the product is necessary, a **return authorization number** will be assigned and the product should be shipped, transportation charges pre-paid, to the indicated service center. To insure prompt handling, the **return authorization number** should be placed on the outside of the package and a detailed explanation of the defect enclosed with the item.

This warranty shall not apply if the defect or malfunction was caused by accident, neglect, unreasonable use, improper service, or other causes not arising out of defects in material or workmanship. There are no warranties, expressed or implied, including, but not limited to, those of merchantability or fitness for a particular purpose that extends beyond the description and period set forth herein.

The manufacturer's sole obligation under this warranty is limited to the repair or replacement of a defective product and the manufacturer shall not, in any event, be liable for any incidental or consequential damages of any kind resulting from use or possession of this product.

Some states do not allow: (A) limitations on how long an implied warranty lasts or (B) the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights. You may also have other rights that vary from state to state.

Section 10 – EC Declaration of Conformity

***EC Declaration of Conformity***



The Products herewith complies with the requirements, as stated below, in accordance to the EC Low Voltage Directive 73/23/EEC and EC Electromagnetic Compatibility Directive 89/336/EEC, and carries the **CE** marking accordingly.

We herewith declare: Brookfield Engineering Laboratories, Inc  
11 Commerce Boulevard  
Middleboro, MA 02346

That the following equipment complies with the essential requirements in respect to safety and health, in accordance to the EC Directives based on its design and type, as brought into circulation by us. In case of alteration of the equipment, not greed upon by us, this will lose its validity.

Product Description: Circulating Baths  
  
TC 602D, TC 602P, TC 502P, TC502D, TC 202P, TC 202D, TC 102P, TC 102D,  
TC 112P.

Applicable Directives and Harmonized Standards: Low Voltage Directive 73/23/EEC & Electromagnetic Compatibility 89/336/EEC and relevant transpositions into national law of the member states, including, but not limited to the following  
Harmonized Standards:  
EN/IEC 61010-1: 1990 +A1: 1992 +A2 :1995  
EN 61326: 1997 +A1: 1998 + A2:2001  
CISPR 11/EN 55011 Class A, Group I

Testing Bodies: CSA International (Certification & Testing Division)  
Ultra Tech Inc. ( EMC approval)

Signature on Behalf of Manufacturer or Authorized Representative: Dennis A. Dougherty 

Date of Validity: March 30, 2003

Title of Signatory: Engineering Manager