

Operators Manual

Analog Controller Models

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Section 1 - General Information

1.1 Warranty

Thank you for your circulator purchase. We are confident it will serve you 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 in parts which develops within 24 months after delivery of this product to the original user. The warranty period for labor is 12 months after delivery. 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's office nearest your location for instructions (for a complete list of offices, see your manufacturer's catalog.) 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 which 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 which vary from state to state.

1.2 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 contact the company where your unit was purchased.

Remove any loose packing material. Check that nothing remains around the heater or circulator pump. Before proceeding, be sure the all switches are in the OFF position.

1.3 Specifications

Temperature Stability ± .2°C	Over Temp Protection Yes
Readout Thermometer	Low Liquid Protection Yes
Heater 1000 Watts	Pump Speeds 7 & 15L/Min

Model Type	Temperature Range	Reservoir Capacity	Amps @ 120v 60Hz	Amps @ 240v 50Hz
Refrig/Heat Circulator	-20°C to 100°C	6L	12A	6A
Heat Only Circulator	Ambient+5°C to 100°C*	6L	9A	4.5A
Heat Immersion Circulator	Ambient+5°C to 100°C*	N/A	9A	4.5A

* See Section 1.5.4 - Attainable Temperatures for Immersion Circulator. Accessory cooling coil must be used for temperatures closer to ambient. Auxiliary refrigeration can be used for temperatures at or below ambient.

1.4 Circulating Bath

1.4.1 Package Contents of Circulating Bath

- Circulating Bath
- Operators Manual
- Warranty Card
- A package of nylon adapters containing:

Description	Qty	Part Number
— 3/16 inch barbed tube fittings	2	300-049
— 1/4 inch barbed tube fittings	2	800-048
— 3/8 inch barbed tube fittings	2	300-047
- Hose, bypass, Buna N (-40°C to 120°C) 590-068
- Thermometer 099590

1.4.2 Description of Circulating Bath

The circulating bath models with analog controller is designed to provide precise temperature control of fluids for closed loop circulation to external equipment or to be used as a stand alone bath. The reservoir may be used for immersing samples while the unit is connected to an external device. All wetted parts are corrosion resistant 300 series stainless steel. Models are equipped with various size reservoirs and refrigeration capacities.

1.4.3 Circulating Bath Fluid Connections To External Apparatus

The pump inlet and outlet are internally threaded with female 1/4 inch NPT to allow use of barbed tubing adapters or hard plumbing. Or, you can slide 1/2 inch (13mm) ID tubing over each pipe and hold it in place with a hose clamp.

Select tubing and fittings that are compatible with bath fluid and temperature range. If the pump inlet and outlet are not used for external circulation, for best results connect the inlet and outlet pipes with a short length of insulated tubing. Or, plug the pipes with male nylon plugs (supplied) or with metal plugs (not supplied) for high temperature use.

The nylon barbed tubing adapter fittings supplied are for applications from -40°C to 93°C. Brass, stainless steel or Teflon® fittings are recommended for applications above 93°C.

Quick connectors are not recommended as they typically restrict flow rate.

1.5 Immersion Circulator

1.5.1 Package Contents of Immersion Circulator

- Immersion Circulator
- Operators Manual
- Warranty Card
- Thermometer099590

1.5.2 Description of Immersion Circulator

The immersion circulator models with analog controller is primarily for accurately heating and circulating fluid in a reservoir supplied by the user. Because it can be used with many sizes and shapes of reservoirs, it is a very versatile unit. Although not designed for closed loop circulation, it can be used for this purpose. Operation of the controller is the same as the reservoir units.

1.5.3 Set Up of Immersion Circulator

Clamp the immersion circulator to the side of a tank (user supplied) or to a support rod adjacent to a tank. Maintain an adequate liquid depth to fully immerse the heater and pump outlet nozzle. When using a plastic tank, position the circulator so the heater does not contact the side of the tank. The rotatable pump outlet nozzle should be pointed along one side of a reservoir wall to produce the best fluid agitation.

1.5.4 Attainable Temperatures for Immersion Circulator

An immersion circulator can be used with reservoirs of various capacities and shapes, as well as with different fluids. These variables may cause a loss of temperature accuracy and stability. For example, a reservoir with large surface area has a great amount of heat loss which may make the circulator unable to reach the desired temperature. The following chart is an approximate guide to performance expectations under the conditions listed.

Attainable Temperatures vs Liters in Uncovered Reservoir

Temperature	30°C	40°C	50°C	60°C	70°C	80°C	90°C	100°C
Water	192L	96L	48L	24L	12L	6L	3L	—
Oil	283L	202L	145L	103L	74L	53L	38L	27L

Results May Vary.

1.5.5 Immersion Circulator Fluid Connection to External Apparatus

The immersion circulator does not have inlet and outlet fittings. However, 1/2inch I.D. tubing may be fastened with a hose clamp to the rotatable pump outlet nozzle and connected to the inlet of external apparatus. Tubing from the external apparatus outlet must return the fluid back into the reservoir.

Section 2 - Operation

2.1 Set Up and Location

Locate your circulator on a level surface free from drafts and direct sunlight. Do not place it where there are corrosive fumes, excessive moisture, high room temperatures, or excessively dusty areas. Refrigerated circulators must be four inches minimum away from walls or vertical surfaces so air flow is not restricted. Avoid voltage drops by using properly grounded power outlets wired with 14 gauge or larger diameter wire and if possible, be close to the power distribution panel. The use of extension cords is NOT recommended, this will avoid low line voltage problems.

2.2 Filling the Reservoir of the Circulating Bath Model

Maximum fill level for the circulating bath is one inch below the top of the reservoir.
Minimum liquid depth is enough to fully cover the heater, pump and one inch of the temperature sensor.

When in operation, add additional fluid to compensate for any additional volume needed for external circulation. If the proper fluid level is not maintained the heater coil may become exposed and possible damage to the heater may result.

An adjustable low liquid level/over temperature safety cutoff is an integral part of all units. Follow the procedure in Section 2.9 - Setting the Safety Thermostat for setting this safety.

Warning: These units are equipped with Over Temperature Protection (OTP). Failure due to low liquid level or failure to set OTP and properly immerse the heater may result in heater burnout. While operating, do NOT allow the heater to contact any potentially flammable materials such as plastic racks or sides of plastic tanks as a fire hazard may result.

2.3 Reservoir Fluids

Use distilled water for temperatures from 10°C to 90°C or a mixture of laboratory grade ethylene glycol and water for temperatures below 10°C. A variety of fluids can be used depending upon your needs. The fluid must be chemically compatible with the reservoir and with 300 series stainless steel in the pump and heater. The fluid must also be able to produce the temperature range desired.

For best temperature stability, the viscosity should be 50 centistokes or less at the lowest operating temperature to allow good fluid circulation and to minimize heating from the pump. Use fluids that satisfy safety, health and equipment compatibility requirements.

The chart below will help in selecting a fluid for your application. Stay within the fluid's normal range for best temperature stability and low vaporization.

**You are responsible for proper selection and use of the fluids.
Extreme range operation should be avoided.**

FLUID DESCRIPTION	SPECIFIC HEAT @25°C	NORMAL RANGE	EXTREME RANGE
Water	1.00	10°C — 90°C	2°C — 100°C
Ethylene Glycol 30% / Water 70%	.90	0°C — 95°C	-15°C — 107°C
Ethylene Glycol 50% / Water 50%	.82	-20°C — 100°C	-35°C — 115°C
Ethylene Glycol 100%	.62	50°C — 125°C	25°C — 155°C*
Dynalene-HC 50™	.76	-50°C — 60°C	-62°C — 60°C
DC510 50 cs Silicone Oil	.39	50°C — 150°C	5°C — 270°C*
DC550 125 cs Silicone Oil	.42	100°C — 200°C	80°C — 315°C*

*WARNING - Fluid's flashpoint temperature.

DC fluids are manufactured by Dow Corning. Dynalene HC is a registered TM of Advanced Fluid Technologies, Inc.

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 acid 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 allowed to build up, the heater may overheat and fail. Higher temperatures and higher concentrations of additives will cause a faster deposit build up. If buildup occurs see Section 3 Maintenance - Heater.

WARNING: Do not use a flammable liquid as a fire hazard may result.

Application Notes

At fluid's low temperature extreme:

1. Presence of ice or slush adversely affects temperature stability.
2. Viscosity above 10 centistokes adversely affects temperature uniformity.
3. High fluid viscosity and high speed pumping generates heat in the fluid.

At fluid's temperature above ambient without using refrigeration:

Without refrigeration and within 15°C of room temperature the viscosity should be 10 centistokes or less to avoid friction heating of the fluid. Heat loss should be encouraged by uncovering the fluid and the pump speed minimized.

At fluid's high temperature extreme:

1. Heat loss from vapor causes poor temperature stability.
2. A fume hood may be required to prevent the buildup of vapors inside the room.
3. Use a cover and/or floating hollow balls to help prevent heat and vapor loss.
4. Fluid lost from vapor have to be replenished.

2.4 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 HI or LO speed selection switch on the rear panel of the controller allows a choice of pump speeds.

Speed Selection	Maximum Pump Outlet Ratings	Maximum Pump Outlet Ratings
	Line Frequency = 60Hz	Line Frequency = 50Hz
HI	15 LPM / 2.6 PSI	12.5 LPM / 2.1 PSI
LO	9 LPM / 1.5 PSI	7.5 LPM / 1.2 PSI

The table above uses 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.
4. When the inlet and outlet are plugged on reservoir models, flow rate refers to internal bath circulation.

Select the HI pump speed where changes in temperature vary and there is a need for fast recovery, or when pumping to multiple external units. The LO pump speed is adequate for most applications and provides quieter pumping.

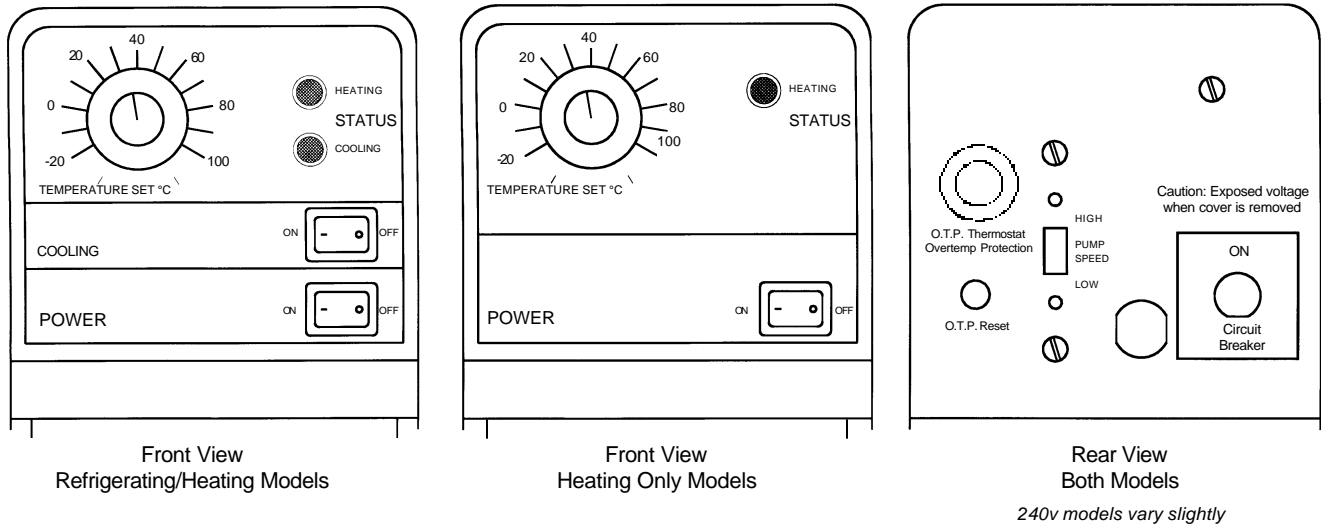
2.5 Closed Loop Circulation

Connect the pump inlet and outlet to your application. Use care to avoid restrictions in the tubing in order to maintain adequate flow. When connecting to more than five closed loops we recommend use of a manifold made of "Y" adapters to divide the fluid into two or more banks. A booster pump may be added without damage to the circulation bath pump. After setting up multiple closed loops, check that there is adequate flow at the return manifold for each loop and recheck bath fluid level.

The control stability of a closed loop system is better at the external apparatus than in the immediate vicinity of the heater (provided the apparatus control point represents a constant load and is well insulated). For example, if you circulate at 50°C through a viscometer, the temperature variation observed in the reservoir may be +0.2°C, whereas in the viscometer it may be only +0.1°C. Although stability is better at the external apparatus control point, depending on the insulation and length of tubing used, the accuracy of temperature may be slightly different than the temperature indicated in the reservoir.

2.6 Power

Plug the unit into a properly wired, grounded outlet with the same voltage and frequency indicated on the identification label on the back of the unit. If there is no response, check if the circuit breaker is in the ON position. An extension cord is not recommended, but if necessary, use one that is properly grounded and will handle the total wattage of the unit. The extension cord must not cause more than a 10% voltage drop to the circulator.



2.7 Setting Temperature

After filling the reservoir with fluid, the circulator must be set for the desired temperature level as follows:

1. Turn the Over Temperature Protection (OTP) safety thermostat knob on the rear panel to full clockwise position. Then press the power switch ON. The pump starts.
2. The temperature values on the front panel TEMPERATURE ADJUST KNOB are approximations of actual control temperature. Turn the TEMPERATURE ADJUST KNOB to desired temperature. Allow sufficient time between adjustments for the temperature to stabilize. When the fluid temperature has stabilized, based on your thermometer reading, some fine adjustment may be necessary.

2.8 Operation of Refrigerated Circulating Bath

For operation at temperatures below 40°C, refrigeration is normally required. To start the refrigeration system, press the cooling switch to the ON position. The refrigeration automatically shuts down if the bath fluid is above 55°C, even if the refrigeration switch is on.

When refrigeration is switched off, it should not be restarted for approximately 10 minutes in order to allow the internal pressures to equalize. System damage could result if you do not observe this waiting period.

2.9 Setting the Safety Thermostat

The Over Temperature Protection (OTP) thermostat safety feature prevents your unit from burnout in case of primary controller failure or a low liquid condition by switching off power to the heater. This feature has a range of 60°C to 220°C

For temperatures less than 60°C:

1. Turn the OTP knob located at the rear of the controller fully counterclockwise (minimum setting)

For temperatures over 60°C:

1. Turn the adjustable thermostat (OTP knob) located at the rear of the controller fully clockwise (Maximum+) until it stops.
2. Stabilize the bath at the maximum desired control temperature.
3. Turn the OTP knob slowly counter-clockwise until you hear a click. The unit will stop.
4. Turn the OTP knob clockwise slightly above the position where the unit tripped then reset the OTP thermostat breaker by pressing the red OTP reset button located below the knob. OTP is now set to trip a few degrees over the stabilized fluid temperature.