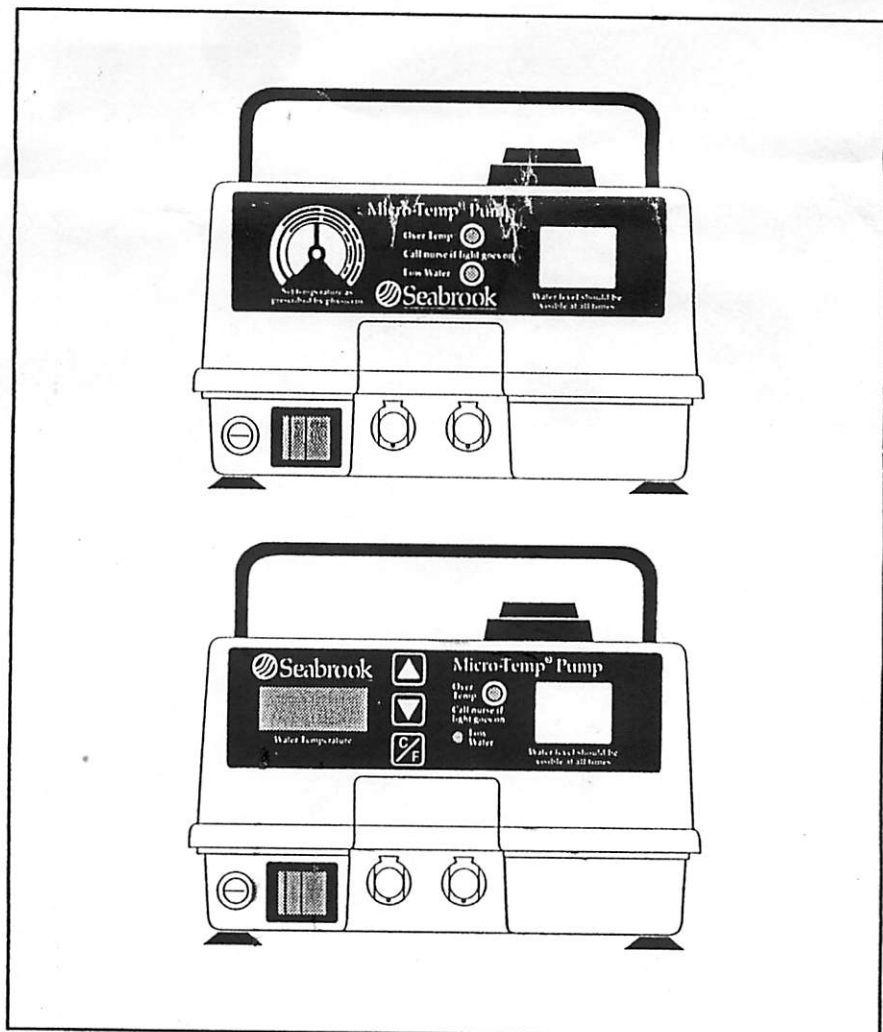


MICRO-TEMP[®]

Operation, Service and Technical Manual SMS-1000 and SMS-2000



1. Introduction

1.1 Purpose

The purpose of this manual is to provide operation, maintenance, repair, service, and calibration instructions for MICRO-TEMP® Heat Therapy Pumps, Cat. No.'s SMS-1000 and SMS-2000.

1.2 Clinical Applications

Localized heat/cold therapy has widespread clinical applications throughout the hospital. The primary indications for heat/cold therapy are as follows:

- Reduce edema
- Enhance wound drainage
- Increase blood flow
- Reduce skin irritation
- Prevent encrustation of tissue

Heat therapy is commonly used for the application of moist or dry heat to localized areas of the body. It is of particular benefit in orthopedic conditions such as lower back pain, strains, acute injuries, chronic pain, muscle spasm, tendonitis, and arthritis. Heat therapy is also prescribed for skin trauma (bruises, contusions, abscesses, boils, burns) and other medical problems like infection, phlebitis, I.V. infiltration, and neuritis.

Cold therapy is employed in the early stages of treatment for many of the same orthopedic conditions stated above. It involves the application of a dry pad with ice water circulating through it to the specific area of the body being treated. Headaches, particularly of a sinus nature, and nosebleeds are two other common indications for cold therapy.

Areas of use of heat/cold therapy in the hospital are:

- Medical/Surgical Floors
- Obstetrics
- Orthopaedics
- Intensive Care Units
- Oncology
- Renal Dialysis Units
- Operating Rooms
- Physical Therapy
- Newborn Nursery
- Emergency Rooms
- Out-Patient
- and Neonatal I.C.U.
- Post-Anesthesia Recovery
- I.V. Therapy

Heat and cold therapies are also used extensively outside the hospital—in physicians' offices, nursing homes, and in home healthcare.

1.3 Description

The MICRO-TEMP Heat Therapy System consists of a pump, connecting hose, and either a vinyl pad with or without foam on one side for moist heat therapy or a urethane pad.

The MICRO-TEMP Pump consists of a plastic reservoir for holding *distilled* water; a pump for circulating water through the hose and pad; a heating element to warm the water; an electronic control to regulate water temperature; two independent over temperature (high limit) devices to protect the patient from injury and the unit from damage should a malfunction occur; a float switch to shut the pump and heater off if the water level in the reservoir becomes too low; a tilt switch to shut the pump and heater off if it accidentally tips over; lights to indicate "OVER TEMP." and/or "LOW WATER"; a lighted power switch; and a 10 foot power cord with hospital grade plug.

MICRO-TEMP SMS-1000 utilizes a solid state temperature controller set via an external key. A dial indicates the temperature at which the unit is set. The temperature range is 86°- 107°F or 30°- 42°C.

MICRO-TEMP SMS-2000 utilizes a microprocessor-based temperature controller featuring digital read-out of water and setpoint temperature selectable to indicate centigrade or Fahrenheit. The temperature range is 78°- 107°F or 25°- 42°C. In addition to the features previously listed, this model includes audible alarms for over temperature, low water, tipover, and open sensor malfunctions, along with visual indicators for heating and open sensor. For cold therapy applications, the display will register down to 31°F or 0°C.

1.4 Accessories

Essential accessories for the MICRO-TEMP® are a TEMP-PAD® and TEMP-HOSE®. The vinyl TEMP-PAD consists of two layers of vinyl, heat-sealed together to provide multiple passageways for water flow in a random-flow pattern to prevent occlusion. Vinyl pads are available with or without a layer of foam bonded to one side to allow moist heat therapy when the foam is wetted. Pads are available in a variety of sizes.

Pads are connected to the pump via an eight foot TEMP-HOSE (Cat. No. SMS-A0800) with "quick-connect" couplings featuring automatic shut-offs at each end. One-hand shut-off clamps are provided on the pad tubing to prevent leakage when disconnected from the hose. Other available accessories are as follows:

Cat. No.	Description
SMS-A0120L	Floor Stand with Lock
SMS-A0122	Flow Rate/Temperature Tester
SMS-A0802	Dual Pad Connecting Hose
SMS-A0801	Connecting Hose (TEMP-PAD® to Baxter K-Module)
SMS-A1066	Quick-Connect Couplings (Adapts Gaymar T-Pump Hose to TEMP-PAD)
SMS-A1026	Test Plug

1.5 Incoming Inspection

Shipping cartons should be inspected upon receipt. If goods are damaged from shipping, make a claim immediately to the carrier.

Merchandise returned to Seabrook must have a Return Authorization Number. See Warranties, 1.6, for instructions about returning goods to Seabrook.

1.6 Warranties

▲ 1.6.1 MICRO-TEMP® Pumps (SMS-1000 and SMS-2000)

Both products are warranted to the user against defective materials and workmanship, under normal use, for a period of one year from the date of purchase. All labor will be performed and parts supplied, free of charge, provided the equipment is returned with prior authorization from Seabrook Medical Systems, Inc., Freight Prepaid.

Factory repairs may be handled on an exchange basis at the discretion of Seabrook. In such cases, at the customer's request, the exchange unit can be shipped prior to receipt by Seabrook of the defective unit. A Purchase Order Number will be required to effect shipment prior to receipt of the customer's returned unit. An in-warranty exchange pump will carry a warranty equivalent to that remaining on the original pump. An out-of-warranty exchange pump will carry a six month warranty.

Pumps may be repaired at your facility by qualified service personnel, in which case parts only will be provided, free of charge, during the warranty period of one year from date of purchase. To initiate shipment of parts to your institution, simply call the number listed in Para. 1.6.4. It will be necessary to provide a Purchase Order number if you desire shipment prior to receipt by Seabrook of the defective part.

▲ 1.6.2 MICRO-TEMP Pads and Accessories

Seabrook will replace any product, free of charge, where defects in materials and/or workmanship are evident, under normal use, within three months from date of delivery, provided the product is returned, with prior authorization (See Para. 1.6.4), Freight Prepaid, to the factory. A Purchase Order Number must be supplied if replacement is to be made prior to receipt by Seabrook of the defective product.

▲ 1.6.3 MICRO-TEMP Replacement Parts

After expiration of warranty, Seabrook will exchange a defective replacement part, free of charge, where defects in materials and/or workmanship occur within six months from date of delivery, provided the part is returned, with prior authorization (See Para. 1.6.4), Freight Prepaid, to the factory. A Purchase Order Number must be provided if the

replacement part is to be shipped before receipt by Seabrook of the defective component.

▲ 1.6.4 Returned Goods Procedure

All merchandise being returned to Seabrook must include a Return Authorization Number which may be obtained by calling Seabrook Customer Service at (800) 477-7757 or (513) 753-7700.

2. Operation

2.1 Safety Precautions

The MICRO-TEMP® Heat Therapy System has been designed to provide maximum thermal transfer efficiency at optimum safety. Safety features include: microprocessor control to ensure accuracy of temperature setting at all times by eliminating need for calibration; digital display of actual water temperature as well as setpoint temperature; a low water cut-off switch and tilt switch which shut off both the heater and circulating pump; and two independent high limit thermostats to guard against possible over-heating and subsequent patient injury.

Warnings

Read the "Operation" portion of this manual before using product. Water temperature must be set as prescribed by physician. Observe patient's skin condition frequently, due to individual differences in sensitivity, and susceptibility to injury from heat and/or externally applied chemicals or pressure. Patients at greatest risk are those unconscious, on prolonged therapy, diabetics, children, and persons incapacitated or with insensitive skin areas or poor circulation.

In surgery, heating may affect toxicity of certain prep solutions, which have been reported to cause skin injury when remaining on patient's skin during application of prolonged heat. For moist heat therapy, use distilled or tap water only.

Risk of explosion if used in the presence of flammable anesthetics.

Electric shock hazard. Do not remove cover. Service to be performed by qualified personnel only.

For continued protection against risk of fire, replace only with same type and rating of fuse.

2.2 Filling Instructions

Remove reservoir cap and fill reservoir to bottom of neck with *distilled water* only. Replace cap.

Connect hose to pump by inserting male couplings on hose into female couplings on pump. Be sure couplings are locked together tightly. (A "click" can be heard when couplings lock together.)

Select a TEMP-PAD® and insert the male couplings from the pad into the female couplings on the hose. Again, make sure couplings are locked together tightly. Check the clamps on the pad making sure they are fully open. The hose and pad must be free of kinks that might restrict flow.

Plug the power cord into a grounded receptacle providing the proper voltage and frequency. Press the power switch to the "ON" position (switch lighted) and allow the pump to run for two minutes. Check water level and refill with distilled water if necessary. Turn pump off. Your MICRO-TEMP Heat Therapy System is now ready to use.

Caution: Do not operate pump without a pad connected or with pad clamps in the "CLOSED" position.

Note: Optimum operation is obtained when water level is visible in window. The low water cut-off switch will activate when water level reaches the bottom of the window.

2.3 Setting Temperature—SMS-1000

Using the key provided with the pump (or a small screwdriver), set temperature by aligning the red line on the adjustment dial with the desired temperature marking on the front panel. Remove key to prevent unauthorized adjustment. (See Fig. 2.1.)

Caution: Set temperature as prescribed by physician.

2.4 Setting Temperature—SMS-2000

MICRO-TEMP® PUMP SMS-2000 must be filled with water and connected to a pad before attempting to set temperature. (See Para. 2.2).

Press power switch to the "ON" (lighted) position. The digital display will flash "1888" four times, sound the audible alarm once, flash setpoint temperature four times, and display water temperature as unit begins to run.

The reason for displaying "1888" is to check for proper operation of all display segments. As an example, if an upper horizontal segment burned out, a seven would become a one. The operator should watch that all segments are operating each time the pump is turned on. If a segment does not illuminate, remove from service and repair.

The audible alarm will sound once to check its operation. If the alarm does not sound, remove from service and repair.

The setpoint temperature at which the pump last operated will flash four times. The first time a new pump is turned on, the setpoint will be 105°F. Afterwards, the setpoint will flash the same temperature at which it was last set, even if a unit has been unplugged.

To prevent inadvertent or unauthorized resetting of the setpoint temperature, a "hidden switch" has been incorporated into the front panel. This switch is the ball-shaped symbol to the left of the Seabrook name. (See Fig. 2.1, Item 13.) Depressing the symbol will cause the digital display to flash the setpoint temperature and "unlock" the increment ("up" arrow) and decrement ("down" arrow) keys. Setpoint temperature will flash to distinguish it from water temperature as these will eventually be the same.

Caution: Set temperature as prescribed by physician.

Set temperature as follows:

- (1) Select centigrade or Fahrenheit readout by pressing °C/°F switch.
- (2) Press and hold Seabrook symbol switch. Display will flash.
- (3) Press increment or decrement switch to raise or lower setpoint temperature. Release Seabrook switch.

To check setpoint temperature, press the Seabrook symbol switch. The arrow keys may only be activated while this switch is held.

2.5 Operating The MICRO-TEMP Heat Therapy System

▲ 2.5.1 Power

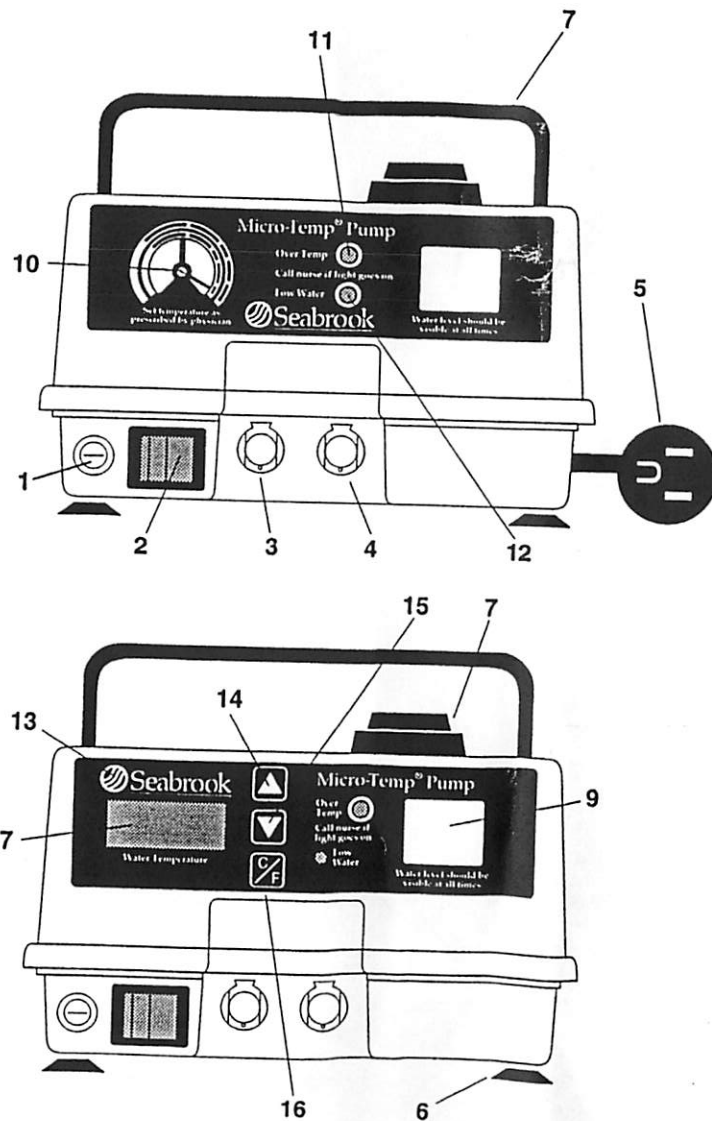
Plug power cord into grounded receptacle providing proper AC voltage and frequency as indicated on rear of pump.

Warning: Risk of explosion if used in the presence of flammable anesthetics.

Warning: Power cord has "HOSPITAL GRADE" plug. Grounding reliability can only be achieved when connected to an equivalent receptacle marked "HOSPITAL GRADE."

Fig. 2.1

Item	Description	Item	Description
1.	Fuseholder	10.	Setpoint dial - Adjustable with key
2.	Lighted power switch	11.	Over temperature pilot light (red)
3.	Output hose coupling	12.	Low water pilot light (amber)
4.	Return hose coupling	13.	Setpoint switch
5.	Power cord with hospital grade plug	14.	Increase setpoint switch
6.	Suction feet	15.	Decrease setpoint switch
7.	Reservoir fill cap	16.	°C/°F selector switch
8.	Folding handle	17.	Digital temperature display
9.	Water reservoir		



▲ 2.5.2 Filling

See Para. 2.2. Maintain water level at mid to upper window level. Refill with *distilled water* as necessary.

▲ 2.5.3 Setting Temperature

See Para. 2.3 for SMS-1000 or Para. 2.4 for SMS-2000.

▲ 2.5.4 Operating

Press power switch to the "ON" position. A lighted power switch indicates the unit is on. The pump will now begin to circulate water. (Note: SMS-2000 goes through an eight second operational check before allowing the pump to start.) Allow ten to fifteen minutes for the water to reach selected temperature.

▲ 2.5.5 Cleaning

The MICRO-TEMP® Pump case is constructed of plastic. Wipe outer surface with a cloth soaked in a solution of water and mild detergent. Rinse cloth of excess solution before applying to unit.

▲ 2.5.6 Pads

The Seabrook TEMP-PAD® is recommended for best results with your MICRO-TEMP. It has been designed to allow maximum flow while resisting restriction or kinks. The unique foam-layered side offers maximum patient comfort while retaining moisture far longer than other brands when used for moist heat therapy.

Caution: Always check clamps to make sure they are fully open. Check hose couplings to be certain they are properly locked together. Make sure hose and pads are free of kinks that might restrict flow.

▲ 2.5.7 Cold Therapy

MICRO-TEMP Pumps may also be used for the application of cold therapy by filling the reservoir with ice water. On SMS-1000 turn the dial to the "HEATER OFF" position. On SMS-2000 lower the setpoint temperature until "OFF" appears on the digital display.

▲ 2.5.8 Hospital I.D. Label

This label on the rear of the pump contains an imprintable ink area which accepts ball point or felt tip pen ink, etc. This is provided as a convenient place to add any additional hospital information, such as dates of preventative maintenance.

▲ 2.5.9 Storage

MICRO-TEMP Pumps can be stored with or without hoses connected. If storing the hose separately from the pump is preferred, simply insert the male connectors from the pump end of the hose into the female connectors from the pad end.

The MICRO-TEMP may be stored full of water or empty for short-term storage. If long-term storage is contemplated, it is best to drain the pump. Any commonly available antibacterial solution may be added to the reservoir to disinfect it prior to prolonged storage.

3. Specifications

Physical	SMS-2000	SMS-1000
Size	8½" w x 6 1/16" d x 5¾" h	same
Weight	5.25 lbs.	4.7 lbs.
Hose length	8 ft.	same
Portability	fold-down metal carrying handle, cordstrap	same
Connectors	quick-connect, self-sealing	same
Case Material	G.E. Noryl®	same
Case Color	off-white	same

Control System		
Type	microprocessor-based, digital	solid state, analog
Accuracy	±1°F (±.55°C)	±1.5°F (±.82°C)
Self-Calibrating	yes	no
Setpoint Read-out	digital	analog
Water Temp. Display	digital	none
Display Range	31°- 121°F (0°- 49°C)	none
Heating System		
Temperature Range	78°- 107°F (25°- 42°C)	86°- 107°F (30°-42°C)
Heating Element	150W	same
Electrical System		
Voltage	115V., 60Hz.	same
Current	1.75 Amp.	same
Fuse	3 Amp. type 3AG	same
Power Cord	3 conductor, 18 AWG, 10' molded hospital grade plug	same
Leakage Current	under 50 microamps.	same
Lighted On/Off Switch	yes	same
Circulating System		
Reservoir Capacity	30 oz. (887 ml)	same
Reservoir Fluid	distilled water	same
Fill Cap	vented	same
Flow Rate (thru pad)	10-14 GPH (37-53 LPH)	same
Water Level Indication	window to translucent reservoir	same
Low Water Cut-Off Switch	yes (heater and pump)	same
Tilt Switch	yes (heater and pump)	same
Storage	wet or dry	same
Safety System		
Overheat Protection		
Primary High Limit Thermostat	110°- 116°F (43.3°- 46.6°C)	same
Secondary High Limit Thermostat	112°- 122°F (44.4°- 50°C)	same
Operating Instructions	printed on pump	same
Warning Lights	"Over Temp" and "Low Water" lights alert patient to call nurse	same
Audible Alarm	"Low Water", "Tilt", "Open Sensor" "High Limit" (111°F- 44°C)	none
UL 544 Listed	yes	yes

4. General Maintenance and Checkout Procedures

4.1 General

This section provides recommended preventative maintenance and checkout procedures and calibration instructions for Seabrook MICRO-TEMP® Pumps. A list of tools and equipment required for maintenance and checkout is listed in Table 4.1.

Maintenance and checkout procedures must be performed by qualified personnel, such as a certified biomedical electronic technician or a certified clinical engineer familiar with good practice for medical devices.

Caution: Repairs of Seabrook Medical equipment by unqualified persons may void the warranty.

4.2 Preventative Maintenance

A complete check of all MICRO-TEMP Pump parameters should be made on a regularly scheduled basis. Frequency of checkout should follow your hospital's guidelines for this type equipment, usually at three to six month intervals. Emergency Care Research Institute (E.C.R.I.) recommends one major and one minor checkout per year at six month intervals. Seabrook Medical Systems suggests preventative maintenance every three months if possible.

The importance of properly documenting test results cannot be overstressed. Follow your hospital's inspection form or follow the sample form shown in Fig. 4.1.

4.3 Checkout Procedures

It is suggested you perform the following procedures in their order of listing and document the results on a Preventative Maintenance Inspection Record. To repair or replace any damaged, missing, or otherwise inoperative component, see **Component Removal and Replacement, Section 5.**

1. Exterior Physical Inspection. Look for cracked, bent, missing, or otherwise damaged parts. Carefully inspect the power cord for cuts or exposed wire. Check the plug for missing or bent pins. Remove the fuse and make sure it is the same type and rating as described on top of the unit.

Connect the pump to the flow rate/temperature tester, Cat. No. SMS-A0122 and to a TEMP-PAD®, as shown in Fig. 4.2. Fill the pump with **distilled water** and plug into a grounded outlet providing the correct voltage and frequency. Set the temperature to its maximum 107°F (42°C). Turn on pump.

2. Flow Test. Maximum flow rate is obtained with water temperature at 107°F/42°C, with the pad laying flat on a smooth surface. If no flow rate is observed, check for reversed connections to pump, kinked pad or hose, clamps closed on pad, or couplings not properly seated and locked together. Allow water temperature to reach its maximum, and check flow rate. If less than 9 G.P.H., check pump and/or pad for restrictions. See **Trouble Shooting Guide, Section 6.**

3. Temperature Test. Let pump run 60 minutes if possible to allow internal operating temperatures to stabilize before performing this test. Take readings from the dial thermometer or add water to the thermometer well and insert a glass thermometer with appropriate range such as 25° to 125°F (0° to 50°C). Note temperature every 30 seconds for five minutes, (10 readings). Record the average of these readings. SMS-1000 should average 107°F ±1.5°F at its maximum (fully clockwise) setting. Temperature swings should not exceed two degrees Fahrenheit from minimum to maximum. SMS-2000 should average ±1°F of reading on digital readout. Temperature swings should not exceed one degree Fahrenheit from minimum to maximum. If out of calibration refer to Para 4.4.

4. Tilt Switch Test. With pump running, tilt unit in any direction. At approximately 35° from horizontal, SMS-1000 should shut off the pump and heater and illuminate the "LOW WATER" pilot light. SMS-2000 should shut off the pump and heater and sound the audible alarm. If tilt switch does not operate, replace switch or P.C. board(s).

5. Low Water Switch Test. To perform this test, first determine which tube on the pad returns water to the pump. (The left coupling on the pump is output, the right coupling, return.) Turn the pump off, clamp the return tube on the pad, disconnect from hose, and place end of tube from pad into a container capable of holding at least a pint of water. Release the clamp and turn pump on. If water does not gush from pad tube, you have selected the wrong tube. As water level reaches the bottom of window area the pump and heater will shut off and the "LOW WATER" light will illuminate. SMS-2000 will also sound an audible alarm. Reconnect pad to hose and pour water back into reservoir. The pump should resume operation.

6. Leakage Current Test. Connect ground lead clamp of leakage current tester to the handle ferrule on the right side of the unit. Plug pump into tester. Test unit

Table 4.1—Tools and Equipment

1. Seabrook flow and temperature tester, Cat. No. SMS-A0122.
2. (Optional) thermometer, glass, 25° to 125°F, or equiv.
3. Leakage current tester--Bio-Tek Cat. No. 170 or equiv.
4. Digital VOM.
5. Seabrook test plug, Cat. No. SMS-A1026.
6. Patchcord with micro-gator clips, 12" length.
7. Screwdriver, phillips, no. 2 point.
8. Screwdriver, regular, ¼" tip.
9. Nutdriver, ¼" hex.
10. Wrench, open end, 9/16".
11. Wrench, open end, 21 mm.
12. Socket, 3/4", six point.
13. Socket, 1¼".
14. Pliers, needlenose.
15. Pliers, strain relief bushing, Heyco, Part No. 0022 (no. 29).
16. Terminal extraction tool--AMP, Part No. 91065-1.
17. Pipe joint compound--Permatex Tack and Seal, Part No. 9A or equiv.
18. Thermal compound--Wakefield, Part No. 120 or equiv.

in all combinations of power switch off and on, heater off and on, normal and reverse polarity, and normal and open ground. Record highest reading. If more than 100 microamperes, refer to Troubleshooting Guide, Section 6. Disconnect current leakage tester set-up. *Note: For the remaining tests, the pump cover must be loosened and/or removed.*

Caution: Risk of electric shock. Only qualified service personnel should remove cover.

7. Ground Continuity Test. Using an ohmmeter, measure the resistance between the heater mounting plate and the ground pin of the power plug. This value shall not exceed 0.2 ohm. If higher than 0.2 ohm, see Troubleshooting Guide, Section 6.

The following tests require the removal of the top for set-up. Refer to Component Removal and Replacement, Section 5. These tests should be performed in a room temperature not less than 70°F (21°C) with a pump which has been running and is warm.

8. Primary High-Limit Thermostat Test. Disconnect the four position connector containing the temperature sensor and float switch leads, from the P.C. board. Install the test plug, Cat. No. SMS-A1026 in this same location. (Note the locating tabs. This is a polarized connector.) Replace cover, connect power plug and turn pump on. Carefully observe rising temperature on the dial or glass thermometer and record the reading at the moment the pump stops and the "OVER TEMP" light illuminates.

The primary high-limit thermostat must operate between 110°- 116°F. If outside this range, it must be replaced. See Component Removal and Replacement, Section 5.

9. Secondary High-Limit Thermostat Test. Turn pump off, disconnect power plug and remove cover. Using jumper leads, short across primary thermostat [44]. (See Fig. 7.2.) This is most easily accomplished by jumpering from the red and black wire combination on the power switch to the brown wire from the secondary thermostat. Be sure to position jumper to not interfere with P.C. board(s) when cover is replaced. Replace cover, connect power plug, and turn pump on. Carefully observe rising temperature on the dial or glass thermometer and record the reading at the moment the pump stops and the "OVER TEMP" light illuminates.

The secondary high-limit thermostat must operate between 112°-122°F. If outside this range, it must be replaced. See Component Removal and Replacement, Section 5.

Note: It is possible for the secondary thermostat to operate at a lower temperature than the primary thermostat. If this happens, simply jumper across the secondary thermostat and retest the primary thermostat.

Turn pump off, disconnect power cord, and remove cover. Remove jumpers and test plug. Replace the four position connector. (Note the locating tabs. This is a polarized connector.) Do not replace cover until next procedure has been completed.

10. Internal Physical Inspection. While the cover is removed, carefully inspect the unit for any signs of leaks, loose components, or damage. Check wiring for breaks in insulation, exposed wires, loose connections, etc. Repair or replace components as necessary and retest unit before placing back into service. Once inspection is complete, replace cover. After unit has cooled enough to allow thermostats to reset, run unit long enough to assure all connections have been properly made and the pump is in good working order.

Fig. 4.2

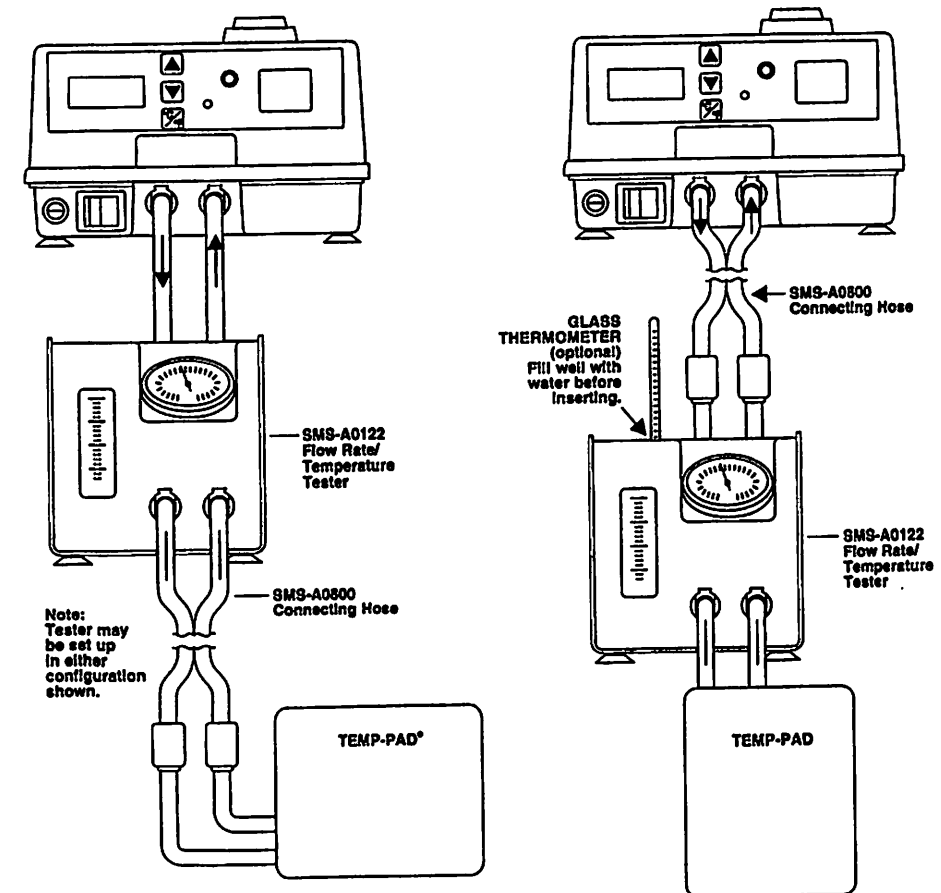


Fig. 4.1 Sample - Preventative Maintenance Inspection

Procedure	1/1/95	3/1/95	6/1/95	9/1/95
1. Exterior physical inspection	OK			
2. Flow test—Insert value	12 GPH			
3. Temperature test—Insert value	107.2°F			
4. Tilt switch test	OK			
5. Low water switch test	OK			
6. Leakage current test—Insert value	18ma			
7. Ground continuity test—Insert value	.09 ohm			
8. Primary hi-limit thermostat test— Insert value	112.8°F			
9. Secondary hi-limit thermostat test— Insert value	118.1°F			
10. Internal physical inspection	OK			

4.4 Calibration

See Checkout Procedures, 4.3. If unit is out of specification, perform the following calibration procedure.

▲ 4.4.1 SMS-1000

1. Turn unit off, unplug, and remove the two phillips head screws from the base. Remove the reservoir cap.
2. Lift the cover and tilt toward the front of the unit.
3. Locate potentiometer R3 on the P.C. board. See Fig. 7.3.
4. Turn R3 counterclockwise to increase water temperature, and clockwise to decrease. Make small adjustments (1/16" or less).
5. Replace cover and turn unit on.
6. Record temperature readings every 30 seconds for five minutes.
7. Repeat steps 1-6 until average reading is 107°F ±1.5°F.
8. Allow unit to run at least 30 minutes and again record temperature readings. If calibration is out of specification, repeat steps 1-7.
9. Replace the two phillips head screws.

Note: Internal operating temperatures will affect water temperature. Allow unit to run at least 30 minutes to stabilize these temperatures before making final recordings. Accurate calibration cannot be recorded unless cover is properly seated on the base.

▲ 4.4.2 SMS-2000

The microprocessor based SMS-2000 does *not* require and *cannot* be calibrated by service personnel. This model self-calibrates every 75-80 seconds, effectively zeroing out component value drifts due to aging, temperature change, etc. If the SMS-2000 is out of specification, factory repair or replacement may be necessary. See Warranties, Section 1.6, or call Seabrook Technical Service at (800) 477-7757 or (513) 753-7700.

5. Component Removal and Replacement

5.1 General

This section provides instructions for the disassembly and removal of the major components contained within SMS-1000 and SMS-2000 heat therapy pumps.

Performing steps in reverse order for reassembly also means substituting reconnect for disconnect, replace for remove, etc. Refer to Figs. 7.1-7.4 for component identification.

Note: Make sure unit is unplugged and all necessary tools are available (see Table 4.1) before attempting any of the following procedures.

5.2 Cover

1. Remove two phillips head screws [60].
2. Remove fill cap [25] and lift cover clear of reservoir neck.
3. Tilt cover toward front of unit and lay on its face.
4. Disconnect the green ground wire from the P.C. board.
5. Disconnect the six position power cable connector from the P.C. board.
6. Disconnect the four position cable connector from the P.C. board.

To replace the cover, perform steps 1-6 in reverse order. Carefully position all wiring so none is pinched or creates interference between the cover and other components.

Note: The P.C. board cable connectors are polarized. Make sure the locating tabs on the housings align with the slots in the headers.

5.3 P.C. Board-SMS-1000

1. Remove cover. See Cover, 5.2.
2. Disconnect the pilot light connector [17] from the P.C. board.
3. Remove the four screws securing the P.C. board and remove the board.

To replace the P.C. board, perform steps 1-3 in reverse order.

5.4 P.C. Board-SMS-2000

1. Remove cover. See Cover 5.2.
2. Disconnect the pilot light connector [16] from the high voltage P.C. board [20].
3. Disconnect the cable connector [24] from the CPU P.C. board [21].
4. Remove the aluminum standoff and lift out the high voltage P.C. board/bracket assembly.
5. Remove the four screws securing the CPU/Display P.C. board. Note the location of the green wires and reattach to this location during replacement.
6. Carefully lift the P.C. board and disconnect the front panel connector from the front of the board. Lift out the P.C. board.

To replace the P.C. board, perform steps 1-6 in reverse order. Make sure the front panel connector is correctly and securely connected to the P.C. board.

5.5 Pilot Light

1. Remove cover. See Cover, 5.2.
2. Remove P.C. board(s). See P.C. BOARD-SMS-1000, 5.3; or P.C. Board-SMS-2000, 5.4.
3. Extract pilot light terminals from terminal housing [16] [17] using extraction tool AMP #91065-1. See Fig. 5.1.
4. The pilot light(s) [13] [14] [15] is secured to the front panel with a spring metal clip. To remove the clip either bend back the clips with a small screwdriver or using cutting pliers, snip through the clip.
5. Press the pilot light out through the front panel.

To replace the pilot light(s) follow steps 6-10.

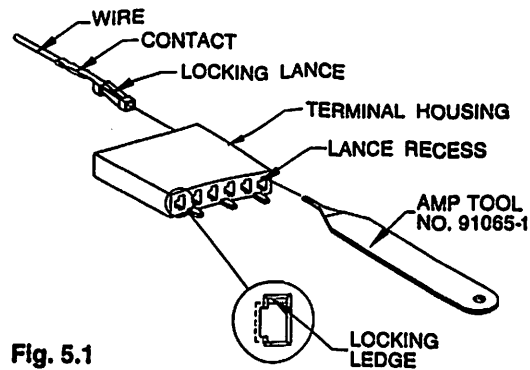
6. Insert the pilot light with terminals through the front panel and press firmly into place.
7. Press and firmly seat a new spring clip over the pilot light. Make sure pilot light remains flush to front of front panel.
8. Insert terminals into terminal housing.
9. Replace P.C. boards and cover.

5.6 Front Panel

1. Remove cover. See **Cover**, 5.2.
2. Remove P.C. board. See **P.C. Board—SMS-1000**, 5.3; or **P.C. Board—SMS-2000**, 5.4.
3. Peel front panel from cover.

To replace front panel, perform steps 4-5.

4. Remove the protective backing from a new front panel and carefully attach to the cover.
5. Replace the P.C. boards and Fig. 5.1 cover.



5.7 Power Switch

1. Remove cover. See **Cover**, 5.2.
2. Depress power switch [46] mounting ears and push switch out through opening in base.
3. Disconnect wires from four terminals on power switch. Note orientation of switch for reassembly. See Fig. 5.2.

To replace power switch, perform steps 1-3 in reverse order. **MAKE SURE WIRES ARE CORRECTLY RECONNECTED.**

5.8 Fuseholder

1. Remove cover. See **Cover**, 5.2.
2. Disconnect black wire from top of fuseholder.
3. Disconnect black power cord lead from end of fuseholder.
4. Remove retaining nut from fuseholder.
5. Push fuseholder out through hole in cover.

To replace fuseholder, perform steps 1-5 in reverse order. **MAKE SURE FUSEHOLDER IS INSTALLED WITH SIDE TERMINAL FACING UP.**

Note: Fuseholder removal/replacement is easier if power switch is first removed. See **POWER SWITCH** 5.7.

5.9 Power Cord

1. Remove cover. See **Cover**, 5.2.
2. Disconnect green power cord lead from manifold.
3. Disconnect white power cord lead from power switch.
4. Disconnect black power cord lead from fuseholder.
5. Remove strain relief bushing [49]. This is most easily accomplished using HEYCO tool no. 29.
6. Pull power cord through opening in cover.

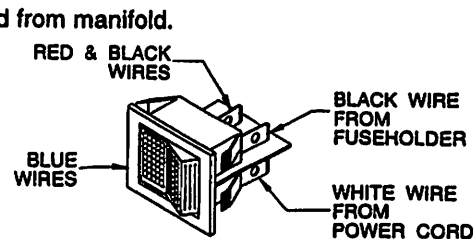


Fig. 5.2

To replace power cord, perform steps 1-6 in reverse order. **MAKE SURE LEADS ARE CORRECTLY AND SECURELY RECONNECTED. ROUTE LEADS THROUGH WIRE CLIP.**

5.10 Hose Coupling

1. Drain reservoir.
2. Remove cover. See **Cover**, 5.2.

3. Remove stainless steel hardware from the coupling. See Fig. 5.3.
4. Using a 3/4", 6 point socket, unscrew the coupling. Be sure the manifold [42] or elbow [39] (depending on which coupling is being removed) does not twist.

To replace hose coupling(s) perform steps 5-11.

5. If replacing a new coupling, first remove the stainless steel hardware. See Fig. 5.3. **Do not lose any parts!**
6. Either wrap the coupling threads with teflon pipe tape or coat with pipe joint compound.
7. Using a 3/4", 6 point socket, screw the coupling into the manifold [42] or elbow [39] (depending on which coupling is being replaced). Secure the manifold or elbow to insure they do not turn during installation of coupling. Make sure coupling is tight and the hole in the hex surface is facing up. If replacing the return (right) coupling, make sure the washer is in place between the base and the elbow.
8. Replace the stainless steel hardware.
9. Replace cover.
10. Fill reservoir and run pump for one hour.
11. Unplug unit, remove cover and inspect for leaks at the replaced coupling(s).

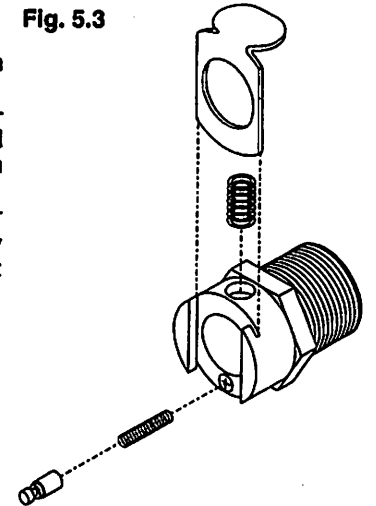
5.11 Primary Thermostat

1. Remove cover. See **Cover**, 5.2.
2. Carefully desolder the brown and red wires from the primary thermostat [44] terminals.

Fig. 5.3

Warning: Extreme care must be taken to avoid touching other wiring or components with hot soldering iron.

3. Remove the two screws securing the primary thermostat to the manifold, being careful not to lose the washers.
 4. Lift off the thermostat.
- To replace the primary thermostat, perform steps 5-8.
5. Set a new thermostat in place on the manifold.
 6. Secure the thermostat to the manifold with the two screws removed in step 3. Make sure the two green wires and the lockwashers are in place.
 7. Solder the brown and red wires to the thermostat terminals.
 8. See **Checkout procedures**, 4.3, and perform the test to insure proper operation of the primary thermostat.



5.12 Secondary Thermostat

1. Remove cover. See **Cover**, 5.2.
2. Carefully desolder the brown and yellow wires from the secondary thermostat [45] terminals.

Caution: Extreme care must be taken to avoid touching other wiring or components with hot soldering iron.

3. Remove the two hex nuts securing the secondary thermostat [45] to the heater mounting plate [31], being careful not to lose the lockwashers.
4. Lift off the thermostat.

To replace the secondary thermostat, perform steps 5-8.

5. Set a new thermostat in place on the heater mounting plate.
6. Secure the thermostat to the heater mounting plate using the two hex nuts and lockwashers removed in Step 3.
7. Solder the brown and yellow wires to the thermostat terminals.
8. See **Checkout Procedures, 4.3**, and perform the test to insure proper operation of the secondary thermostat.

5.13 Thermistor Temperature Sensor

1. Remove cover. See **Cover, 5.2**.
2. Using cutting pliers, carefully snip the cable ties securing the temperature sensor [43] leads to the float switch [37] leads.

Note: Extreme care must be taken to avoid damage to leads.

3. Using extraction tool, AMP No. 91065-1 (See **Fig. 5.1**), remove the sensor lead terminals from the terminal housing.
4. Unscrew the temperature sensor from the manifold.
To replace the thermistor temperature sensor, perform steps 5-9.
5. Coat the threads of a new thermistor temperature sensor with thermal compound, such as WAKEFIELD ENGINEERING Part No. 120, and screw the sensor tightly into the manifold.
6. Insert the sensor lead terminals into the terminal housing.
7. Secure the sensor leads and float switch leads together using standard small cable ties.
8. Replace cover.
9. Perform a temperature calibration check. See **Checkout Procedures, 4.3**.

5.14 Heater

*Note: Although not necessary, this procedure may be easier to perform after removing the pump/reservoir assembly. See **Pump/Reservoir Assy. 5.15**.*

1. Drain reservoir.
2. Remove cover. See **Cover, 5.2**.
3. Remove the two screws securing the heater mounting plate [31] to the base [2].
4. Using cutting pliers, carefully snip all the cable ties securing the heater leads. *Note: Extreme care must be taken to avoid damage to other wiring.*
5. Using extraction tool, AMP No. 91065-1 (See **Fig. 5.1**), remove the heater lead terminals from the six position connector housing.
6. Separate heater leads from all other wiring.
7. Lift the reservoir just enough to allow the heater to clear the base and unscrew the heater from the heater mounting plate.

To replace the heater, perform steps 8-14.

8. Either wrap the new heater threads with teflon pipe tape or coat with pipe joint compound.
9. Lift the reservoir just enough to allow the heater to clear the base and screw the heater tightly into the heater mounting plate.
10. Route the heater leads along the other wiring and secure together with standard small cable ties.
11. Insert the heater lead terminals into the six position terminal housing.
12. Secure the heater mounting plate to the base using the two screws removed in Step 3. Make sure the lockwashers are in place.
13. Fill reservoir and check for leaks around heater threads.
14. Replace cover.

5.15 Pump/Reservoir Assy.

1. Drain reservoir.
2. Remove cover. See **Cover, 5.2**.
3. Remove the output (left) hose coupling [41]. See **Hose Coupling, 5.10**.

4. Remove the two screws securing the heater mounting plate [31] to the base [2].
5. Disconnect tubing [38] from the reservoir [27].
6. Move the pump/reservoir assembly up and away from the power switch to allow better access to the rear of the power switch.
7. Disconnect the green power cord wire from the manifold [42].
8. Disconnect the red and black wires combination by sliding the black wire piggy-back connector off the upper left terminal of the power switch. (As viewed from front of unit.)
9. Disconnect the blue wires combination by sliding the piggy-back connector off the lower left terminal of the power switch.
10. Lift and remove the pump/reservoir assy. from the base.

To replace the pump/reservoir assy., perform steps 1-10 in reverse order.

*Note: Make sure the wires are correctly reconnected to power switch. Blue wires to lower terminal. Black and red wires to upper terminal. See **Fig. 5.2**.*

5.16 Float (Low Water) Switch

1. Remove pump/reservoir assembly. See **Pump/Reservoir, 5.15**.
2. Using cutting pliers, carefully snip the cable ties securing the float switch [37] leads to the temperature sensor [43] leads.

Note: Extreme care must be taken to avoid damage to leads.

3. Using extraction tool, AMP No. 91065-1 (See **Fig. 5.1**), remove the switch lead terminals from the terminal housing.
4. Remove the eight hex nuts securing the heater mounting plate [31] to the reservoir [27].
5. Pull the plate straight out from the reservoir until it clears the mounting studs and swing it to the left out of the way.
6. Remove the retaining nut from the float switch.
7. Reach through the opening in the reservoir, grasp the float switch, and maneuver it out of the reservoir.

To replace the float switch, perform steps 8-17.

8. Remove the retaining nut from a new float switch.
9. Feed the switch leads through the reservoir opening and through the switch mounting hole.
10. Maneuver the switch into the mounting hole in the reservoir. Position switch as shown in **Fig. 5.4**.

Note: Make sure the gasket is properly seated in the switch mounting flange before the switch is secured in place.

11. Replace and tighten the retaining nut.
12. Carefully slide the heater mounting plate over the mounting studs and secure with the eight (8) hex nuts. Make sure all lockwashers are in place and the green wire is attached to the lower left stud.
13. Insert the switch lead terminals into the terminal housing.
14. Secure the float switch leads to the temperature sensor leads using standard small cable ties.
15. Replace pump/reservoir assembly into the base.
16. Fill reservoir and thoroughly inspect for leaks.
17. Replace cover.

5.17 Pump

1. Remove pump/reservoir assembly. See **Pump/Reservoir, 5.15**.
2. Remove the screw attaching the green wire from the pump [33] to the manifold [42].
3. Disconnect the pump blue wire from the other blue wire.

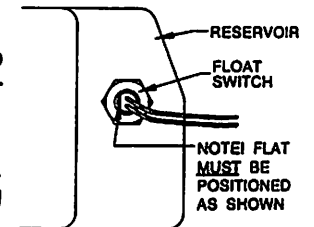


Fig. 5.4

4. Using cutting pliers, carefully snip the cable ties securing the brown pump lead to the other wiring.
5. Using extraction tool, AMP 91065-1 (See Fig. 5.1), remove the brown lead from the six position terminal housing.
6. Remove the eight hex nuts securing the heater mounting plate [31] to the reservoir [27].
7. Pull the plate straight out from the reservoir until it clears the mounting studs and swing it to the left out of the way.
8. Remove the three mounting screws [56] securing the pump to the reservoir.
9. Separate the pump [33] from its housing which is still attached to the reservoir.

To replace the pump, perform steps 10-20.

10. If a new pump is being installed, remove the three screws securing the housing to the pump and lift off the housing.
11. Carefully maneuver the new pump into place on the housing (still attached to the reservoir), making sure the O-ring is properly seated.

Note: The O-ring must be properly installed to prevent leaking.

12. Replace the three screws [56] securing the pump to the reservoir.
13. Carefully slide the heater mounting plate over the mounting studs and secure with the eight hex nuts. Make sure all lockwashers are in place and the green wire is attached to the lower left stud.
14. Insert the brown pump lead into the six position terminal housing.
15. Secure the brown lead to the other wiring as before, using standard small cable ties.
16. Reconnect the blue pump lead to the other blue wire.
17. Reattach the green wire to the manifold [42].
18. Replace the pump/reservoir assembly. See Pump/Reservoir, 5.15.
19. Fill reservoir and thoroughly inspect for leaks.
20. Replace cover.

6. Troubleshooting Guide

6.1 General

This section provides information to aid the service technician in diagnosing problems with the MICRO-TEMP® Heat Therapy Pump. The left column lists problems that could occur; the right column lists the most probable causes. If additional help is needed, call Seabrook Technical Service at (800) 477-7757 or (513) 753-7700.

<i>Problem</i>	<i>Probable Cause</i>
Unit will not turn on. (Power switch will not illuminate.)	1. Unit not plugged into proper voltage supply. 2. Blown fuse.
Unit turns on but will not pump or heat. No warning lights on.	1. Terminal housings improperly connected to P.C. board(s). 2. Defective P.C. board(s).
Unit will heat but pump will not run.	1. Loose or defective connection in pump leads. 2. Defective pump.
Pump runs but unit will not heat.	1. Loose connection or broken lead from temperature sensor. 2. Defective P.C. board(s). 3. Defective heater.

Display will not illuminate.
(SMS-2000)

1. Cable between high voltage P.C. board and CPU board disconnected or improperly connected.
2. Front panel connector disconnected or improperly connected to display P.C. board.
3. Defective high voltage P.C. board.
4. Defective CPU/display P.C. board assembly.

Low water warning light on.

1. Reservoir water level too low.
2. Loose connection or broken lead from float switch.
3. Defective float switch.
4. Defective P.C. board(s).
5. Unit tilted (SMS-1000).

Audible alarm sounds
(SMS-2000)

1. Reservoir water level too low.
2. Unit tilted.
3. Temperature readout indicates 111°F (44°C) or higher.
4. Loose connection or broken lead from float switch.
5. Defective P.C. board(s).

Over temp. warning light on.

1. Hose and pad not connected to pump.
2. Hose or pad coupling(s) not properly locked together.
3. Clamps on pad closed.
4. Kink or other restriction in hose or pad.
5. Water used to fill pump too hot.
6. Defective thermostat.
7. Defective P.C. board(s).
8. Defective pump.

Display indicates 121°F (50°C)
(SMS-2000)

1. Four position connector from temperature sensor and float switch leads reversed at P.C. board.
2. Shorted temperature sensor.

Display indicates 31°F (0°C)

1. Loose connection or broken lead from temperature sensor.
2. Opened temperature sensor.

Flow rate less than 9 GPH.

1. Water temperature not at maximum 107°F (42°C).
2. Reversed connection to test setup.
3. Hose or pad coupling(s) not properly locked together.
4. Clamps on pad closed.
5. Kink or restriction in hose or pad.
6. Defective pad.
7. Defective pump.

Ground continuity exceeds .2 ohm.

1. Loose or disconnected ground (green) wire(s).
2. Defective connector on ground wire.
3. Defective power cord.

Leakage current exceeds 100 microamperes.

1. Defective heater.
2. Defective pump.
3. Defective high voltage P.C. board (SMS-2000)

Unit fails dielectric voltage withstand test (HY-POT)

1. Secondary thermostat terminal arcing to handle standoff.
2. Primary thermostat terminal arcing to ground.
3. Defective heater.

7. Service and Parts Information

7.1 Obtaining Service

▲ 7.1.1 Under Warranty—See Section 1, Para. 1.6.1.

▲ 7.1.2 Out of Warranty—Several alternatives exist regarding out of warranty service of your MICRO-TEMP® Pumps. They are as follows:

1. In-house service by your Biomedical Engineering Department.
2. Contract service by our authorized distributor either at his facility or in the hospital, at the distributor's option.
3. Factory service by Seabrook Medical Systems upon return, Freight Prepaid, of the defective product. The pump must be accompanied by documentation including a Return Authorization Number obtained when the problem was first reported to the Seabrook Customer Service Department.

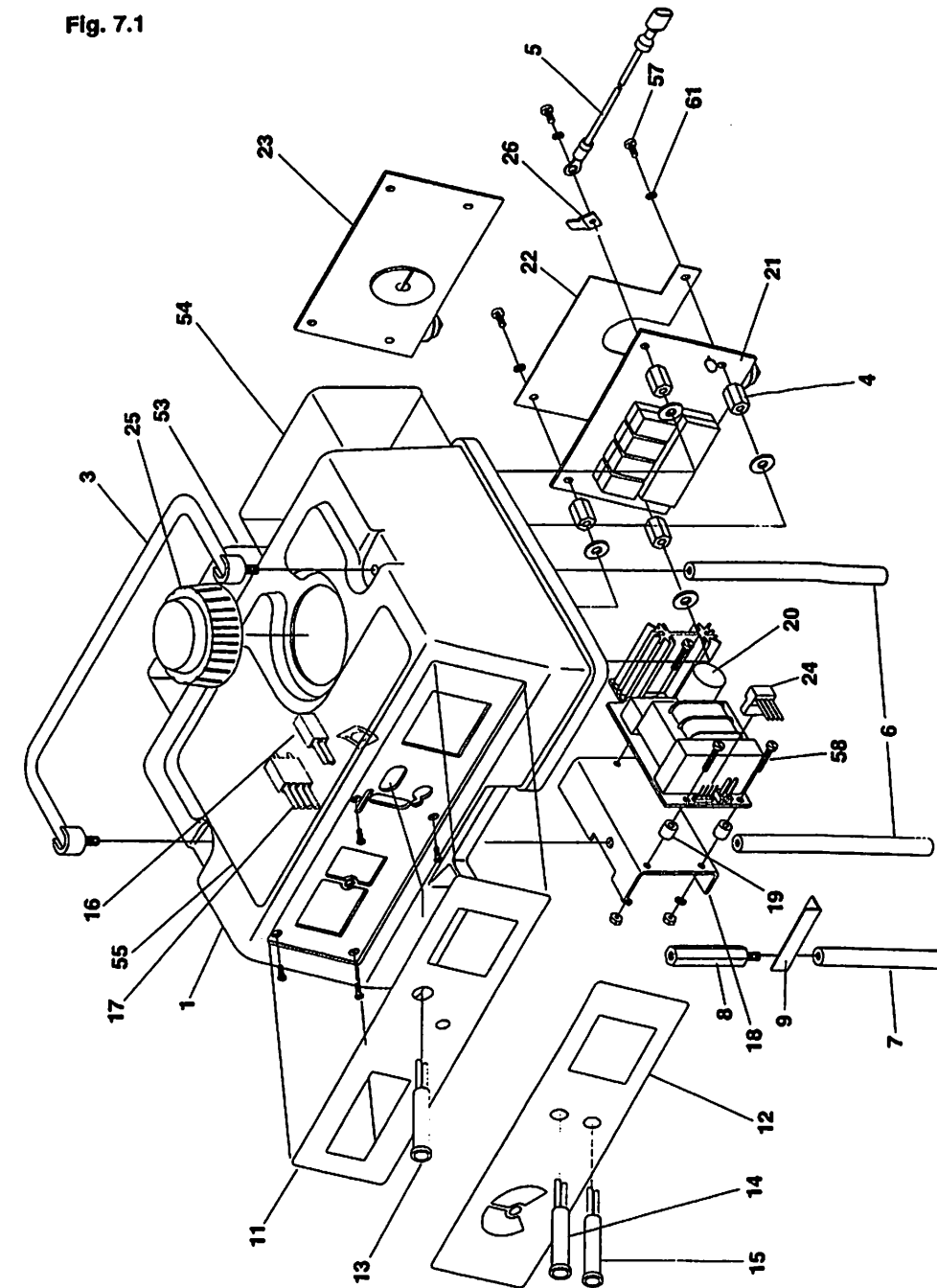
7.2 Ordering Replacement Parts

▲ 7.2.1 Under Warranty—See Section 1, Para. 1.6.3.

▲ 7.2.2 Out of Warranty—Replacement parts are available directly from Seabrook Medical Systems. Please refer to the parts list and order by the part number. Orders may be mailed or phoned to:

Seabrook Medical Systems, Inc.
Customer Service Department
4043 McMann Road
Cincinnati, Ohio 45245-1933
(800) 477-7757
(513) 753-7700
(513) 753-7744 fax

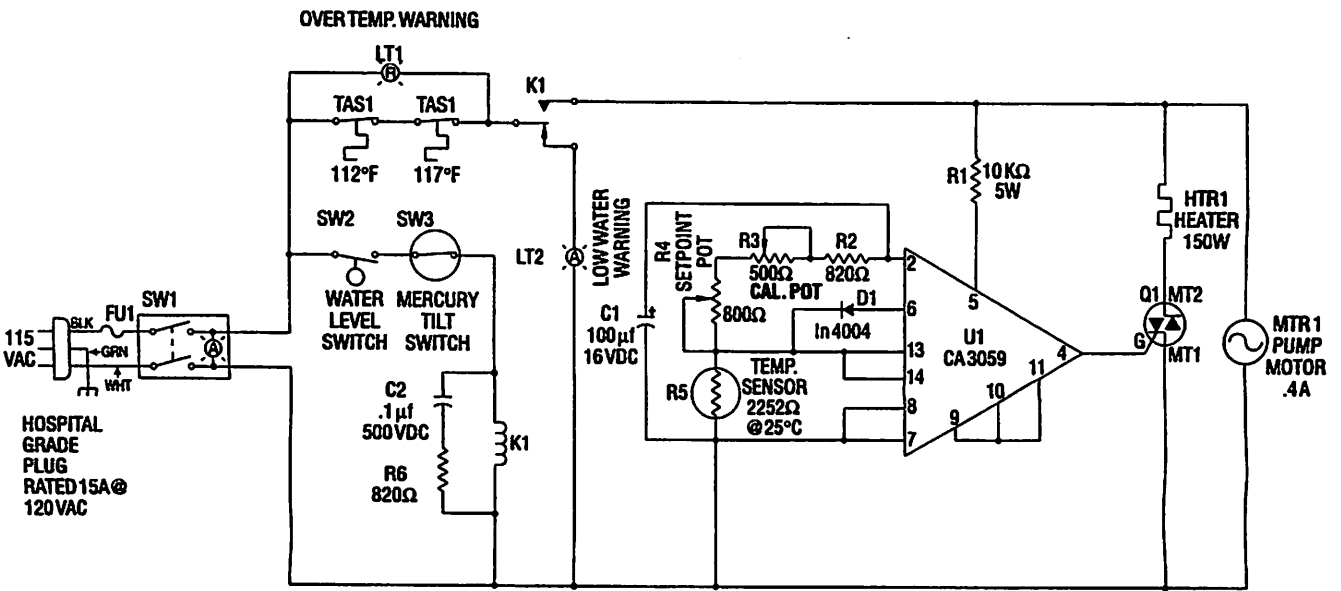
Fig. 7.1



Item	Part No.	Description	SMS-1000	SMS-2000
1	10002	Enclosure, Top	1	1
2	10001	Enclosure, Base	1	1
3	A-1019	Handle Assy.	1	1
4	11433	Standoff, F/F 3/8" lg.	4	4
5	A-1475	Ground wire assy.	0	1
6	10074	Standoff, 5/16 D x 4 1/4 lg.	1	2
7	10075	Standoff, 5/16 D x 2 1/16 lg.	1	0
8	10076	Standoff, M/F, 1 9/16 lg	1	0
9	10014	Bracket, pump holdown	1	0
10	11490	Housing, impeller		
11	11324	Panel, Front, Micro	0	1
12	10083	Panel, Front Analog	1	0
13	A-1013	Pilot Light Assy, Red Micro	0	1
14	A-1012	Pilot Light Assy, Red Analog	1	0
15	A-1011	Pilot Light Assy, Amber, Analog	1	0
16	10027	Housing Receptacle, 2 Pos.	0	1
17	10029	Housing Receptacle, 5 Pos.	1	0
18	10013	Bracket, high voltage bd.	0	1
19	10095	Spacer, nylon, 1/4" Lg	0	3
20	A-1001	High voltage circuit bd. assy.	0	1
21	11435	Micro Control Circuit Bd. Assy.	0	1
22	11434	Insulator, CPU Board	0	1
23	A-1000	Analog Control Circuit Bd Assy.	1	0
24	A-1018	Power Supply Cable Assy	0	1
25	10012	Cap, vented screw, 1 5/8 x 6	1	1
26	10135	Terminal, Faston .250	1	1
27	10000	Reservoir, Water	1	1
28	10006	Gasket, fill opening	1	1
29	10003	Plate, support ring	1	1
30	10005	Gasket, Heater Mounting Plate	1	1
31	10004	Plate, Heater Mounting	1	1
32	A-1015	Heater Assy.	1	1
33	A-1014	Pump Assy, 115 VAC	1	1
34	10159	Washer, Nylon	3	3
35	11465	O-ring, #122	1	1
36	11464	Nut, Hex, Jam, 7/8"-14	1	1
37	A-1016	Float Switch Assy.	1	1
38	10082	Tubing, Clear, .250 ID 3 1/4" LG.	1	1
39	10081	Fitting, Elbow, Female	1	1
40	10073	Washer, 1 x .562 x .062 or		
	10119	Washer 1 x .562 x .032	1	1
41	10065	Coupling, hose, female 1/4 NPT	2	2
42	11491	Manifold, Outlet	1	1
43	A-1017	Temp., Sensor Assy.	1	1
44	10099	Thermostat, 112°F	1	1

Item	Part No.	Description	SMS-1000	SMS-2000
45	10100	Thermostat, 117°F	1	1
46	10114	Switch, DPST, Rocker	1	1
47	10055	Fuseholder	1	1
48	10056	Fuse, 3AG, 3AMP, 250V	1	1
49	10134	Bushing, Strain Relief	1	1
50	10154	Power Cord	1	1
51	10010	Foot, Suction Cup	4	4
52	10086	Label, "Caution"	1	1
53	10088	Label, Cat. No./Serial No. SMS-1000	1	0
	10089	Label, Cat. No./Serial No. SMS-2000	0	1
54	10087	Label, "Hospital ID"	1	1
55	10090	Label, Instructions SMS-1000	1	0
	10091	Label, Instructions SMS-2000	0	1
56	10104	Screw, SS, 8-32 x 7/8 w/O-Ring	3	3
57	10037-1	Screw, 4-40 Pan Head 1/4" LG	7	7
58	10037-7	Screw, 4-40 Pan Head 5/8" LG	0	3
59	10038-3	Screw, 6-32 Pan Head 3/8" LG	2	2
60	10039-5	Screw, 8-32 Round Head 1/2" LG.	2	2
61	10043	Lockwasher #4, Ext. Tooth	19	22
62	10044	Lockwasher #6, Ext. Tooth	2	2
63	10045	Lockwasher #8, Ext. Tooth	2	2
64	10041	Hex Nut 4-40	10	13
65	11462	O-ring, #029	1	1
66	10416	Cable Tie, Large	2	2
67	10441	Tubing, 3/8" ID x 1 5/8" LG.	1	1
Not Shown	10028	Housing Receptacle, 4 pos.	1	1
Not Shown	10030	Housing Receptacle 6 Pos	1	1
Not Shown	11341	Cordstrap	1	1
Not Shown	10092	Key, Temperature Set	1	0

Schematics-Fig. 8.1



Schematics-Fig. 8.2

