



General

In-line solution heating is the simplest and most effective method of warming perfusion solutions prior to use. The **SHM-828** is an eight line solution heater designed primarily for superfusion applications.

Constructed to allow simultaneous flow in all lines, solution is heated as it flows through 21.5 cm of 18 gauge type 316 stainless steel tubing. The straight flow path allows for easy cleaning and facilitates the insertion of polyethylene tubing to reduce dead volume and eliminate contact with the metal walls.

The **SHM-828** Solution Heater is designed for use with the Warner's family of temperature controllers. The compact design of the heater makes it possible to install the device immediately adjacent to the input port of a perfusion chamber insuring minimum heat loss.

Each heater is supplied with a **TA-29** thermistor cable assembly (which allows for monitoring of the actual bath temperature; T2 output on the heater controller), a stopcock, and 3 meters of **PE-160** tubing.

Solution temperatures can be maintained at 37°C for flow rates up to 5 ml/min per line, or at 50°C at 3 ml/min per line, when all eight lines are in simultaneous use. Higher flow rates are possible if fewer lines are used.

Tubing Connections

PE-160 tubing (or any other tubing with a 1/16" (1.5 mm) OD) is used to connect the **SHM-828** to both the solution reservoir and the outflow receptacle. Connections are made by press fitting the PE tubing onto the 18 gauge stainless steel hypodermic tubes.

For single output applications a Warner **MP-8** perfusion manifold can be connected directly to the eight 18 gauge outflow tubes. An **ML-8** miniature manifold may be used for the same purpose if PE-50 tubing has been pulled through the heater tubes.

NOTE: In all cases, best performance is achieved if the length of PE tubing between the heater output and the outflow receptacle is kept as short as possible.

Operation

1. Connect the **POWER CABLE** from the **SHM-828** to the **OUTPUT TERMINAL** of the heater controller. Connect the **TC-29** **THERMISTOR CABLE ASSEMBLY** to the front panel input of the heater channel being used on the controller.
2. Attach the input ports of the inline heater to your solution reservoirs using **PE-160** or equivalent tubing.
3. Attach the output port of the heater to your outflow receptacle using **PE-160** tubing or equivalent.

NOTE: All lines attached to the heater must be fluid-filled prior to use. Sequentially fill each line attached to the device.

4. Place the **TA-29** thermistor into the bath (at a point of interest) to measure its temperature. Set the flow rate to the desired level and adjust the set temperature to the desired temperature.
5. Turn *on* the power to the solution heater.
6. Allow a few minutes for the system to stabilize. Readjust the set temperature to obtain the desired temperature reading at the point of interest.

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Note: Additional adjustment of the heater voltage may be required if any of the following change substantially during the experiment:

- Solution flow rate
- Temperature of solution entering the heater
- Ambient (room) temperature
- Air currents around chamber

Efforts to minimize these factors will be rewarded.

Outgassing

A common problem with rapid heating of solutions is outgassing. The bubbles formed can cause blockages or disruptions to the flow in the chamber bath. An effective solution to this problem is to pre-warm the perfusate at the reservoir.

Maintenance

Salt solutions can be corrosive to metal components and can shorten the life of the heater if left in the unit during storage.

The heater should be flushed with distilled water and blown dry after each use to eliminate the effects of salt and moisture.

Specifications

Heater resistance	6.7 Ω
Voltage requirement	variable to 15 V maximum
Maximum temperature	50 °C
Internal dead volume	157 μ l / line
Maximum flow rate	5 ml/min – all eight lines flowing

Physical Dimensions

Body	18 mm diameter x 16.8 cm long
Tube length:	21.5 cm
Weight	98 g
Cable length	1.9 m
Warranty	1 year

Accessories

TA-29	Replacement cable with bead thermistor
TA-30	Replacement cable with glass thermistor
PE-160/10	Polyethylene tubing 3 meter
MB/B	Magnetic base
U9404	3-Prong clamp

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