900A Micropressure System

For measuring hydrostatic pressure in small vessels and cells

INSTRUCTION MANUAL

Serial No._____

8/97

World Precision Instruments, Inc.

900A Micropressure System

Contents

Description

WPI's model 900A micropressure system measures hydrostatic pressures from -200 to +400 mm Hg in small blood vessels, cells, and other electrolyte-filled micro-cavities. The 900A is extremely stable and accurate. The micropressure system includes a main electronic Control Unit, probe, and an independent pressure controller or *Pressure Pod*, and housing an amplifier, piezoelectric valve, and a pressure transducer. The Pressure Pod is small and lightweight, so it can be mounted near the microelectrode to reduce dead space. Fluid-filled glass micropipettes (supplied by the user) pulled to an outside diameter of 2 to 5 µm are paired with the 900A sensing probe. A pressure source supplying up to +500 mm Hg of pressure, and a vacuum source supplying up to -300 mm Hg vacuum is supplied by the user.

The 900A uses a salt concentration gradient at the tip of the sensing electrode to measure hydrostatic pressure. The internal pressure of the microelectrode is continuously adjusted to equal the hydrostatic pressure outside the tip, to keep the salt concentration gradient in dynamic equilibrium. The amount of pressure required to maintain equilibrium is digitally displayed on the front panel; the voltage proportional to this reading can be sent to a recording device via the "Pressure Signal" output connector.

To equilibrate the salt gradient in equilibrium, the piezoelectric pressure controller controls air flow in and out of a small pressure chamber. A vacuum source connected to the chamber outlet removes air to reduce pressure; a piezoelectric valve at the inlet admits pressurized air to increase pressure.This in turn regulates pressure inside the micropipette electrode so that it equals pressures outside the tip.

The response rate of the piezoelectric valve (from fully closed to fully open) is 0.5 ms. The response rate of the overall system, when properly configured, is typically less than 10 ms. This figure is affected, however, by the pressure chamber's residual volume, which includes the micropipette, fluid trap, connecting tubing, and the pressure transducer piezoelectric valve outlet. Long lengths of tubing add dead space, which slows overall system response. Keeping the residual volume low by mounting the Pressure Pod close to the microelectrode, and using short lengths of small-bore tubing, minimizes dead space and contributes to a rapid system response. (See page 6 for specific instructions on installing tubing.)

Equipment List

Each 900A system includes the following components:

- 900A Control Unit
- Power Cord
- 900A Probe
- 900A Pressure Pod
- 2 Electrode Holders
- Fluid Trap
- 2 Luer Fittings
- 1 ft. 3/32 in. plastic tubing
- 4 ft. 1/8 in. tygon tubing
- Instruction Manual

Specifications

PRESSURE RANGE .....+500 to -300 mm Hg

LINEARITY .....< ±0.5% from a straight line

STABILITY .....+/- 0.1 mm Hg up to 1 hour or more

ACCURACY .....±0.5% of full scale

RISETIME .....>10 ms (10-90%), depending on residual volume

OUTPUT ("Pressure Signal") ...10 mV per mm Hg

AMPLIFIER PROBE .....Input Resistance >10^{10} Ohms,Voltage Gain 1.0

DIMENSIONS .....Main Frame: 17x5.25x10 in. (43.2x13.3x25.4 cm)
Pressure Pod: 3.7x1x2.25 in. (9.4x2.5x5.7 cm)

POWER .....110 VAC / 220 VAC

Setting up the 900A

Refer to Figure 1 when setting up the 900A micropressure system. Be sure setup is complete before you turn on the power.

- Connect the seven-pin cable on the Pressure Pod to the connector labeled “Pressure Pod” on the front panel of the Control Unit.
- Connect the microelectrode probe to the connector labeled “Probe” on the front panel of the Control Unit. Ground the probe to CKT and CHAS ground connections.
- Connect the power cord to the receptacle on the rear panel of the Control Unit. Plug into the wall socket.
- Connect the reference electrode to the circuit ground terminal, marked “CKT” on the front panel of the Control Unit.
- Place the “Loop Status” in the “Zero Set” position. This maintains a pressure of 0 mm Hg in the pressure chamber.

Turn power on.

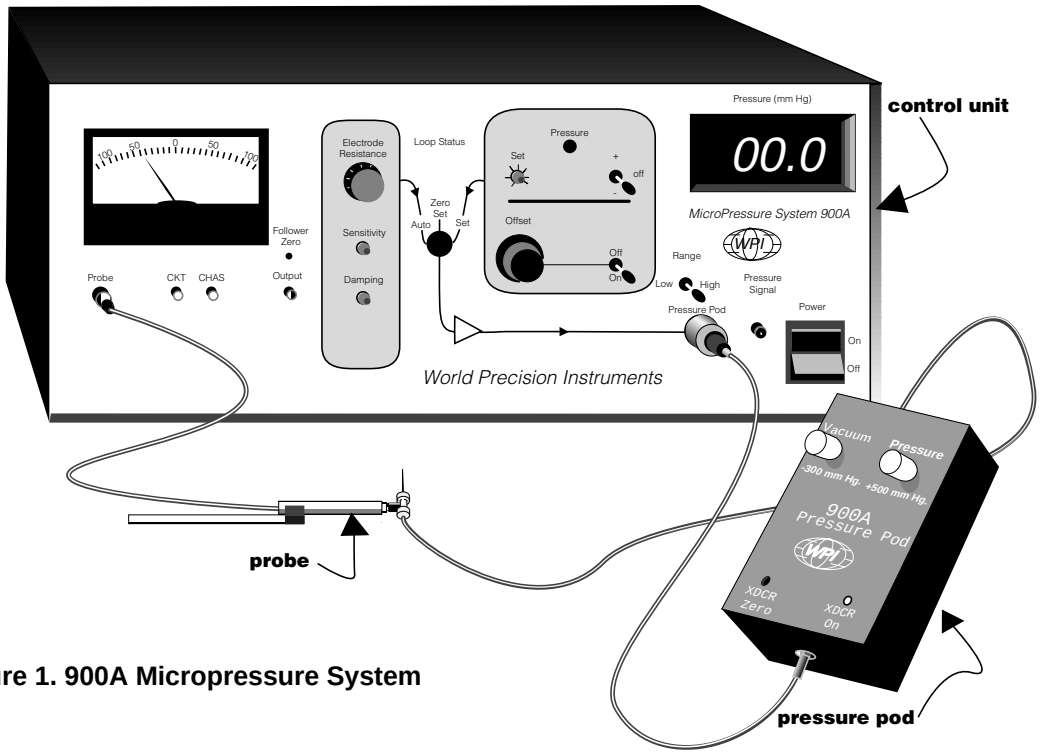
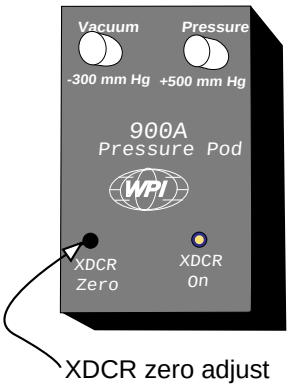


Figure 1. 900A Micropressure System



XDCR zero adjust

Zero adjust procedure

Disconnect the vacuum and pressure sources and the tubing to the microelectrode from the Pressure Pod, so that the Pressure Pod is open to atmosphere. Turn the Control Unit on, and let it warm up for 15 minutes.

The digital meter should read 0 mm Hg. If the reading is incorrect, insert a small screwdriver into the recess marked “XDCR Zero” on the front of the Pressure Pod, and turn clockwise or counterclockwise to bring the digital meter reading to 0 mm Hg.

Connect the pressure and vacuum sources to the Pressure Pod. Make sure that the pressure source supplies clean, dry air. Turn the pressure and vacuum sources on. Block the micropipette output on the Pressure Pod by placing one finger over the tubing port. The digital meter should read 0 mm Hg. If the reading is incorrect, insert a screwdriver into the “Pressure” recess on the front panel of the 900A and turn clockwise or counterclockwise to bring the digital reading to 0 mm Hg. *(If you are unable to get a 0 reading, turn off and disconnect the pressure and vacuum supplies, and repeat the previous step.)* Now open the pipette output by removing your finger. The panel pressure meter should remain at 0 mm Hg.

If your work requires highly accurate readings, re-calibrate the instrument at this time. Connect the pressure and vacuum sources to the Pressure Pod. Using a "T" fitting, connect the pressure source (supplying clean, dry air) to the microelectrode outlet port and to a WPI PM Series pressure manometer or other accurate pressure-measuring device. This pressure source must supply pressures of the same order of magnitude as the pressures to be measured in your application. Turn the pressure source on. The pressure reading on the 900A should match that given on the reference meter. If the reading is not correct, insert a screwdriver into the recess on the back of the Pressure Pod, and turn clockwise or counterclockwise until the correct reading is displayed on the 900A.

Since the system gain has now been changed it is necessary to repeat the previous three steps, possibly several times, until all zero adjusts are correct and the pressure input is measured accurately.

Preparing the microelectrode holder and pipette

Use a micropipette pulled to a tip diameter of 2 to 5 µm. Prepare a KCl or NaCl filling solution with a concentration of 1 Molar (M) or higher. A high concentration is important in order to maintain a large concentration gradient between the microelectrode’s internal salt solution and the solution outside the tip.

Immerse the pipette tip into the 1 M solution and fill the tip by allowing the solution to wick up. Next, backfill the shank of the micropipette. (MicroFil,WPI's flexible syringe needle, works particularly well for this application.) Do not allow air bubbles to remain in the pipette.

Fill the electrode holder, making sure that no air bubbles remain in the holder, and that the filling solution covers the Ag/AgCl pellet. Insert the pipette into the holder and tighten the cap.

Check again to be sure that no air bubbles remain in the pipette or the holder. If fluid leaks from the microelectrode tip, or if it becomes necessary to purge the tip, make sure, to avoid an open circuit, that the level of the filling solution is high enough to maintain contact with the Ag/AgCl pellet.

Insert the holder onto the probe tip. Connect a 12-inch or shorter (30-cm or shorter) length of small-bore tubing to the pressure port on the electrode holder.

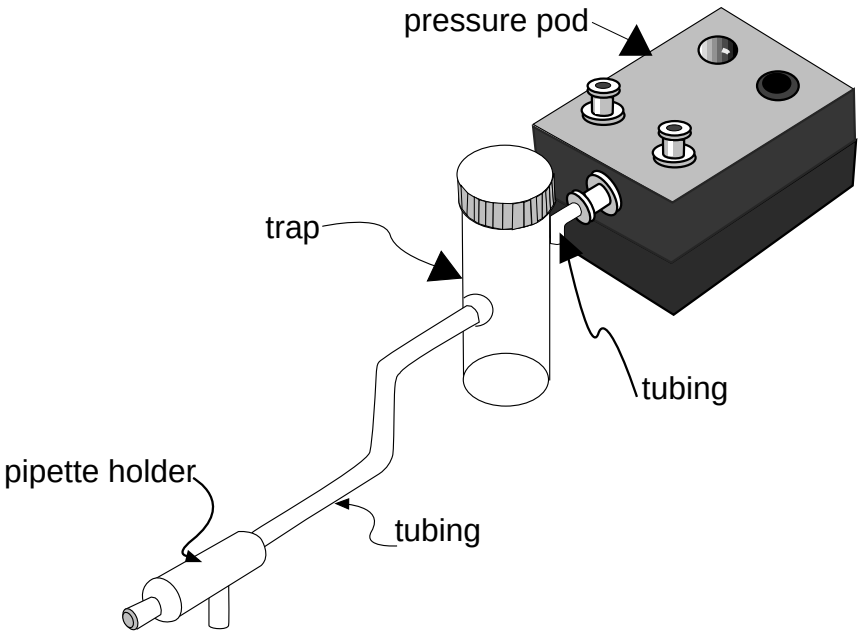
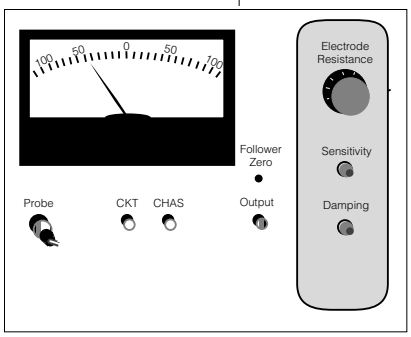


Figure 2. Pipette assembly attached to pressure pod

Do not connect this tube to the Pressure Pod yet! First connect the pressure and vacuum supply tubes to the Pressure Pod, and turn them on. If the microelectrode is connected to the Pressure Pod before the pressure and vacuum sources are connected and turned on, fluid may be pushed through the Fluid Trap and into the Pressure Pod causing damage to the piezo valve. This damage is not covered under warranty.

Referring to Figure 2 on page 6, connect the pipette holder to the fluid trap. Check that the pressure and vacuum sources are connected to the Pressure Pod and that both are turned on. Connect the microelectrode/holder assembly to the micropipette outlet port.



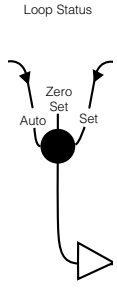
Rotate the electrode resistance knob clockwise or counterclockwise until the null detector meter reads 0 DC microamperes.

Adjusting electrode resistance

If everything is correct, the 900A adjusts the pressure in the tubing to maintain 0 mm Hg at the microelectrode tip. Turn the “DAMPING” and the “SENSITIVITY” knobs to about 1/2 of full rotation. Immerse the pipette tip into a dilute electrolyte solution — for example, 0.1 M concentration of the filling solution.

Place a ground reference electrode into the solution. Connect the ground reference electrode to the circuit ground on the front panel, marked “CKT” — Use WPI’s Dri-Ref 2 or Dri-Ref 5, or other Ag/AgCl wire reference electrode.

Rotate the “Electrode Resistance” knob on the 900A front panel until the “Null Detector” meter reads 0 DC microamperes (0 is at the center of the scale). The dial setting of the “Electrode Resistance” knob, which ranges from 0 to 10 meg Ohm (1 full turn per meg Ohm), now directly indicates microelectrode resistance. Electrode resistance typically ranges from 100 K Ohms to 1 meg Ohm, depending on tip diameter and filling solution concentration. The ideal tip diameter, from 2 to 5 microns, produces resistance of 150 to 250 K Ohms.



loop status switch

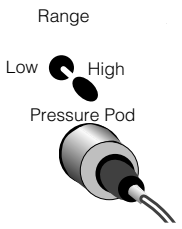
Operating the 900A

Set the Loop Status switch at “Zero Set”. Advance the Electrode Resistance knob to the right until the Null Detector reads from 50 to 100 microamperes. The resistance value will be about twice that of the actual resistance of the microelectrode as obtained above. Turn the “loop status” switch to “auto”. In this operating mode, the electronic feedback system will automatically adjust the microelectrode tip resistance to the higher value of resistance selected by drawing some of the external dilute solution into the tip. When the proper resistance is

reached, the “null detector” needle returns to 0 microamperes.

The instrument is now ready for use. The pressure reading should be slightly negative. This is because the height of the filling solution exerts pressure on the electrode tip.

To compensate this slight negative pressure, turn on the “pressure offset” toggle switch and adjust the “pressure offset” knob until the meter reads 0 mm Hg. Adjusting the pressure offset adjusts only the meter reading, and does not affect the recorder output value.



To view pressures greater than ±199.9 mm Hg, toggle the “range” switch above the Pressure Pod connector to “high”.

The pressure transducer in the Pressure Pod has a maximum pressure rating of 500 mm Hg. Great care should be taken not to apply pressures greater than 500 mm Hg, to avoid damaging the transducer.

Before moving the micropipette from one recording site to another, set the “loop status” switch to “zero set.” This ensures that no pressure is applied to the micropipette while it is being moved. If this is not done, the pressure controller tries to compensate the increased tip resistance (caused by the open circuit) by applying pressure to the micropipette. This may expel the filling solution from the micropipette.

Once the micropipette is placed in the desired recording site, check the electrode resistance. If the null detector needle is deflected completely to the left, the tip resistance has increased. Turn the “electrode resistance” knob clockwise until the needle begins to move to the right. The needle need not reach 0, but must only move from the maximum left position in order to confirm that the open circuit has been closed.

Turn the loop status switch to “auto”. The 900A controls the pressure in the micropipette to generate the tip resistance preset on the “electrode resistance” dial. The “null detector” should return to 0. If the null detector reading or the pressure reading is unsteady, adjust the DAMPING and/or SENSITIVITY. If this does not correct the instability, there may be air bubbles in the micropipette/holder system.

If the “null detector” pointer fails to move when the “electrode resistance” dial is adjusted, one of three situations may have occurred:

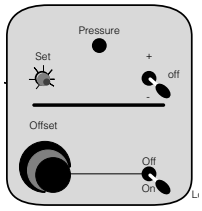
1) The external pressure applied to the micropipette was large

enough to force an excessive amount of dilute solution into the tip, resulting in a resistance greater than 10 meg Ohms. To correct this, turn the “electrode resistance” dial down to the original setting, as described above. Turn the loop status switch to “auto”. The 900A will then adjust the pressure inside the micropipette to expel the dilute electrolyte and decrease the tip resistance to its original value. Another method of purging the micropipette tip is to follow the procedure described below in "Set pressure".

2) The microelectrode is not making contact with the electrolyte solution, or the reference electrode is not connected. In either case, the problem is an open circuit. Adjusting the “electrode resistance” dial or changing the loop status switch to auto has no effect. Check the placement of the micropipette, the reference electrode, the liquid level in the micropipette, as well as all connections. **Take care not to leave the loop status switch on “auto”, to avoid discharging the contents of the microelectrode.**

Set pressure mode

“Set Pressure” mode allows you to preset the internal pressure of the micropipette. This is useful for applying positive pressure to flush the tip or applying negative pressure to draw solution into the tip. **Extreme care must be taken when using negative pressures not to force fluid through the fluid trap and into the Pressure Pod.** Disconnect the microelectrode holder, and attach the pressure tubing to a manometer to check the calibration of the 900A pressure transducer against an external standard.



Toggle the ± switch to off, and turn the set knob to zero before presetting the internal pressure of the micropipette.

To enter the set pressure mode, toggle the ± switch to the center or off position, and rotate the “set” knob to 0. Switch the loop status control to set. Select “+” for positive or “-” for negative pressure, using the toggle switch. A selected hydrostatic pressure can be applied to the inside of the micropipette. Turn the “Set” knob to select the magnitude of the pressure. The selected internal micropipette pressure is displayed in mm of Hg. on the digital meter.

Set pressure mode can be used to purge the micropipette tip when too much dilute solution has diffused into the microelectrode. Applying a few mm Hg of positive pressure gently expels filling solution from the the shank of the micropipette into the tip. The tip resistance can be monitored by watching the “null detector”. If the tip resistance is greater than the dial setting, the needle points left; if the tip resistance is less than the dial setting, the needle points right.

Alarm

An alarm sounds when the pressure controller valve is completely open to indicate that maximum pressure has been reached. The alarm sounds also when electrical continuity is broken for any reason, for example, if the microelectrode comes out of the solution, the filling solution level drops below the Ag/AgCl pellet, the ground reference is disconnected ,etc., or the tip is blocked.

Pressure and vacuum sources

The maximum pressure that should be applied to the pressure controller is +500 mm Hg. The maximum recommended vacuum is -300 mm Hg. In the “auto” mode, the system can compensate for small fluctuations in the supply pressures, but large supply pressure changes may cause a pressure reading error. If possible, therefore, both pressure and vacuum sources should be stable.

If your experiment involves pressure measurements consistently lower than the rated maximum, you can use lower supply pressure and vacuum. For example, if pressure readings at the pressure measuring site are fairly consistent and slow-changing at approximately 150 to 200 mm Hg, a positive supply pressure of +300 mm Hg would suffice, and the vacuum source could be eliminated, with the vacuum port venting to the atmosphere. The pressure gradient would be sufficiently large to provide at fast response rate. Likewise, if you are measuring negative pressures only, atmospheric pressure can replace the positive pressure source.

To keep the pressure gradient high and ensure a quick, accurate response, plan to provide hydrostatic positive/negative pressures at least 50 mm Hg greater that the maximum positive/negative pressures to be measured. Pressure differentials of less than 50 mm Hg are inadequate to move air quickly, causing response times to increase considerably.

> **It is important that the pressure and vacuum sources supply clean, filtered, dry air. Air that is not clean and dry damages the piezovalve, and damage of this sort is not covered under warranty.**

Measuring DC potential

Although the primary function of the 900A is to measure hydrostatic pressures, it can also be used to measure DC potential at the microelectrode site. Connect a recording device to the follower “output”. To offset background current from the amplifier, insert a small screwdriver into the recess labeled “ follower zero.” Turn

clockwise or counterclockwise until the recording device reads 0 amperes. Excursion in this mode is limited. You can, of course, provide additional offset correction externally, for example, at the reference electrode or the recording device.

Microelectrode resistance

When the value set by “electrode resistance” dial is greater than the intrinsic value *(i.e.*, the value obtained by adjusting electrode resistance, described on page 7), the concentration gradient interface is shifted inside the pipette tip. This can affect the rate of response to an externally applied, stepped pressure, but this is not significant for most applications. When the interface is shifted inside the electrode, the tip opening contains a solution that is more ionically compatible with the fluid outside the tip. This gives a longer diffusion path from the pool of high concentration electrolyte to the outside, which may be advantageous.

The shape of the microelectrode tip significantly affects the 900A’s response. Shorter tipped microelectrodes that do not have an excessively long taper work best.

All electrode resistance and potential measurements are referred to ground. Ground should be established through an appropriate salt solution and reference half cell such as WPI’s DriRef 2 or DriRef 5.

Using sensitivity and damping to correct oscillations

All feedback control systems tend to become unstable and oscillate under certain conditions. The 900A provides two controls for combatting instability and oscillation — “sensitivity” and “damping”. Decreasing “sensitivy” or increasing “damping” often reduces or stops oscillations. The proper settings for both controls depends on the particular application.

Keep the sensitivy knob as high as possible to provide close matching and following of the external pressure by the internal pressure in the micropipette. We recommend starting at 1/2 of a full rotation, then adjusting in a counterclockwise direction as needed. Generally, sensitivity should not be set below 1/3 of the full rotation, in order to maintain proper response.

The “damping” knob reduces ringing or oscillation as it is turned clockwise; 1/3 to 1/2 rotation typically produces a stable, quiet baseline.

Use an oscilloscope or recorder to monitor the pressure output signal to gain better control of oscillations. The digital pressure meter on the 900A front panel tends to average oscillations, especially those with higher frequencies. For this reason, the digital display may give a constant reading, when in fact almost full-scale oscillations are occurring.

Circuit discussion

The Model 900A consists of an oscillator, head stage, phase detector, buffer amplifier, pressure transducer, and pressure controller.

OSCILLATOR: A Wein bridge oscillator generates a 1000 Hz sinusoidal voltage; this is amplitude stabilized by internal negative feedback transistors in the bridge circuit.

HEAD STAGE: (or FOLLOWER) A 1000 Hz carrier constant current is injected through the microelectrode. The resulting voltage drop is compensated in the follower circuit by advancing the “Electrode Resistance” dial so that balance null is achieved. The microelectrode resistance is then read directly in meg Ohms from the dial. If the microelectrode resistance changes, a 1000 Hz imbalance signal will be amplified and detected by a phase detector.

PHASE DETECTOR: A synchronously switched detector in a single integrated circuit package. The resulting detected signal is filtered and is available at the output of the 741 amplifier.

BUFFER AMPLIFIER: The buffer amplifier lies between the detector and the pressure controller driver. It compensates the detector signal with output from the pressure transducer in order to compensate for the inherent lag in propagating the pressure changes transmitted to the micropipette tip. The lag would normally cause the system to oscillate. The DAMPING knob sets the amplitude of the buffer amplifier. Insufficient damping (*i.e.*, DAMPING knob turned too far counter clockwise) causes the system to oscillate at higher frequencies. Too much damping (*i.e.*, DAMPING knob turned too far clockwise) can result in a slow rate of response and low frequency oscillations.

PRESSURE TRANSDUCER: The pressure transducer is a silicon strain gauge resistance bridge device. Its volume and pressure displacement are small and sensitivity is high. The bridge output is amplified, scaled, and displayed on the digital meter. The meter has a resolution of 0.1 mm Hg from +199.9 to -199.9 mm Hg. Pressures outside this range can be viewed by toggling the “range” switch to “high”. The pressure output can also be monitored via the BNC connector marked

"output" on the front panel. The output level of this signal is 10 mV per mm Hg.

PRESSURE CONTROLLER: The pressure controller consists of a driver circuit to operate the piezoelectric controller and an alarm circuit to warn when the maximum pressure of the controller has been reached.

Service

Except for replacing the fuse, refer all service needs to WPI. You can easily replace the fuse in Control Unit. The part number for replacement fuses is

#3822 for 110V line power
#6408 for 220 V line power.

Accessories

Electrode Holders MEH6RF and MEH6SF may be ordered to accommodate any of the following glass sizes: 1.0 mm, 1.2 mm, 1.5 mm, and 2.0 mm diameter. The recorder output may be connected using a BNC-to-BNC cable, WPI Part No. 2851. The Control Unit may be rackmounted using WPI Part No. 2933.

Further notes on setting up the 900A

These additional tips may assist you in setting up this complex apparatus.

1. Zeroing the pressure pod: Set “loop status” to “zero set”. Connect both the pressure pod and pipette probe to the 900A. Turn the POWER on, and allow the unit to warm up for half an hour. In the “zero set” mode, applying no pressure or vacuum to the pressure pod, insert a screwdriver into the recess on the pressure pod marked “XDCR zero” and turn clockwise or counterclockwise until the digital meter reads 0.00 mm Hg.

2. Re-zeroing after pressure and vacuum is applied: Remain in “zero set” mode. Apply up to 500 mm Hg of pressure and up to 300 mm Hg of vacuum to the pressure pod. Close the tubing port on the pressure pod by placing one finger over it. Insert a screwdriver into the recess marked “pressure” on the 900A front panel, and turn clockwise or counterclockwise until the digital meter reads 0.00 mm Hg. If the unit has been properly re-zeroed, very little change occurs when the tubing port is opened.

3. Setting up the microelectrode and micropressure system: Connect the filled electrode (1.0 Molar KCl or NaCl) and probe to the electrode holder. Use a manipulator to hold the probe and dip the tip of the electrode into a beaker of 0.1 Molar KCl,NaCl, or Ringers solution containing a reference electrode (such as WPI’s Dri-Ref 5). Connect the reference electrode to the circuit ground terminal marked “CKT” on the 900A front panel. Set the “sensitivity” knob to mid-position; set the “Damping” knob to 3/4 of full rotation. Turn the electrode resistance dial clockwise or counterclockwise to bring the needle of the null detector meter to zero.

- **a.** Connect the pressure port on the pipette holder to the tubing port on the pressure pod with a short tube (less than 10"). A long tube may create oscillation when 900A is in the “auto” mode.
- **b.** If the intrinsic pipette resistance is in the range of 200K-1M Ohm, adjust the “electrode resistance” knob to 20% to 40% greater than intrinsic resistance. If electrode resistance is greater than 1M Ohm, adjust the “electrode resistance” knob to 15% to 30% greater than intrinsic resistance.
- **c.** Switch to “auto” mode. The null detector needle should proceed promptly to zero. A small negative pressure of 2-5 mm Hg reflects the pressure of the water column in the micropipette.
- **d.** Return to “zero set” mode. Insert a screwdriver into the recess marked “pressure” on the 900A front panel, and turn clockwise or counterclockwise until the digital meter reads 0.00 mm Hg.Re-zero the panel meter to 00.0 with the screwdriver pot on the front panel.
- **e.** Repeat steps **c** and **d** until the panel meter reading is 00.0 to ±0.3 mm Hg.

4. Some further miscellany:

- Carefully wash the holder, beaker and syringes with distilled water before and after use.
- Use fresh micropipettes each time it is to be used.
- Be sure the air pressure source provides clean, dry air.
- Use micropipettes with tips pulled to 2 to 5 µm in diameter.
- Always pay attention to the tube between the holder and the tubing port. If you find that solution drops have been sucked into the tube, turn to “zero set” mode. Disconnect the tube, and use the air pressure supply to blow the solution drops out. Leaving solution in the pressure tube may damage the Pressure Pod.
- Use a short tube — **12 inches (3 cm) or less** — to connect the microelectrode holder to the Pressure Pod tubing port.

Warranty

WPI (World Precision Instruments, Inc.) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of one year* from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

• Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within 10 days after receipt of shipment. Claims for lost shipments must be made within 30 days of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim settles. In some instances, photographic documentation may be required. Some items are time sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container.

• WPI cannot be held responsible for items damaged in shipment en route to us. Please enclose merchandise in its original shipping container to avoid damage from handling. We recommend that you insure merchandise when shipping. The customer is responsible for paying shipping expenses including adequate insurance on all items returned.

• Do not return any goods to WPI without obtaining prior approval and instructions (RMA#) from our returns department. Goods returned unauthorized or by collect freight may be refused. The RMA# must be clearly displayed on the outside of the box, or the package will not be accepted. Please contact the RMA department for a request form.

• Goods returned for repair must be reasonably clean and free of hazardous materials.

• A handling fee is charged for goods returned for exchange or credit. This fee may add up to 25% of the sale price depending on the condition of the item. Goods ordered in error are also subject to the handling fee.

• Equipment which was built as a special order cannot be returned.

• Always refer to the RMA# when contacting WPI to obtain a status of your returned item.

• For any other issues regarding a claim or return, please contact the RMA department

Warning: This equipment is not designed or intended for use on humans.

** Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.*

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DECLARATION OF CONFORMITY

We: World Precision Instruments, Inc.
175 Sarasota Center Boulevard
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USA

as the manufacturers of the apparatus listed, declare under sole responsibility that the product(s):

Title: 900A Micropressure System

to which this declaration relates is/are in conformity with the following standards or other normative documents:

EN 55011:1991 – Class B
EN 50082-1:1992

and therefore conform(s) with the protection requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility and Council Directive 73/23/EEC relating to safety requirements.

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