PicoLE Environmental Control User's Manual

v1.0

Molecular Imaging

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Environmental Chamber

The PicoAPEX Environmental Control chamber is equipped with eight ports for 1/8" ID (inner diameter) tubing and electronic feeds. One gas port may be used for filling the chamber with gas and another for venting the chamber. The venting line is provided in the event the chamber is filled with a vapor that cannot be safely vented into the lab. In this situation, the venting line should be placed into a fume hood. An example would be saturation of an inert gas with an organic solvent when non-aqueous electrochemistry is carried out.

Figure 1 (PicoAPEX Environmental Control chamber)

One important use of the chamber is for displacing oxygen from solutions used for electrochemistry. Good results have been obtained by first bubbling an inert gas (nitrogen or argon) through the solution to be placed into the liquid cell, and then setting the environmental chamber up with a steady flow-through rate of 1 to 2 SCFH. When the microscope and environmental chamber are placed in the PicoIC™ isolation chamber, both the inlet and the outlet can be connected, by tubes, to ports on the PicoIC feed-thru panel. The PicoIC is equipped with a needle valve and gas flow gauge suitable for this type of operation.

Even if control of the atmosphere is not important, the environmental chamber offers excellent acoustic isolation and protects the microscope from drafts. The necessary connections for the temperature stages are provided with the devices and can easily be screwed into the 8 ports of the PicoAPEX.

Glove Box

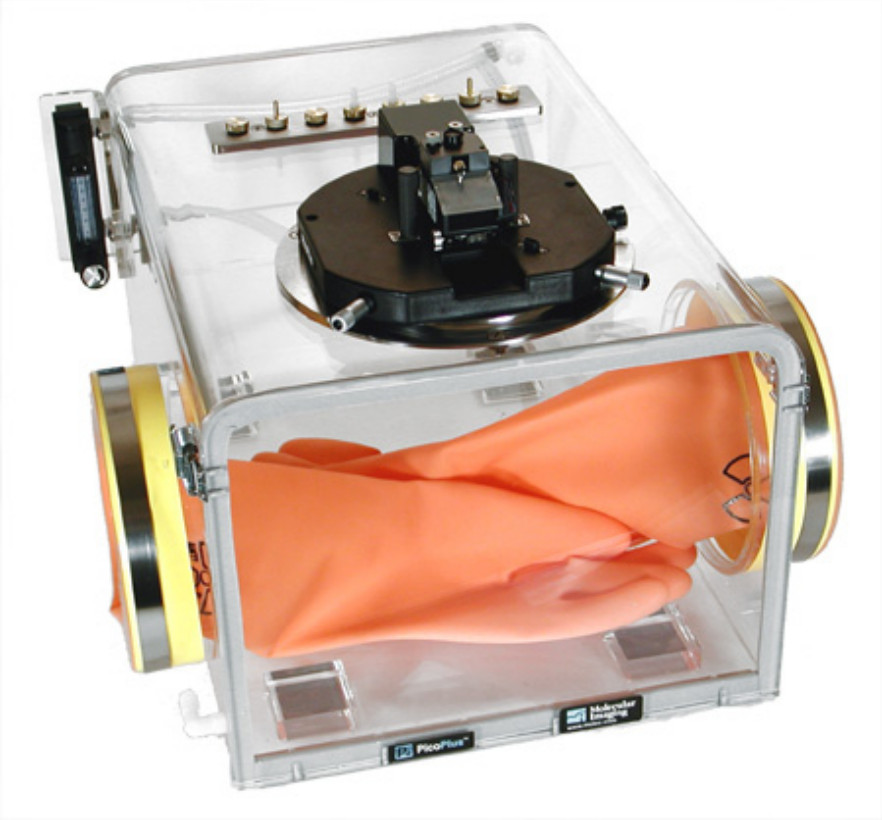

Figure 2 (Pico LE microscope in place on Cleanload Glove Box)

In order to prepare, as well as view, samples under controlled conditions, Molecular Imaging also offers the Cleanload Glove Box. The gloves are made of heavy-duty, 15 mil Latex. The box cavity is 9.6" high, 12.8" wide and 13.8" deep and can be used at temperatures below 0° C. The PicoLE microscope mounts directly to the top of the box via a stainless steel mounting plate. The large, clear acrylic box has eight 3/8" –32 UNEF threaded ports, similar to the PicoAPEX, to which gas inlets or exhaust lines may be connected, or through which cables or detector lines can be run.

To Use the PicoSPM II with the Cleanload Glove Box

The mounting ring will have already been attached at the factory. The PicoSPM II microscope simply rests on top of the stainless steel ring with the motor screws and translation pegs extending below the ring into the Glove Box. The user can make the appropriate connections to create the desired environment within the Glove Box and prepare and image the sample in those same conditions. Any of the eight ports that are not being used should be closed using the plugs provided.

Flow-Through Cell System

The flow-through cell system consists of a gravity-feed system that operates at about 1mL/minute. The fluid is removed by a peristaltic pump, operated somewhat faster than the inflow, so that the level is always maintained at the height of the output tube. See Figure 3 below.

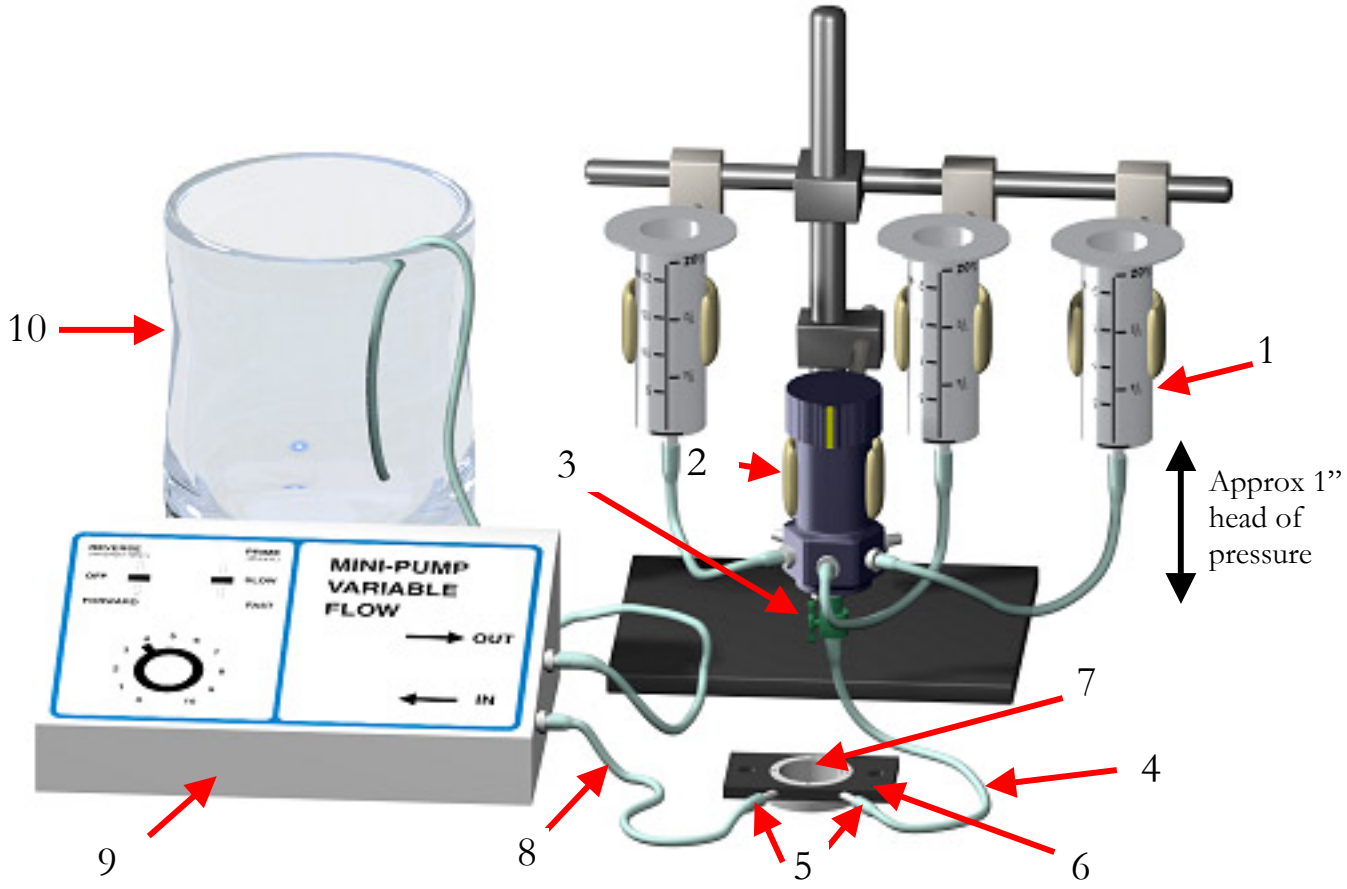

Figure 3 (Flow-through liquid cell schematic)

1. **Syringe body**: The fluid reservoir.
2. **Stream Selection Valve**: Up to six syringes can be connected here.
3. **On/Off Tap**: Controls flow of fluid to the sample cell.
4. **Silicone Tube**: The system uses 0.8mm ID tube.
5. **Teflon Tube**: This 1.0mm OD tube feeds through the Cell Clamping Plate and into the Sample Cell.
6. **Cell Clamping Plate**: Clamps cell in place.
7. **Sample Cell**: Holds sample.
8. **Silicone Tube**: This 0.8mm ID tube couples up to 1/16" ID silicone tube for connection to the Peristaltic Pump.
9. **Peristaltic Pump**: Pumps the liquid out of the flow-through liquid cell.
10. **Beaker**: Repository of the liquid removed by the peristaltic pump.

The reservoirs are the bodies of large syringes with Luer connectors (e.g., Beckton Dickenson Luer Lok, 60cc). They are arranged on an adjustable lab stand and all reservoirs should be filled to the same level so the flow rates don't change on switching. They are connected via female Luer to barb adapters and a length of 0.8mm ID silicone tubing to a screw-in male Luer adapter, threaded for use with the stream selection valve. This adapter is screwed into the stream selection valve. A male Luer in the bottom of the stream selection valve is connected to a tap with a Luer fitting. A Luer to barb fitting is used to connect 40 inches of the 0.8mm ID silicone tubing to feed the fluid to the cell. One end of a 2" long Teflon tubing section (1.0mm OD) is pushed into the 0.8mm ID silicone tubing. The other end of the 1.0mm OD Teflon is inserted into the cell clamping plate. The end pokes through into the cell. The tubing should be cut at a very sharp angle for easier insertion into the clamping plate.

If the environmental chamber is used, the tube should be fed through a brass fitting with ID such that the 2.4mm OD of the silicone tubing fits tightly into the fitting.

A similar arrangement of 1.0mm Teflon tubing and 0.8mm ID silicone tubing is used for drainage from the cell. Note that the level of the drainage tube end determines the fluid level in the cell.

The tube is fed out (via an adapter for an environmental chamber if needed) and coupled to a larger bore silicone tube with a double barb connector. This is connected to the barb on the 3/32" pump tube used in the peristaltic pump. This gives about the right pumping rate for drainage at a slow speed setting (switch on slow, pump speed about 1/3 way up). The output is connected to a drainage collector (e.g., a beaker).

Parts List

FLT-CP1	Modified cell clamping plate.
FLT-FT1	Modified environmental chamber plugs: 2 per unit.
FLT-TB1	Silicone tubing, 0.8mm ID, 0.8mm wall. Need 2.5m per unit.
FLT-FL1	Female Luer to barb connector. Need 13 per unit.
FLT-V1	Luer-fitted tap. Need 1 per unit.
FLT-V2	6 Port Stream Selection Valve. Need 1 per unit.
FLT-ML1	Tefzel threaded male Luer adapters for valve. Need 7 per unit.
FLT-TB2	Silicone tubing, 1/16" ID, 3/16" OD. Need 10 ft per unit.
FLT-CP1	Barbed 3/32" coupler. Need 1 per unit.
FLT-TB3	1.0mm OD Teflon tubing, 22 gauge Teflon tube. Need 4" per unit.
FLT-PP1	Variable flow peristaltic pump. Need 1 per unit.
FLT-SY1	Sterile syringes with Luer-Lok tip, 60cc. Need 6 per unit.

Assembly Instructions

1. Assemble reservoirs: Cut 6 six inch lengths of 0.8mm ID silicone tubing (FLT-TB1). Insert a barb to Luer adapter at each end (FLT-FL1). Take the bodies of 6 syringes (FLT-SY1) and attach the 6 inch tubes.
2. Assemble flow valve: Screw threaded male Luer adapters (FLT-ML1) into each of the six input ports and the output port (on bottom) of stream valve (FLT-V2). Insert tap (FLT-V1) onto bottom Luer. Cut a 40" length of 0.8mm ID silicone tubing (FLT-TB1) and fit a Luer to barb connector (FLT-FL1) at one end. Connect this to the bottom of the tap.
3. Assemble the pump: Select the 3/32" tubing (third from smallest) and assemble the pump (FLT-PP1) according to the instructions. Push an 8 ft length of the 1/16" ID silicone tubing (FLT-TB2) onto the INPUT side (marked on pump). Push a 2ft length onto the output side. Use a coupler (FLT-CP1) to join the input tube to a 15" length of the 0.8mm ID silicone tube (FLT-TB1).
4. Assemble the fluid cell: Cut two 2inch lengths of the Teflon tubing (FLT-TB3). Push them into the cell clamping plate (FLT-CP1) so they just protrude into the liquid cell:

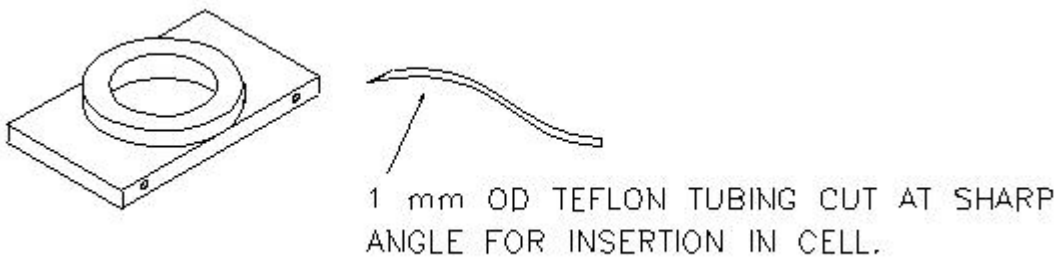

Figure 4

The above schematic shows the 1mm tubing pushed through cell clamping plate. The level of the drain tube will be the level of the top of the liquid.

Final Assembly and Operation

Set up the reservoirs and stream selection valve next to the PicoIC. Use a lab stand to hold the reservoirs above the selection valve:

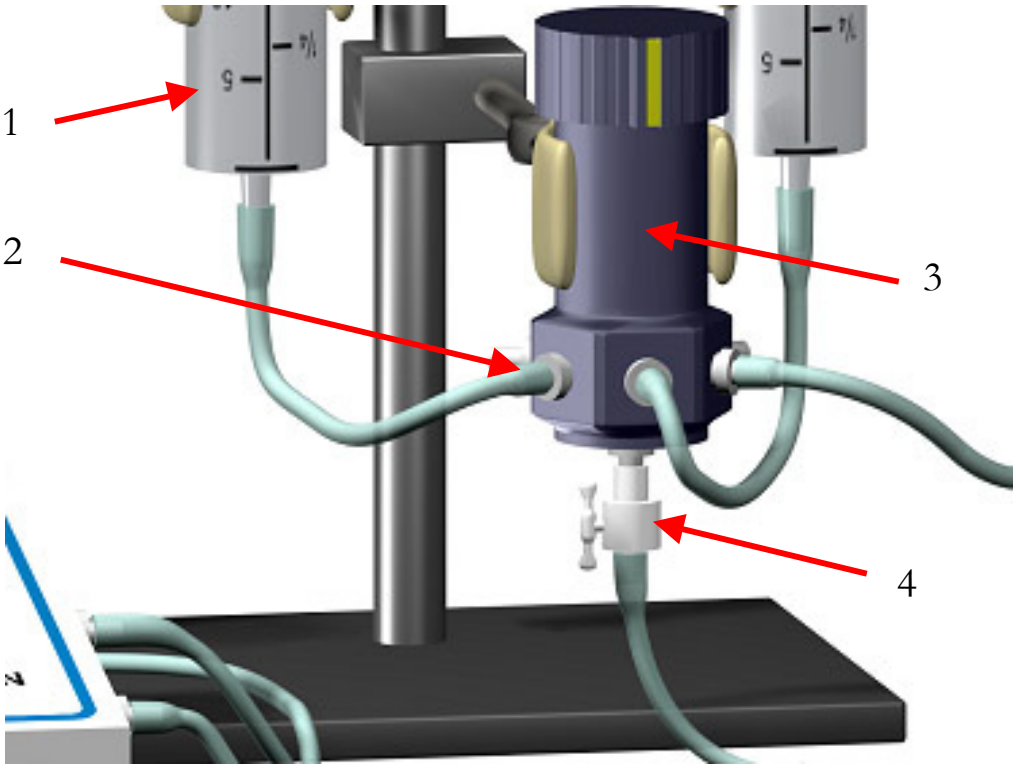

Figure 5 (The lab stand and six-way selector valve assembly)

The selector valve supports up to six reservoirs (1) that connect to the input side (2) of the stream selection valve (3). Output is controlled by the tap (4). As long as the tap is below the selection valve, unneeded inputs can be left blank. Selecting them will merely run air into the system.

1. Couple the 0.8mm ID tube to the 1.0mm OD Teflon tube by pushing 0.5" of the Teflon tube into the silicone tube. The tight fit will hold.
2. Fill the reservoirs with clean water, pull out the Teflon tubes and flush the whole system.
3. Assemble the sample stage for an experiment. Push the Teflon tubes in to the desired depth (use clean tubes for each experiment). Reconnect the Teflon and silicone tubes. Note: pass the inlet and outlet tubes through openings in the PicoIC and environmental chamber prior to connecting the Teflon and silicone tubes. Use the modified environmental chamber Plugs (FLT-FT1) if a sealed chamber is desired.
4. Fill each reservoir to the same level with the desired reagent. Start the drainage pump at the slow setting on the switch, but turned up all the way. Run a dummy or test reagent into the cell and back off the pump speed until the cell is just kept level. Practice imaging like this.
5. For an experiment, top off all reservoirs to the same level before switching. Note that it is important to have the microscope and reagents **at the same temperature to avoid drift!**

Resolution does not appear to be compromised at flow rates of a few mL/minute.

Two-Channel "MASTERFLEX" Pump Connection

The option of the two-channel MASTERFLEX pump allows greater flexibility. One channel can be used for pumping liquid into the cell, while the second channel is used to evacuate the cell. Since both channels operate at the same flow rate, no adjustment in syringe height is needed, as it is with the gravity feed setup.

Various diameter tubing can be used with the pump, allowing flow rate from 0.002 - 1.30 mL/min. The 2.06mm ID tubing has been shipped with your pump, which will allow flow rates from 0.15 - 0.88 mL/min. Figure 9.5 below shows one possible connection scheme. This can be duplicated for both channels if needed. The 0.8mm ID tube is used to adapt the tiny 1.0mm OD tubing up to a size that can be mated to the barbed connector. Any convenient length can be used.

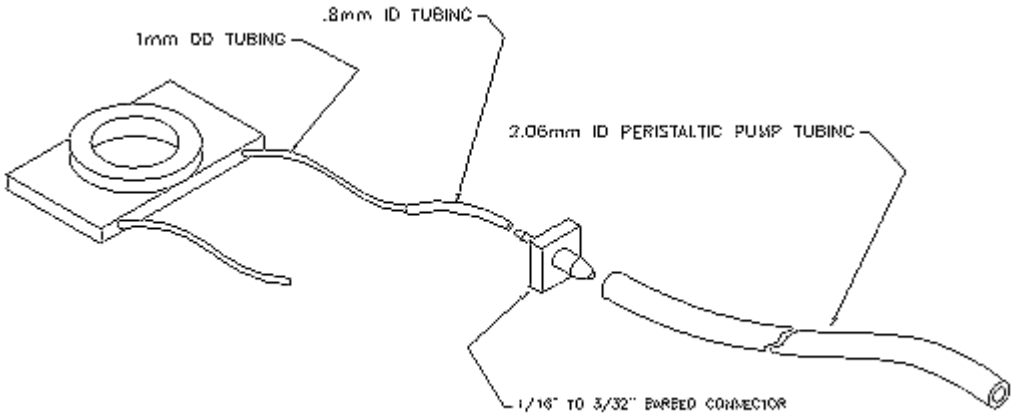

Figure 6 (Possible hose connection scheme to step from the 1.0mm OD tube that connects to the cell up to a more usable diameter)

Notes

- It is critical to maintain the whole system (from the reservoirs, the tubing to the liquid cell) at a constant temperature in order to avoid any imaging drift due to the liquid temperature change.
- Always keep an eye on the liquid level in the cell to make sure that the rate of in-flow and out-flow are kept equal and constant.