Dissolved Gas Sampling using Copper Tubing

Dissolved Gas Lab

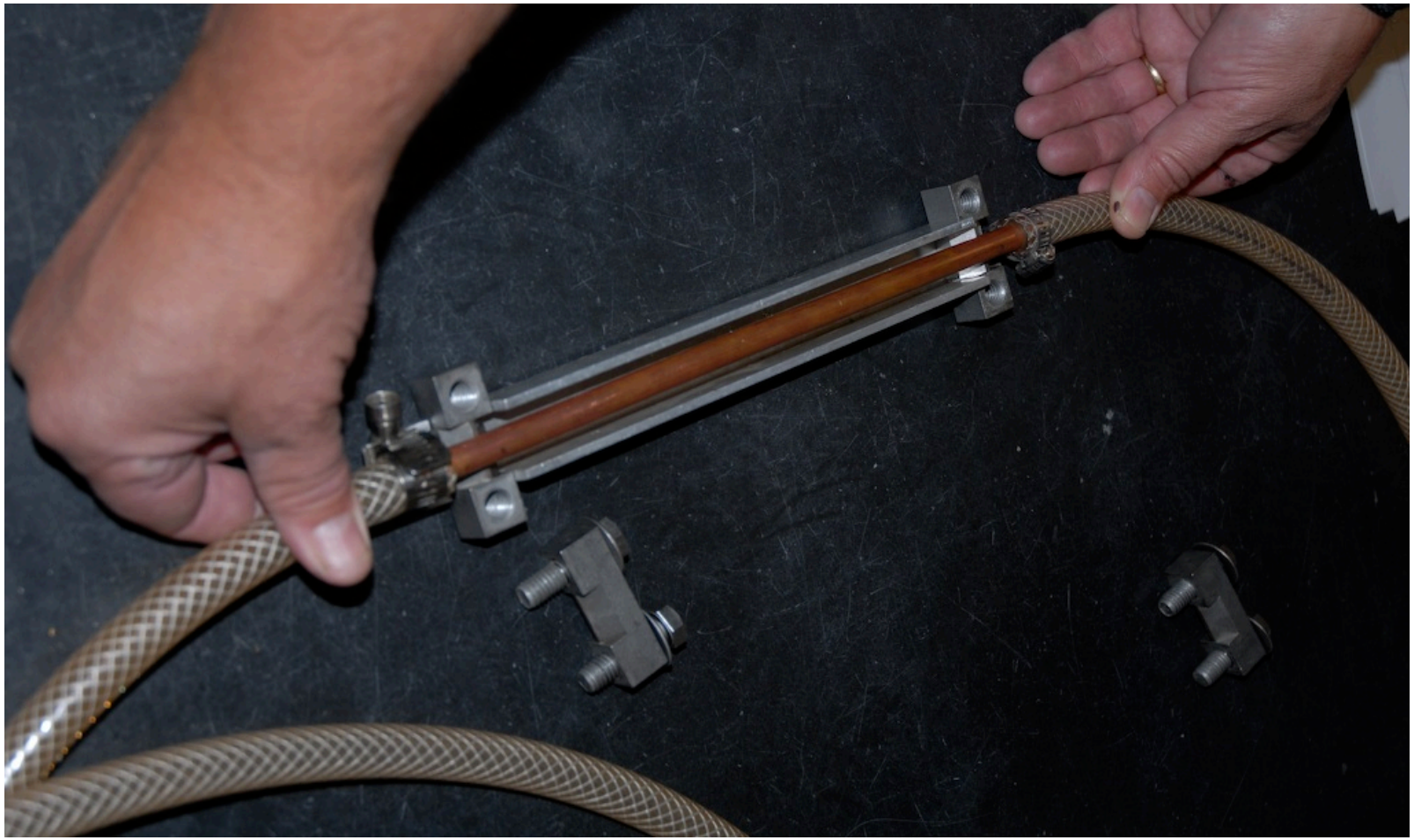
University of Utah

General Comments

- Dissolved gas water samples must be collected according to the procedures described to prevent common sampling artifacts. The most common problem in sampling for noble gases is bubble formation. If the sampling equipment is not leak-tight, air bubbles may form as outside air is pulled into the sampling-string. Noble gases have low solubilities in water and even a very small bubble can provide enough of a gas phase for noble gases to partition into it, thereby stripping the water. Purging water through the sampling-string too quickly under a vacuum can lead to bubble formation, effectively degassing the water. The converse of these situations can also occur; a bubble that contains partitioned gasses can be trapped within the sample volume resulting in dissolved gas concentrations higher then expected.
- Sampling quality is of utmost importance for accurate dissolved gas measurements; several precautions can be taken to reduce the risk of bubble interference. First, several liters of water are purged through the sampling-string to flush it. Second, while purging the system, a tool (wrench or other metal object) is used to tap the tubing of the sample string along its entire length. This helps dislodges air bubbles from the inside of the copper tube and connected equipment, allowing them to flush out of the system. Third, a visual inspection is made throughout the purging process for bubble formation; using the clear flexible tubing portion of the sampling-string. Fourth, a valve is used downstream of the sampling tube to provide backing pressure if bubbles are present. This can occur when samples are collected from depth, the reduction in hydrostatic pressure as the sample is brought up can cause bubble formation to occur. By watching the water flow through the plastic tubing and slowly turning the valve provided, bubble formation can usually be eliminated.
- In our experience, the best pumps for dissolved gas sampling are electric submersibles that can be regulated to produce a low flow (e.g. the Redi-Flo II or similar.)
- Dedicated bladder pumps can be a problem especially if they employ a teflon bladder. The teflon is fairly permeable to gases, especially helium.
- If it is not possible to use a low flow submersible pump, we recommend that you discuss the issue with the lab before sampling (801-585-5214)

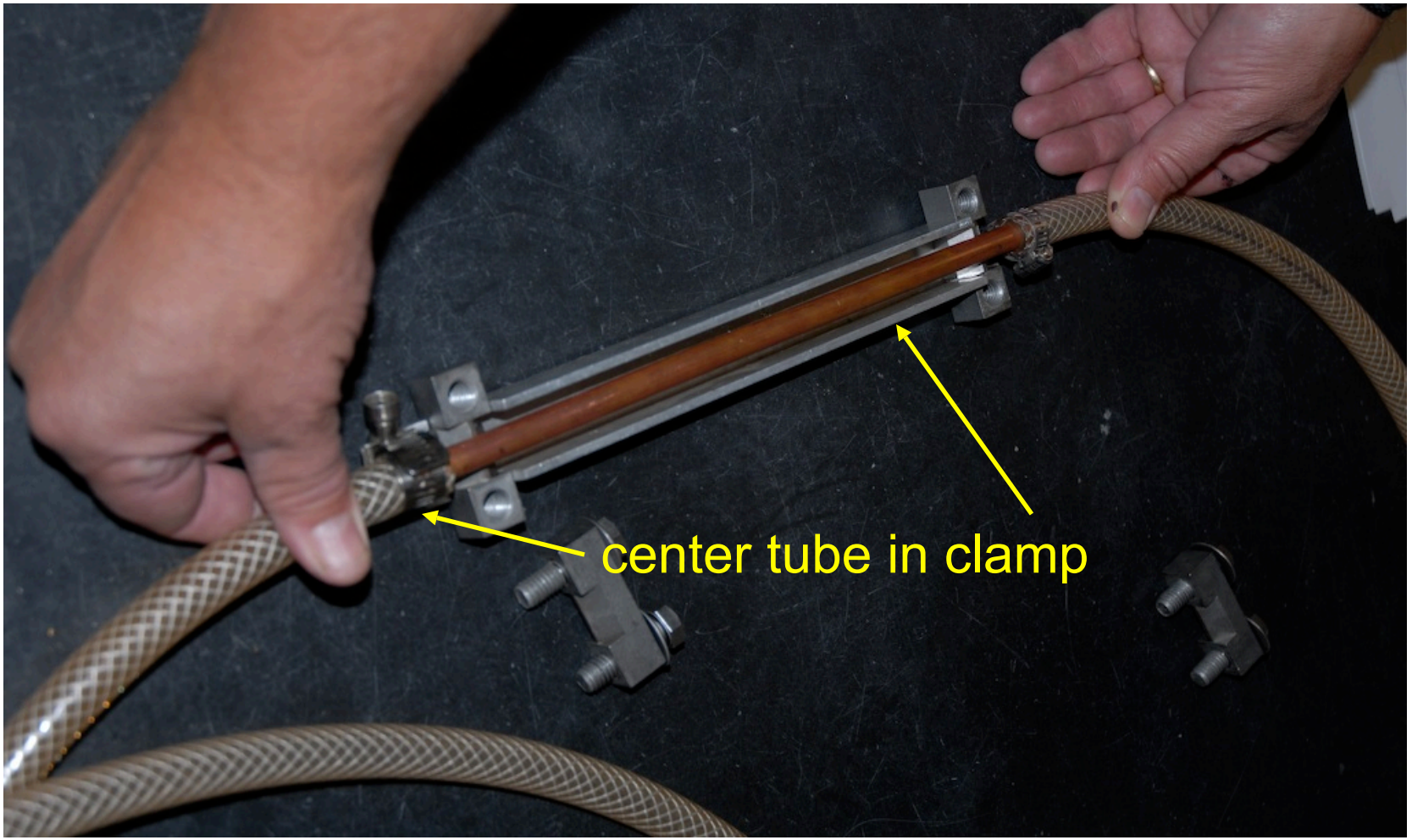
Sampling Procedure

- Place the metal pinch clamps in the holder and secure them using a short screw (10-32) - one screw for each clamp. Using the screw is not absolutely essential, but helps especially if sampling alone. NOTE: Not all of our clamps have hole in the bottom for this.

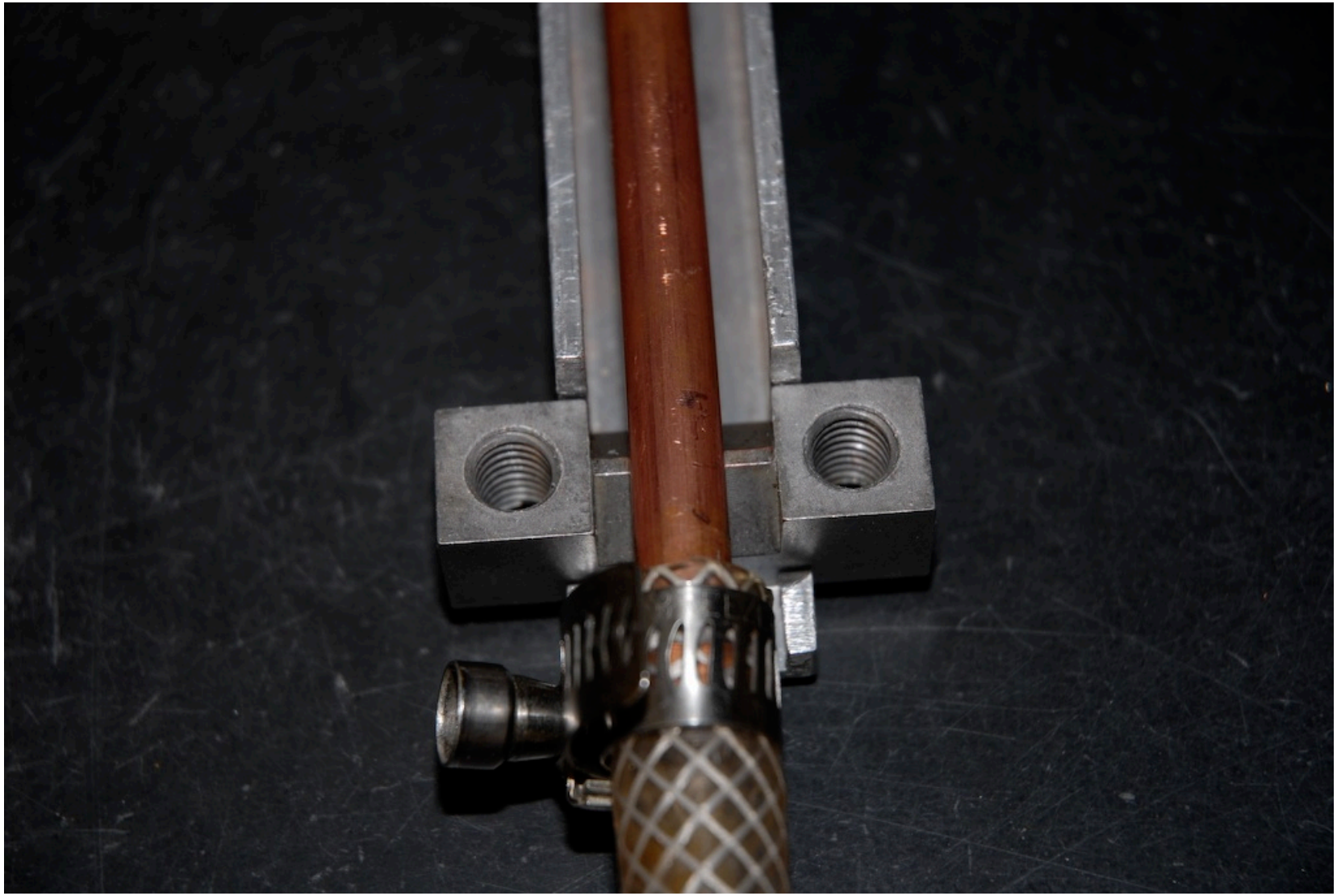


- Insert the copper tube into the plastic hose about 2 cm and secure using the hose clamps as shown.

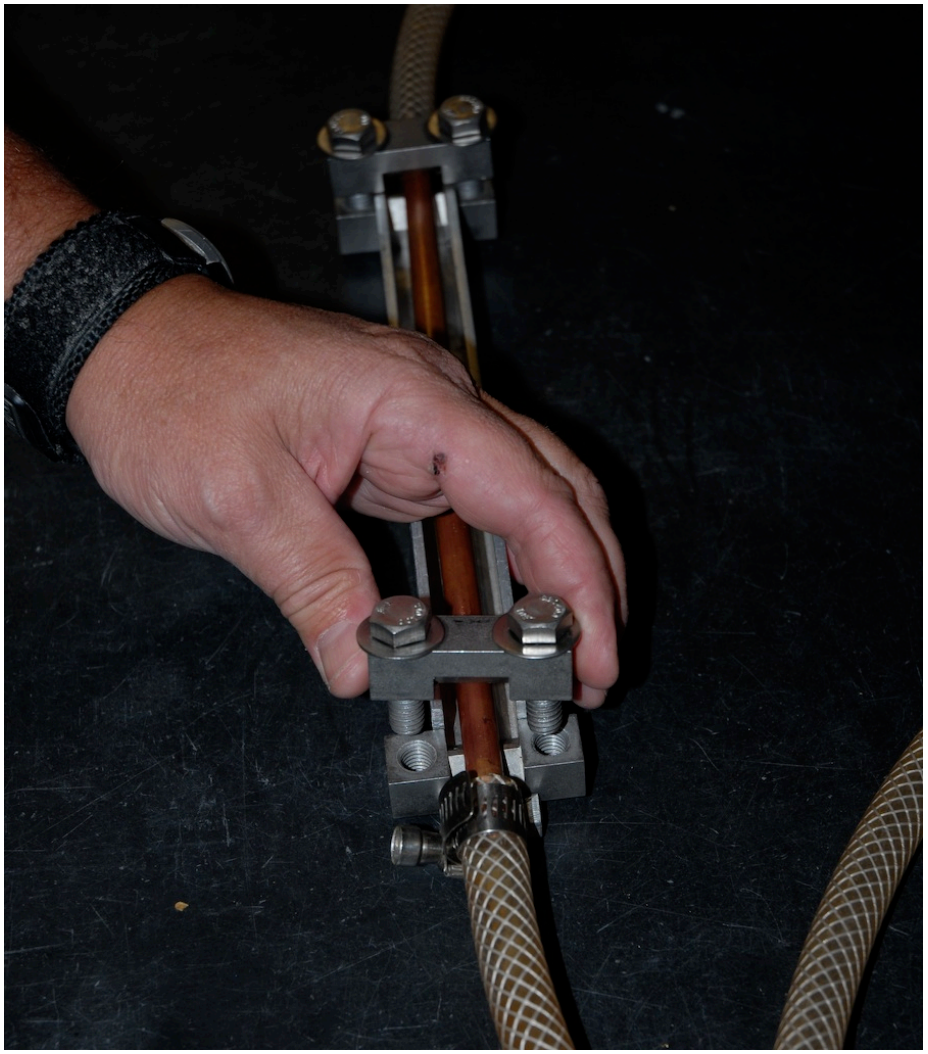
- Remove the upper portion of the both pinch clamps.
- Center the copper tube (in both directions) within the clamp holder as shown.



- Centering the copper tube in the clamp is very important.



- Replace the upper portion of the pinch clamps and tighten using fingers only (do not yet deform the copper tube by excessive tightening).



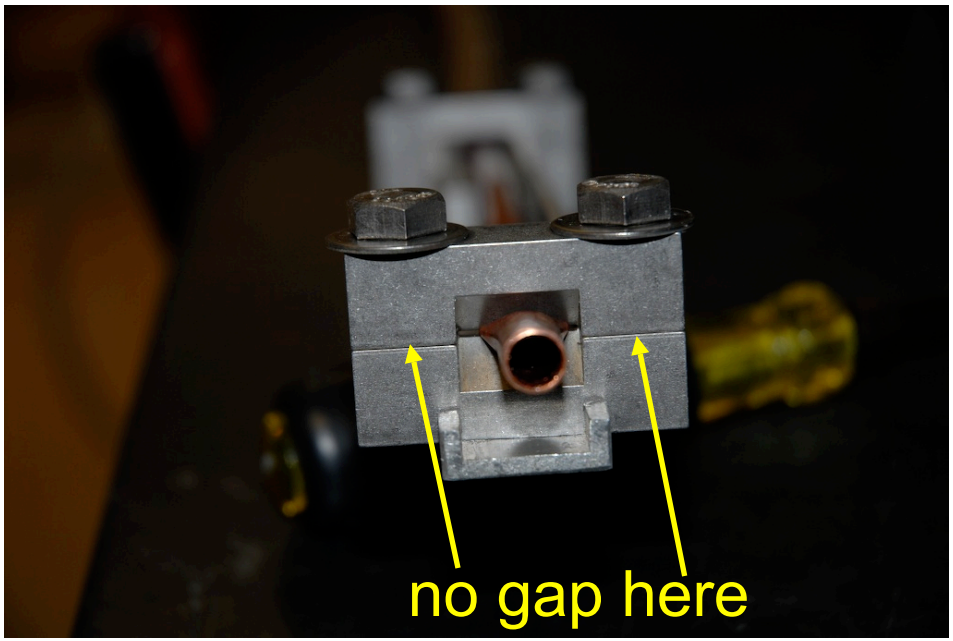
- Make sure tubing is connected to sample tube.
- Open the valve on the downstream plastic tube.
- Start the pump and varify that water is flowing through system.

- While keeping the downstream end of the copper tube elevated relative to the upstream end (as shown) tap the tube with wrench to help dislodge bubbles.
- Maintain the orientation of the tube such that the downstream end is always elevated relative to the upstream end during the remainder of sampling procedure (until the clamps are closed.)

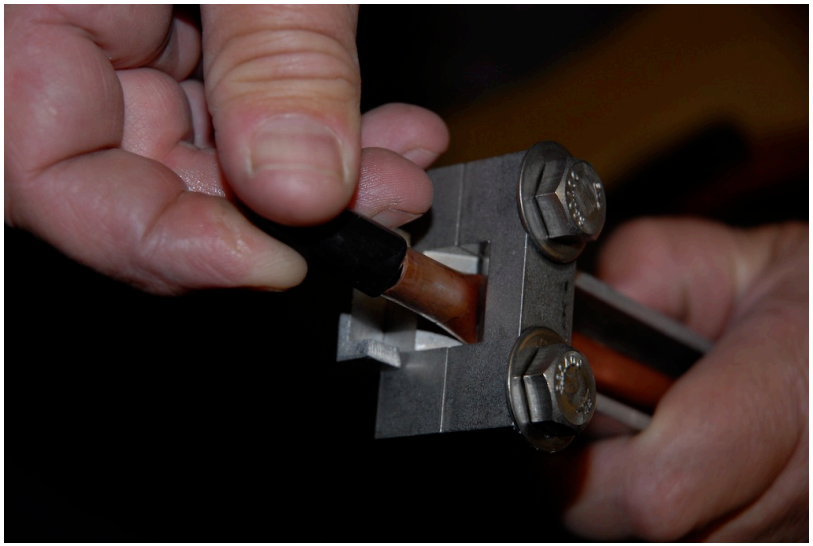
- Purge approximately 1 liter of water through the tube and watch for bubbles in the downstream plastic tube.
- Partially close the valve on the downstream tube. This will elevate the pressure inside the copper tube and will help eliminate bubbles.

- Once the copper tube is purged and NO bubbles can be observed in the downstream plastic tube, begin to close the downstream pinch clamp
- Caution - If you cannot eliminate the bubbles by further closing of the valve, it is unlikely that the sample will yield acceptable results.
- Close the downstream pinch clamp by turning 1 bolt about 1 turn, and then switch to the other bolt (i.e. alternate so that the clamp closes on the tube uniformly without a shearing - scissor-like - motion.)

- While keeping the pump operating, close the upstream clamp in a similar manner as before.
- Once both clamps are closed, the pump can be turned off.
- Note: The metal clamps contain a precision gap between the sealing surfaces. You should tighten the clamps completely such that no gap exists near the bolts as shown. (The precision gap will prevent the copper tube from shearing off.) You should tighten the bolts as much as reasonably possible using a wrench that is approximately 20 cm long. Over tightening the bolts is generally better than under tightening them (but don't hurt yourself of break the bolts!)



- Remove the plastic hoses and make sure that the ends of the copper tube are filled with water.
- Fill the plastic caps with water and install them on the copper tube as shown. (With the ends of the copper tube filled with water, any leakage across the clamped surface will be reduced.
- Remove the clamped copper tube from the holder.



- Carefully label the copper tubes. This can be done directly using a sharpie, but it is then a good idea to cover the marking with clear tape.
- Treat the sample with care. The ends are delicate and if they break off the sample will probably leak, and/or we will not be able to attach it to the extraction line in the lab.

Additional Comments

- Samples in properly-sealed copper tubes have a very long shelf life (years) and do not require refrigeration.
- Do NOT allow the samples to freeze. There is NO (hopefully) headspace inside the copper tube and freezing will often break the tube.
- FedEx triangular “map” boxes make fairly good shipping containers.

Shipping Address

Dissolved Gas Lab
University of Utah
115 South 1460 East, Room 420
Salt Lake City, UT 84112-0102

Phone 801-585-5214
Fax 801-581-5560