

Cell 6 System User Manual



Probe Loading

1) Ready the Probe for Mounting

- a. After Mounting the sample, pull the load lock down to fully cover the sample end of the probe. Attach the probe clamp on the shaft just above the load lock.
- b. Attach any Thermometry/Signal cables that will be needed during the probe load/cooldown procedure. The next opportunity to do so won't occur until after your sample has cooled to 4K.

2) Mount Probe

- a. Due to the long length of the Cell 6 probes, two people are required to carry and mount them to the cryostat. Have one person support the head of the probe and the other support the area near the top of the load lock. While guiding any attached cables, carefully walk the probe up the stairs to the user platform.
- b. The person carrying the head of the probe should then walk up the ErectaStep and hold the probe vertically while the second person prepares the gate valve.
- c. Verify that the gate valve on top of the cryostat is completely closed before proceeding.
- d. Remove the KF-40 clamp and blank from atop the gate valve and ensure that the centering ring/o-ring is in good condition.
- e. Align and mount the load lock to the gate valve, making sure that the probe is held completely vertical. Tighten the clamp securely.
- f. Use the railing on the ErectaStep and hook and loop tape to relieve cable strain.

3) Ready Probe for Insertion

- a. Attach the KF-25 pumping line to the KF-16 port on the probe load lock with a reducer and open both green Swagelok valves leading to the sliding seal and load lock pumping spaces.
- b. Open the valve on the turbo pump and begin pumping. Wait until the pressure reads (at most) 5.0×10^{-3} mbar before continuing. If the pressure does not reach this level in 10 minutes or less, there is most likely a leak. It may be necessary to remove the probe to fix the leak.

³He Insert Operation

1) Lowering the Probe into ³He Insert

- a. **Close the load lock valve (bottom green Swagelok valve on the probe) before proceeding.** Failure to do so may result in the loss of ³He gas. It may be helpful to secure the knob with tape to prevent accidental opening later. Keep the sliding seal valve (top green Swagelok valve on probe) open.
- b. Check again that the load lock valve is **CLOSED**. A loss of ³He gas is an expensive mistake in both time and money and may end your experiment.
- c. Watch the pressure at the turbo pump and slowly open the gate valve at the top of the cryostat. Constantly decreasing pressure is reassuring. If you observe the pressure increase when the gate valve is opened, **halt the loading procedure and immediately close the gate valve**. This may indicate a loss of ³He.
- d. Before lowering the probe, double check that the gate valve is completely open.
- e. Set the sorb temperature to 21K. This will heat the sorb enough to provide some exchange gas to cool the probe while lowering.
- f. The Lakeshore 336 temperature controller can be monitored on the Data Mac via the LabView VI "Big Temp Display". This will provide an easy to view readout of both

temperature and rate of change. It may be helpful to set this up on the computer before continuing.

- g. Firmly grasp the probe shaft and remove the probe clamp from the top of the load lock. Do not let go of the probe shaft while removing the clamp.
- h. Begin lowering the probe. As the probe is lowered, watch the temperature of the 1K pot to ensure that it stays below 1.8K. If the probe is lowered too fast, boiling of the helium bath may be heard via a check valve, or you may hear a significant change in the tone of the 1K pot pump. If this occurs, stop loading the probe and allow the boil off to subside. Continue loading the probe until a hard stop is felt. There is an orange plastic clip-on depth gauge to ensure that the probe is fully seated. There should be approximately 1.5 inches of the probe shaft sticking out of the load lock when the probe is fully inserted.
- i. If the probe stops short of the fully seated position, slightly raise the probe, rotate the shaft 45-90 degrees, and try again. If this proves unsuccessful after a couple attempts, please ask for assistance as there may be ice in the insert. Do not force the probe down as this can damage the probe and your sample.
- j. After fully lowering the probe, close the sliding seat pumping valve (top green Swagelok valve) and turn off the turbo pump.

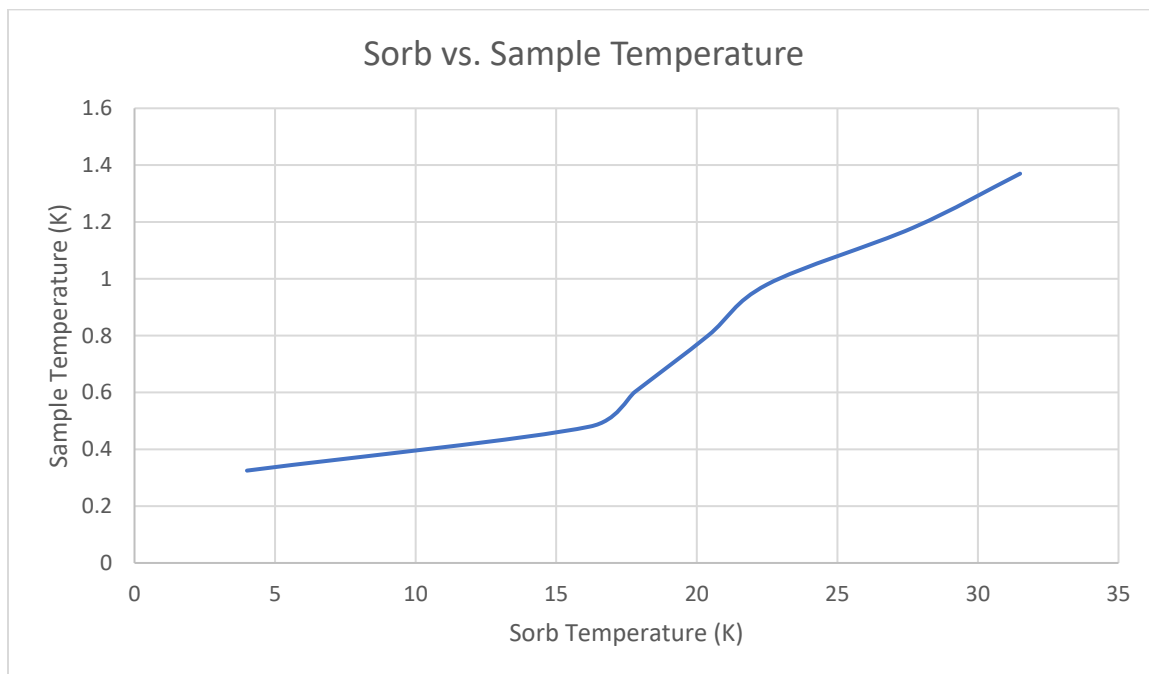
2) Condensing ^3He

- a. Verify that the 1K pot and probe temperatures are below 1.8K.
- b. Turn the sorb helium flow down to ~ 2 L/min via the valve at the bottom of the flow meter on the cryostat. Set the sorb temperature to 45K.
- c. After approximately 30-45 minutes, the gas will be fully condensed, and the sorb heater can be shut off or set to an intermediate temperature. Return sorb helium flow to $\sim 6-7$ L/min.

As the sorb cools, the vapor pressure of the ^3He will drop, further cooling the ^3He liquid. The sorb can be cooled faster by opening the valve on the flow meter of the sorb cooling

loop. Flow should not be increased to the point that frost occurs near the flow meter. Once base/desired temperature is reached, sorb helium flow should be restored to ~6-7 L/min. Expected base temperature is approximately 325 mK.

The sorb is used to obtain sample space temperatures between 325 mK and 1.8K. The provided chart serves as a guideline for desired sample temperature vs sorb temperature. The temperature range of 1.8K-2.2K is unstable and may be difficult to control.



The ^3He insert can also run at temperatures up to 80K by using the heater on the sample holder of the probe. The probe heater is controlled using the output of the probe's Lakeshore 336. The sorb should be set to 12K to provide some exchange gas for better temperature control. When heating the sorb, turn down the helium flow rate of the sorb cooling loop to ~2 L/min.

2) Removing Probe from ^3He Insert

- a. If not already attached, connect the turbo pump line to the KF-16 flange on the probe load lock.
- b. Check to make sure that the lower green Swagelok valve on the probe load lock is closed and open the upper valve.

- c. Open the valve at the turbo pump and turn the pump on. The minimum pressure required before raising the probe is 5.0×10^{-3} mbar.
- d. Set the sorb temperature to 21K and set heater range to "High". This will provide exchange gas to help warm the probe as it is raised.
- e. Once the sliding seal pressure is at an acceptable level, begin raising the probe. It is important not to raise the probe too fast to prevent freezing the sliding seal. If the sliding seal freezes, air can leak into the insert and contaminate the ^3He . Raise the probe until the shaft feels cold and stop for 5-10 minutes to allow the shaft section to warm up. Do not allow the upper section of the load lock tube to frost up. Continue until the probe is fully removed.
- f. The probe will come to a positive stop when it is fully removed from the insert. Leave the sample end of the probe to warm up to at least 285K before proceeding.
- g. Once the probe has reached 285K, turn off the sorb heater and wait until the sorb cools to 4K or lower. This can be sped up by increasing the sorb flow rate to 10 L/min.
- h. After the sorb reaches 4K, carefully close the gate valve on top of the cryostat. **Make sure that the gate valve closes completely.** If resistance is felt before the valve is fully closed, the probe may not be fully removed from the insert. Ensure that the probe is pulled out fully from the insert. Ask for assistance if you are unsure. **Do not attempt to force the valve closed.**
- i. Close the upper green Swagelok valve on the probe, close the valve at the turbo pump, and turn off the turbo pump.
- j. **After checking that the gate valve is fully closed,** open the lower green Swagelok valve to equalize the pressure in the load lock. Using two people, the probe can now be removed from the cryostat and carefully walked down to the probe table.
- k. Install a KF-40 blank on the gate valve.
- l. Turn sorb flow rate back down to ~ 6 L/min.

VTI Operation

1) Lowering Probe into VTI Insert

- a. Complete steps 1-3 of the "Probe Loading" section on page 1 of this manual. Once the pressure is below 5.0×10^{-3} mbar, close the load lock valve (bottom green Swagelok) and leave the top valve open for the sliding seal.
- b. Set the temperature of the VTI. The temperature can be set anywhere between 1.5K and 350K. Use the lower Lakeshore 336 to set the temperature and heater range. It is best to use the lowest heater range that will stabilize the system. The needle valve may need to be adjusted depending on the setpoint.
- c. Open the gate valve on top of the cryostat fully and slowly lower the probe until fully seated. There should be approximately 1.5 inches of the probe shaft sticking out of the load lock.
- d. Close the sliding seal valve on the load lock of the probe, close the valve on top of the turbo, and turn the turbo station off.

2) Removing Probe from VTI Insert

- a. If not already attached, connect the turbo pumping line to the KF-16 flange on the probe load lock.
- b. Check to make sure that the lower green Swagelok valve on the probe load lock is closed and open the upper valve.
- c. Open the valve on the turbo pump and turn the pump on. The minimum pressure required before raising the probe is 5.0×10^{-3} mbar.
- d. Begin raising the probe after reaching the appropriate pressure. When the probe shaft feels cold, stop raising and place the clamp on the shaft. Wait 5-10 minutes for the shaft section to warm up and continue this process until the probe is fully removed.

Removing the probe too fast can cause the sliding seals to freeze and leak air into the insert. Make sure that frost is not reaching the upper portion of the load lock tube.

- e. There will be a positive stop when the probe has been fully removed from the insert. Install the shaft clamp.
- f. Close the upper green Swagelok valve, close the valve on the turbo pump, and turn the turbo pumping station off.
- g. Wait for the probe to reach 285K.
- h. Close the gate valve on top of the cryostat and ensure that the valve is fully seated. If resistance is felt before the valve closes fully, check to make sure that the probe is fully pulled out of the insert. **Do not attempt to force the valve closed.**
- i. **After checking that the gate valve is fully closed**, open the lower green Swagelok valve to equalize the pressure in the load lock. Using two people, the probe can now be removed from the cryostat and carefully walked down to the probe table.
- j. Install a KF-40 blank on the gate valve.

Turbo Pump Operation



1) Turning Pump on

- a. To avoid damaging the turbo, verify that it is not actively spinning before continuing. If it is actively spinning, allow turbo to come to a stop before opening to atmospheric pressure.
- b. Open V33 (on top of turbo).
- c. Press the left button. The pump will turn on. The backing pump will make a loud screeching noise if pumping down from atmospheric pressure, but it quiets down as pressure decreases.
- d. Pressing the right button will cycle through various displays, including pressure readout (mbar) and turbo speed percentage.

2) Turning Pump Off

a. Close V33.

b. Press the left button twice.

c. Press the center button to verify input and the pump will turn off. The turbo will continue to spin down naturally and is not automatically vented.