

2.3 Bubble Chamber CF<sub>3</sub>I Fill Procedure*Written Procedure*2.3 Bubble Chamber CF<sub>3</sub>I Fill Procedure

This procedure covers filling of the bubble chamber inner vessel with its nominal charge of CF<sub>3</sub>I. Obviously there is plenty of room to screw up here, hence this is a written procedure.

- 1) Ensure that the hydraulic pressure cart has been filled and appropriately initialized.
- 2) Setup the CF<sub>3</sub>I transfer cart and CF<sub>3</sub>I transfer plumbing. The cart is equipped with a 25 lb Arlyn Scale that is read out via a 4-20 ma current loop. The CF<sub>3</sub>I transfer bottle sits on the balance. The plumbing consists of a flexible connection from the CF<sub>3</sub>I transfer bottle to the CF<sub>3</sub>I inlet port (the filter leading into the auxiliary port on Cartan Valve V1) and is equipped with a tee to a vacuum pump down line with an isolation valve. The pump down port should be near the Cartan valve.
- 3) Evacuate the CF<sub>3</sub>I transfer lines.
- 4) Ensure that you have the “Commissioning Tool” VI operating. This software will provide access to and logging of all of the state variable data for the chamber, the CF<sub>3</sub>I mass transfer data, the control and read-back data from the hydraulic cart and the heater/chiller unit, and photography data for the inner vessel. The goal would be to log data from the initial setup through cool-down, CF<sub>3</sub>I distillation, and warm up to normal operating conditions.
- 5) Initiate data logging.
- 6) The initial condition is that the inner vessel is filled with water and under vacuum. The pressure vessel has been backfilled with de-gassed propylene glycol. The hydraulic cart is not under pressure.
- 7) Initiate cool-down<sup>1</sup> to just above 0°C. This will take a while. Follow procedure 2.5 “Bubble Chamber Temperature Ramp up/down” until an appropriate temperature has been achieved and stabilized.
- 8) Compress (slightly) the chamber. Use the hydraulic piston position controls to drive the fast piston up to near its upper stop. Be very careful not to generate a pressure more than a few psi. It is only necessary to take the slack out of the system so that the bellows does not overextend<sup>2</sup> when the inner vessel is pressurized with CF<sub>3</sub>I gas.

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<sup>1</sup> The actual temperature is not critical. It needs to be cool enough to maintain the distillation relative to the ~20°C reservoir temperature.

<sup>2</sup> The bellows range, starting from its stop under vacuum, is roughly 200 cm<sup>3</sup>. The range of the fast piston is 50 cm<sup>3</sup>. Mainly you just need to establish that the hydraulic piston is in fact pushing up on the fast piston, and that there isn't some slack space.

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*Written Procedure*

- 9) Isolate the vacuum pump.
- 10) Open the CF<sub>3</sub>I tank valve to pressurize the lines
- 11) Open the main Cartan Valve to initiate the distillation. Over time, one should observe the CF<sub>3</sub>I dripping down from above and forming a puddle in the bottom of the vessel. The mass in the tank should continuously decrease.
- 12) Adjust the position of the inner vessel using the hydraulic cart piston. The water fill is near the top of the quartz. The vacuum volume above the bellows is roughly 800 cm<sup>3</sup>. If the quartz inner vessel is lowered to near maximum bellows extension, this will create an additional 200 cm<sup>3</sup> into which we can distill roughly 1 liter of fluid.
- 13) Allow the distillation to proceed until it stops on its own at the roughly 1-liter mark.
- 14) Now iterate to complete the fill:
  - a. Close off the CF<sub>3</sub>I inlet valve.
  - b. Open a purge valve to the inner vessel.
  - c. Use the hydraulic piston to lift the vessel and drive out 200 cm<sup>3</sup> of water.
  - d. Close off the bleed valve.
  - e. Open the CF<sub>3</sub>I inlet valve.
  - f. Use the hydraulic piston to draw in 200 cm<sup>3</sup> of CF<sub>3</sub>I gas, creating a new condensation space.
- 15) On the last iteration, cross-check the mass transfer data, the CF<sub>3</sub>I level in the vessel, and the quantity of water removed from the vessel. Make sure you're done.
- 16) Close off the Cartan valve and the CF<sub>3</sub>I bottle valve.
- 17) *SLOWLY*, pressurize the chamber. Do this by adding compressed air to actuate the fast pneumatic/hydraulic cylinders. Once you've established that the inner vessel is "floating" (i.e. that when all of the CF<sub>3</sub>I is condensed the bellows is off its stop) you can run the pressure up to the nominal 200 psig.
- 18) Break down the temporary plumbing installation.
- 19) Initiate warm up of the chamber to its operating point following procedure 2.5 "Bubble Chamber Temperature Ramp up/down".
- 20) Terminate data acquisition and secure the data.