

C₃F₈ fill procedure

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This procedure covers filling of the bubble chamber inner vessel with its nominal charge of C₃F₈. While completing this procedure, it is possible, through operator negligence, to release small quantities of C₃F₈ to the atmosphere.

- 1) Review C₃F₈ handling procedure.
- 2) Ensure that the hydraulic system is filled and appropriately initialized. The bellows should be at a slightly extended position. The inner vessel should be completely filled with water, all the way up to the fill and bleed valves. All valves to the inner vessel – MV-010, MV-011, MV-012 – should be closed.
- 3) Start the “Commissioning Tool” VI and initiate data logging every 5 seconds.
- 4) Initiate cool-down¹ to just above 0°C using the NESLAB chiller bath. If the bath contains only water, set it to maintain a temperature no lower than 2°C.
- 5) Assemble the C₃F₈ transfer lines, vacuum pump, transfer cart, C₃F₈ transfer bottle, and, optionally, a C₃F₈ sample bottle. The plumbing consists of a flexible line from the C₃F₈ transfer bottle with a tee to a vacuum gauge, an isolation valve, and a vacuum pump down port. The cart is equipped with an electronic balance. The C₃F₈ transfer bottle sits on the balance.
- 6) Follow the “Before Handling C₃F₈” section of the handling procedure.
- 7) If a sample is not to be taken, skip to step 13. Otherwise, position the transfer line so that any condensed C₃F₈ flows into the sample bottle. Zero the balance. Place the sample bottle in an ice water bath.
- 8) Ensure that MV-011 and the transfer bottle valve are closed. Open the plumbing to the vacuum pump and evacuate the C₃F₈ transfer line. Once it is evacuated, open the valve to the empty sample bottle and evacuate it. Then isolate and turn off the vacuum pump. Record the vacuum pressure, wait 5 minutes, and re-check the vacuum pressure to ensure there are no leaks.
- 9) Record the mass of the transfer bottle and of the sample bottle.
- 10) Open the transfer bottle and condense some C₃F₈ into the sample bottle for 5 minutes, or until 50g has been transferred.
- 11) Close the valves to both bottles and rerecord the mass of the transfer bottle.

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

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- 12) While facing away from the gas stream, vent the transfer line to atmosphere through the pump down port. Disconnect the sample bottle.
- 13) Connect the transfer line to the bubble chamber main fill valve (MV-011).
- 14) Ensure MV-011 and the transfer bottle valve are closed. Open the plumbing to the vacuum pump and evacuate the C_3F_8 transfer line. Once that is evacuated, isolate and turn off the vacuum pump. Record the vacuum pressure, wait 5 minutes, and re-check the vacuum pressure to ensure there are no leaks.
- 15) Cycle the hydraulic system to bring the pressure to about 100psi, so that, during distillation, water does not enter the transfer line, but C_3F_8 condenses into the vessel.
- 16) Verify that the vacuum pump is isolated and MV-011 is closed, then slowly open the valve to the C_3F_8 tank to pressurize the lines. The line pressure should rise to approximately 115psi.
- 17) Begin the distillation by opening MV-011. Open MV-012 slightly, such that water leaks slowly from the bleed line, but does not allow C_3F_8 to boil out. The goal is to keep chamber pressure high enough to prevent C_3F_8 from boiling, so that it condenses in the fill line and settles to the bottom of the chamber, while only water is displaced through MV-012. This will require delicate modulation of MV-012. There should be a large pressure differential across MV-012. If the beginning of a gas bubble is seen entering the vessel through the fill line, immediately close MV-012 and allow some C_3F_8 to condense in the fill line.
- 18) Allow distillation to proceed until the desired mass of C_3F_8 has been transferred from the vessel into the chamber. Over time, C_3F_8 should be observed forming a puddle in the bottom of the vessel. The mass in the C_3F_8 tank should continually decrease.
- 19) Cross-check the mass transfer data, the C_3F_8 level in the vessel, and the quantity of water removed from the vessel. Make sure the appropriate amount of fluid has been transferred.
- 20) Isolate the C_3F_8 transfer bottle. Remove it from the warm water bath.
- 21) Wait for the overpressure of C_3F_8 in the transfer line to condense into the fill line, which may take a few minutes. When C_3F_8 stops dripping into the inner vessel, when the line pressure is minimized, close MV-011 and isolate the transfer line.

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- 22) Vent the transfer line and disconnect it from both the inner vessel and the transfer bottle. Cap the transfer bottle and the inner vessel port.
- 23) Ensure the “After Handling C_3F_8 ” section of procedure 3 was followed.
- 24) Slowly charge the hydraulic system. Once you’ve established that the inner vessel is “floating” (i.e. that when all of the C_3F_8 is condensed the bellows is off its stop) the pressure can be run up to the nominal 200 psig.
- 25) Terminate data acquisition and backup the data.