

# Frozen Spin Target Manual

## Document 10: Removing the Frozen Spin Target Insert

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This document describes the preferred method for removing the target insert from the Frozen Spin dilution refrigerator.

### Risk Assessment

Minor risk of cryogenic burn due to handling of LN<sub>2</sub>. Minor risk of over-pressurization of FROST vacuum load lock to dilution refrigerator. Risk of radiation exposure is assumed to be negligible due to low ionizing properties of the gamma ray beam used in the FROST experiments.

### Hazard Control

Cryogenic gloves and a full face shield must be worn whenever handling LN<sub>2</sub>. Long-handle stainless steel tools are used to remove the cup from the insert. Vacuum load lock is protected by a 2 psig pressure-relief valve to prevent over-pressurization of load lock. Insert will be surveyed by a member of the Radiation Control Group shortly after its removal. Performance of this procedure in accordance with this document reduces procedure to Risk Code 1.

### A. Overview

The butanol beads used for the Frozen Spin Target fill a PCTFE cup (50 mm X 15 mm ID) that is loaded inside the mixing chamber of the FROST dilution refrigerator. This document describes the preferred method for safely removing the target. The beads must be maintained at a temperature below 150 K during the entire procedure to prevent them from melting.

Four individuals are necessary to perform this procedure:

**Individual A:** Stops the 3He pumps, back fills the dilution refrigerator with 4He gas. Restarts the pumps and condenses helium in the refrigerator after insert has been removed;

**Individual B:** Stops the load lock turbo pump and back fills the load lock with 4He gas. Restarts the turbo pump after insert has been removed;

**Individual C:** Removes the beam entrance window from the vacuum load lock. Removes heat shields from load lock and target insert from the refrigerator.

**Individual D:** Transfers insert from Individual C to LN<sub>2</sub> container.

The list of necessary equipment for performing this procedure is:

1. small helium cylinder for purging the target stick during removal/insertion;
2. target insert torque wrench;

3. target removal tool;
4. LN2 tray, small LN2 dewar and insert handling tools;
5. electronic balance (for weighing the material if desired);
6. zip lock bags for butanol storage during the weighing;
7. fresh kapton gasket (if necessary to replace insert);

## **B. Removing the Insert**

1. Individual D should prepare the target removal tube by cooling its downstream end in LN2 and applying a purge of helium gas to its clear plastic shroud.
2. If  $^3\text{He}/^4\text{He}$  is circulating through the dilution refrigerator, it must be pumped back into its storage tanks. Refer to FROST Document 6, "How to Remove the  $^3\text{He}/^4\text{He}$  mash". If the circulating fluid is pure  $^4\text{He}$ , refer to Document 7, "How to Remove Pure  $^4\text{He}$  from Circulation".
3. Once the circulating mash has been properly removed, Individual A should turn OFF all  $^3\text{He}$  pumps.
4. Next, Individual A back fills the dilution unit with  $^4\text{He}$  from the  $^3\text{He}$  gas panel:
  - a. CLOSE MV8361, OPEN MV8364, OPEN the vent/check valve MV8360V at the rear of the L70 dry pumps.
  - b. OPEN the  $^3\text{He}$  bypass valve 3 full turns.
  - c. Set the helium regulator to about 4 psig.
  - d. OPEN valves MV8373 and MV8371 to bleed  $^4\text{He}$  into the dilution unit via the bypass valve.
  - e. maintain a constant purge of  $^4\text{He}$  thru the refrigerator in this manner through the procedure of removing the target insert.
5. Individual B back fills the load lock tube with helium (best done in parallel with Step 3):
  - a. CLOSE MV8380 and Turn OFF the load lock turbo pump TP8380. Its backing pump MP8380 can remain ON.
  - b. OPEN MV8381 to bleed helium into the load lock tube. Relief valve RV8381 will open at about 2 psig.
6. Individual C, wearing cryo gloves and a face shield, should slowly unscrew the quick connect coupling at the upstream end of the load lock tube to remove the kapton beam entrance window,
7. Individual C should remove the heat shield assembly from the load lock tube and place it on top of the microwave generator shielding box behind him.
8. Individual D hands the insert removal tool to C, who breaks the kapton seal at the mixing chamber using the removal tool and its torque wrench.
9. Individual C removes the target insert and passes it (still connected to the removal tool) to D.
10. Individual D places the target insert in LN2.
11. Individual C replaces the beam entrance window.
12. Individual B CLOSES valve MV8371, OPENS MV8380 and STARTS TP8380.
13. Individual A STARTS the  $^3\text{He}$  pumps.

NOTE: If it is desired to re-insert a fresh target stick in the mixing chamber at this time, the above procedure should stop at Step 10, and the procedure “How to Insert the Target Stick” should commence.

### **C. Weighing the Target Material**

1. Place a small zip-lock bag on the electronic balance and weigh it. Record the weight and zero the balance while the bag is on it.
2. Pull the target stick and removal tool from the LN2 dewar and place the insert horizontally in the LN2 tray.
3. Allow the insert removal tool to warm to room temperature, and detach it from the target insert.
4. Stand the insert upright in the LN2 tray and using the long-handled manipulation tools, detach the cup from the insert.
5. Using the long-handled manipulation tools, carefully pour the butanol beads from the target cup into the zip-lock bag. Seal the bag immediately to prevent moisture from the air condensing on the beads.
6. Place the bag back onto the balance and weigh the material. Record the weight.