

# Frozen Spin Target Manual

## Document 9: How to Insert the Frozen Spin Target Stick

C Keith

rev. March 11, 2008

This document describes the preferred method for inserting the target stick into 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. Performing the procedure according to this document reduces Risk Code to 1.

### A. Overview

The butanol beads used for the Frozen Spin Target are used to fill a PCTFE cup (50 mm X 15 mm ID) that is then loaded inside the mixing chamber of the FROST dilution refrigerator. This document describes the preferred method for safely loading the cup and inserting 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. Inserts the target into the load lock tube and makes up the kapton mixing chamber seal. Places the heat shield assembly into the load lock tube.

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

The list of necessary equipment for performing this procedure is:

1. Butanol target material and PCTFE target cup;
2. small helium cylinder for purging the target stick during removal/insertion;

3. target insert torque wrench;
4. target insertion tool;
5. LN2 tray, small LN2 dewar, brass holder for PCTFE cup and insert handling tools;
6. fresh kapton gasket (if necessary to replace insert);

## **B. Loading the Cup**

1. Attach a fresh kapton gasket to the target insert.
2. Remove the container of butanol from the LN2 storage dewar and place it in the LN2 tray;
3. Place the PCTFE target cup in the same LN2 tray, upright in its brass holder.
4. Using the long-handled manipulation tools, remove the cover from the target material container;
5. Using the long-handled funnel, pour beads from the container into the target cup;
6. Precool the downstream end of the target insert with LN2 and then attach it securely to the target cup;
7. Attach the target insert to the insertion tool and place it into a small LN2 dewar. The assembly should be cooled up to and including the female threaded nut;
8. Attach a source of helium gas to the insertion tools clear plastic shroud and place a steady purge into the shroud;
9. Individual D should hold onto the insertion tool until ready.

## **C. Inserting the target**

1. 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".
2. Once the circulating mash has been properly removed, Individual A should turn OFF all  $^3\text{He}$  pumps.
3. 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  $^4\text{He}$  through the refrigerator in this manner through the procedure of removing the target insert.
4. 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.

5. 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,
6. If necessary 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.
7. Individual D hands the insert assembly to C, who inserts it into the vacuum load lock, and makes the kapton seal at the mixing chamber using the insertion tool and its torque wrench.
8. Individual C removes the target insertion tool and passes it (still connected to the removal tool) to D.
9. Individual C replaces the heat shield assembly in the load lock tube and replaces the beam entrance window;
10. Individual A STARTS the  $^3\text{He}$  pumps and starts cooling the refrigerator.