

Frozen Spin Target Manual

Document 7: Swapping the LN2 traps

C Keith

rev. March 11, 2008

This document describes the preferred method to change from one liquid nitrogen (LN2) trap to the spare trap *while the dilution refrigerator is cold and running*.

Risk Assessment

Minor risk of cryogenic burn due to handling of LN2.

Hazard Control

Cryogenic gloves and a full face shield must be worn whenever handling LN2. Use of gloves and face shield reduces procedure to Risk Code 1.

A. Overview

There are two LN2 traps located behind the brown, 3He gas panel, although only one is in use at a given time. The traps are used to filter out any heavier-than-helium contaminants (such as air or pump oil) in the 3He gas stream before they reach the dilution refrigerator. Such contaminants would freeze inside the refrigerator's heat exchangers, and impede or even stop the flow of 3He. There is no remedy for this occurrence other than warming the refrigerator completely to room temperature and flushing the system.

Each trap consists of a stainless canister (3" x 15" long) filled with stainless steel wool and activated charcoal. The 3He gas to be purified enters at the bottom, flows through the steel wool and charcoal and exits the trap at the top. In use, a trap is immersed inside a 1 m tall dewar of LN2 with a 5 day hold time. A probe inside the dewar monitors the liquid level. Any value above 20 inches is considered OK. A spare trap is included in the gas panel in the event that in the first becomes overloaded with contamination. This document describes the preferred method to change from one liquid nitrogen (LN2) trap to the spare trap *while the dilution refrigerator is cold and running*.

B. Diagnosis

Two 0-2000 mbar pressure gauges on the 3He panel can be used to determine if the LN2 trap needs to be changed. The first, PI8361, measures the 3He pressure upstream of the trap and is called the *Circulation* pressure. The second gauge, PI8360, measures downstream of the trap and this pressure is referred to here as the *Condensation* pressure. Under normal circumstances these two pressures should be equal to one another (+/- 50 mbar). They normally operate in the range 100 – 400 mbar except during the polarization process when they may reach as high as 800 mbar. A flow meter is also located

downstream of the traps and reads the volumetric flow of ^3He as it enters the cryostat. Typical values are 2 – 7 slpm while in frozen spin mode and up to 25 slpm while polarizing.

A problem with contaminants in the LN2 trap or in refrigerator itself can be spotted by watching both pressure gauges and the flow meter. Here are two possible scenarios:

1. The ^3He flow drops for no apparent reason while both the Circulation and Condensation pressures rise. This indicates that a flow obstruction exists inside the dilution refrigerator. This is going to be a bad day.
2. The ^3He flow for no apparent reason. The Circulation pressure rises while the Condensation pressure falls. This indicates that flow obstruction exists in the LN2 trap and the latter needs to be swapped with the spare trap. Use the steps below to swap traps without warming the refrigerator. Be quick -- you have about 15 minutes before the refrigerator begins to warm.

C. How to Swap Trap A (cold) with Trap B (warm)

Warning: use appropriate safety equipment during this procedure – this means cryo-gloves and a full-face shield.

1. Ensure that valves MV8371, MV8372 and MV8373 are CLOSED.
2. Turn on the auxiliary vacuum pump at the bottom of the ^3He panel and open the butterfly valve attached to the pump inlet (located behind the gas panel). The thermocouple vacuum gauge PI8363 should quickly drop to a few mtorr.
3. OPEN MV8374B to pump out the spare trap to a pressure less than 100 mtorr, then CLOSE MV8374B.
4. Close off the trap currently in use by CLOSING valves MV8362A and MV8363A.
5. OPEN MV8374A to begin pumping on the bad trap (Trap A).
6. Using cryo gloves and a full-face shield, remove Trap A from the LN2 dewar and place it in its holder located in the back of the ^3He gas panel.
7. Carefully drop the spare trap (Trap B) into the LN2 dewar and wait for the violent boiling to subside.
8. OPEN valves MV8362B and MV8363B to resume normal circulation.