

Frozen Spin Target Manual

Document 1: 3He Pump and Purge Procedure

C. Keith

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This document describes how to pump and purge the 3He portion of the Frozen Spin Target (comprising the dilution refrigerator, the 3He circulation pumps and brown, 3He gas panel). It assumes the following:

1. The entire Frozen Spin Target has been assembled and fully leak checked;
2. The 3He and 4He storage tanks are filled with the proper charge of 3He/4He mash.
3. The above tanks are connected to the 3He gas panel, but the valves on the tanks themselves are CLOSED.
4. A clean source of 4He gas is connected to the 3He panel at valve MV8372. This can either be a bottle of Scientific Grade helium or the 4 atm supply from ESR, but it assumed that the line leading to valve MV8372 has been properly pumped and purged independently of the following procedure. If a bottle is used the regulator on the bottle should be set to about 5 psiG. Likewise if the 4 atm supply is used, regulator PR8300 should be at 5 psiG.

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. Uses of gloves and face shield reduces procedure to Risk Code 1.

A. Initial state before Pump/Purge

1. Ensure that all pumps are OFF and all valves on the 3He panel CLOSED. The valves mounted on the 3He and 4He storage tanks are CLOSED (the storage tank valves are to remain CLOSED during the entire procedure).
2. Check that a clean source of 4He gas is connected to the 3He panel at valve MV8372. If the 4 atm source is to be used, make sure it was connected while under purge, or was connected and then cleaned in an appropriate manner. Set the supply regulator to about 5 psiG.
3. Check that valve MV8343, located at the bottom of the blue, 4He gas panel is CLOSED.
4. Check that the automatic dump solenoid valve SV8360 is CLOSED (the indicator lamp is located on the control chassis beneath the gas panel).
5. OPEN the KF-40 manual angle valve (MV8360V) between check valve CV8360V and the exhaust line of the two L70 dry pumps. This valve always the L70s to vent safely to atmosphere and should remain OPEN throughout the pump/purge procedure.
6. OPEN valve MV8360. This is a green 1/2" Nupro valve located at the inlet of the large roots

pump (beam left side). It connects the 3He pump line to the RGA. OPEN the ultra-fine needle valve between the RGA and its turbo pump. Turn the knurled knob counter-clockwise to open.

7. OPEN all six gate valves for 3He roots pumps.
8. CLOSE both the 3He run and bypass valves on the rear end of the cryostat. Then OPEN both valves two turns.
9. Proceed to *CLEAN the LN2 Traps*.

B. Clean the LN2 traps

1. Turn ON the auxiliary vacuum pump (Control chassis beneath 3He gas panel). OPEN the butterfly valve at the pump inlet (this valve is located BEHIND the 3He panel, lower left corner). The Thermocouple gauge PI8363 on the lower left corner of the 3He panel should fall to a few mTorr.
2. OPEN all valves on the 3He panel EXCEPT MV8372 and MV8373 (3He and 4He bottle connections), and MV8361, MV8364 and MV8365. Turn on the Edwards scroll pump (aka the “recoup” pump).
3. Wait for the thermocouple gauge to drop to a few mTorr. If the two charcoal LN2 traps are dirty, this could take a while. Heating the traps with a heat gun or heat tape will speed things along.
4. When the thermocouple gauge is at a few mtorr, fill the dewar for the LN2 traps with LN2 and drop in the trap labeled `A`. CLOSE valves MV8374A, MV8374B, MV8362B and MV8363B. These valves should remain CLOSED henceforth.
5. Turn off the recoup pump. CLOSE valve MV8366.

C. Pump and purge of the 3He system

1. Turn on the four roots pumps (or *blowers*) and the two L70 dry pumps used for 3He circulation. Use the following procedure:
 - turn ON both L70s, MP8265 and MP8275;
 - wait for the still pressure PI8360 fall below 5 torr;
 - turn ON the small blowers MP8263 and MP8273
 - close the two aft gate valves SV8260 and SV8270;
 - wait for PI8360 to fall below 1 torr;
 - turn ON the large blowers MP8361 and MP8371
 - close the two mid gate valves SV8262 and SV8272;
2. OPEN valves MV8361 and MV8364. Thermocouple gauge PI8363 will rise to atmosphere, but should eventually begin dropping. MV8364 will remain OPEN.
3. When the thermocouple gauge has reached 100 mTorr or lower, close the butterfly valve at the pump inlet (located behind the 3He panel).
4. CLOSE MV8361.
5. Turn OFF the roots and dry pumps using the following procedure:
 - OPEN both mid gate valves, OPEN both aft gate valves;
 - turn OFF both large blowers and wait 30 seconds;
 - turn OFF both small blowers and wait 30 seconds;
 - turn OFF both L70 dry pumps;
6. OPEN MV8372 and begin filling the system with 4He. The dilution refrigerator and pumping line are filled with 4He through the 3He run and bypass valve only **after** it has passed through LN2 trap A. When the system is at about 500 mbar, CLOSE MV8372.
7. OPEN the butterfly valve at the inlet of the auxiliary pump.
8. Repeat steps 1 through 7 for a total of six pump/purge cycles. During the sixth cycle stop at the end of step 5. Proceed to Part D, *Measuring Flow through the Run Valve*.

D. Measuring Flow through the Run Valve

Following step 5 of the final pump and purge cycle, the 3He dilution refrigerator, its circulation pumps and the entire 3He gas panel should be under a vacuum of 100 mTorr or less. To check that flow through the fine 3He run valve and the heat exchangers downstream of the valve is ok, perform the following procedure.

1. CLOSE all six gate for the 3He pumps (2 aft, 2 mid and 2 big);
2. check that the butterfly valve is closed;
3. CLOSE valves MV8361, MV8365, MV8366 and MV8364. CLOSE the 3He bypass valve;
4. OPEN MV8372 and bleed 800 mbar of 4He into the gas panel.
5. OPEN MV8364 to fill the 3He condensing line with 4He gas. Throttle MV8372 to maintain a pressure of about 800 mbar on the inlet of the run valve;
6. Watch the still pressure via the 0-10 torr manometer readout PI8360A. It should rise steadily to about 1.5 torr in 5 minutes. Note this rate of rise in the FROST logbook. If it is significantly slower than the above value, there is an obstruction somewhere in the 3He condensing line. A significantly faster rate of rise indicates that either the bypass valve is partially open or a leak exists somewhere in the condensing line.

If the flow seems ok, you can now do one of three things:

1. Establish a continuous 4He flow through the system in anticipation of cooling down;
 - CLOSE MV8372 and OPEN the 3He bypass valve;
 - Use steps B1 through B3 to pump out the system. Turn off the aux. pump and CLOSE its butterfly valve;
 - Slowly OPEN (throttle) MV8372 until a flow of about 8 slpm is established. The condenser pressure PI8363 should be 600—800 mbar;
 - turn OFF both L70 dry pumps;
2. Leave the system under vacuum:
 - CLOSE MV8372 and OPEN the 3He bypass valve;
 - Use steps B1 through B5 to pump out the system. Turn off the aux. pump and CLOSE its butterfly valve;
3. Back fill the system with an atmosphere of 4He:
 - OPEN the 3He bypass valve;
 - OPEN MV8372 until the system is at or slightly above 1000 mbar;
 - CLOSE MV8372;

