Frozen Spin Target Manual
Document 4: How to Remove Pure 4He from Circulation

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This documents describes the preferred method to remove pure 4He circulating through the dilution refrigerator.

Risk Assessment
No risk to personnel.

Hazard Control
Not applicable.

A. Overview
In certain conditions it is desirable to have pure 4He circulating the the dilution refrigerator instead of the usual 3He/4He mash. It is assumed in this document that the 3He pumps are running and that all valves on the 3He panel are CLOSED except MV8361, MV8362A (or B), MV8363A (or B), and MV8364. Note that this is the valve configuration for standard circulation.

B. Removing the 3He from Circulation
1. Confirm that valve MV8360V between the L70s exhaust line and check valve CV8360V is OPEN.
2. Turn ON the auxiliary vacuum pump MP8374 and open its butterfly valve MV8374.
3. OPEN MV8371 and CLOSE MV8364 to stop circulating;
4. From the EPICS control screen FROST.adl, apply 1W to the still heater and 1W to the mixing chamber heater.
5. Monitor the still pressure PI8360. If it approaches 1 torr, decrease both the still heater and mixing chamber heater (the pressure switches for the large blowers are set for 1 torr);
6. When PI8371, the thermocouple gauge at the inlet of the auxiliary pump, read a few torr, you can assume that all the helium has been removed from circulation;
7. CLOSE MV8371 and MV8374. Turn OFF the auxiliary pump.

B. Removing the 4He from Circulation

1. OPEN MV8368B, the gas panel valve leading to the 4He storage tanks.
2. Increase the still heat to 1 W and increase the mixing chamber heat to 1 W. The 4He tank

pressure PI8368A should begin to increase. If the still manometer pressure rises above 1 torr, the large blowers will trip off. If it appears that this is going to happen, try turning down the still heater.

3. Continue to recover the 4He until the tank pressure is about 950 -- 1000 mbar. It is important to watch the thermocouple vacuum gauge at the inlet of the large blowers, PI8360B. During recovery the pressure will be greater than 100 mtorr. When all the gas has been removed from the dilution refrigerator, this pressure will drop below 10 mtorr. Keep recovering the gas for at least 10 minutes after the thermocouple gauge has dropped below 10 mtorr. It will typically "burp" once or twice.
4. When you are confident that all the gas has been recovered (PI8368A is about 980 mbar, fridge temperatures above 10 K and thermocouple gauge below 10 mtorr), switch OFF the recoup pump, CLOSE MV8370A/B, and CLOSE MV8368A/B/C (the latter two are the valves on the 4He storage tank). Set both the still and mixing chamber heaters to 0 W. Please record the value of the still level probe. Empty, it's value (as read by EPICS) should be about -95% while the lock-in amplifier should say +95%.

Once all the 4He has been removed you now probably want to do one of two things.

1. **Condense 3He/4He** mash in the refrigerator and run below 1K.
2. **Warm the fridge to room temperature**.