Solid Hydrogen Target Cooling and Warming Procedure

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1 Introduction

This document contains the instructions for cooling and warming processes when formig the hydrogen target.

2 Setting up the Labview Program

1. Open Labview using SHT program shortcut on Desktop.
2. In Labview, change the logging file path. Define todays date in format yymmdd in place of xxxxxx and hit enter.
3. Click the arrow in the upper left corner of the window to start.
4. Click 'Configure' to send command to instrument, then click 'Run' to start running scan cycle for data logging.
5. In the upper right corner of the Labview window, set the scan interval (default 10 s) and the file-save interval (default 1/30).

The following list contains the labels and their descriptions from the Labview program.

VAC-CC10 Wide range vacuum monitor.

VAC-TM1 Hydrogen line vacuum monitor.

VAC-TM2 High vacuum monitor.

VAC-PM Low vacuum monitor.

PtCo1 Target temperature.

PtCo2 Radiation shield temperature.

TGT-Heater Target heater DC voltage.

H2-Press Hydrogen Pressure.

VAC-CC10 and **VAC-TM2** read the same vacuum using different gauges.

3 Cooling Process

Valve	Initial Condition	Purpose
$\mathbf{V}_0$	closed	Controls flow of H to diffuser.
$\mathbf{V}_1$	closed	Fine control of H from system to V_0.
$\mathbf{V}_2$	closed	Bypasses V_1 to hydrogen supply line and V_0.
$\mathbf{V}_3$	closed	Controls H flow from system to V_2.
$\mathbf{V}_4$	open	Controls flow from small hydrogen cylinder to system.
$\mathbf{V}_5$	closed	Opens system to roughing pump.
$\mathbf{V}_6$	closed	Controls flow of H_2/D_2 from V_7 to system.
$\mathbf{V}_7$	closed	Controls flow from H_2/D_2 bottle to V_6.

1. Check helium supply gauge. The ideal range is between 1.60 and 1.65 MPa on the compressor. If the pressure is lower than this, use the connected helium bottle to increase the pressure.
2. Fill out a log sheet (`https://documents.triumf.ca/docushare/dsweb/Get/Document-161977/iris_sht_log_sheets.pdf`).
3. Turn on the compressor ('Drive SW' on/off switch). Record the time.
4. Wait until PtCo1 reaches ≈ 4 K, and both PtCo1 and PtCo2 have stabilized. This should take 2-3 hours.
5. While the cell is cooling down, turn on the roughing pump. Make sure $\mathbf{V}_{1-3}$ are closed, then open $\mathbf{V}_5$.
6. After a few minutes make sure that $\mathbf{V}_7$ is closed and open $\mathbf{V}_6$.
7. Again after a few minutes, close $\mathbf{V}_6$, then open $\mathbf{V}_2$ and $\mathbf{V}_3$.
8. When the foil and heat shield have reached their final temperature, close $\mathbf{V}_2$ and $\mathbf{V}_3$. Open $\mathbf{V}_7$ for a few seconds to fill the line up to $\mathbf{V}_6$. Purge the line by filling it a couple of times by opening $\mathbf{V}_7$, then pumping it out by opening $\mathbf{V}_6$.
9. Estimate the amount of hydrogen necessary for the planned target thickness. The volume between $\mathbf{V}_6$ to $\mathbf{V}_3$, including the pressure sensor and the hydrogen cylinder is 706 cc at 0.086 g/cc. For a target thickness of 100 μm, a pressure of 101 Torr is needed. Additionally ≈ 50 Torr will be needed to ensure a steady gas flow all the way through the formation.
10. Close $\mathbf{V}_5$. Fill the small hydrogen cylinder. A safe way to do so is to repeatedly fill the line up to $\mathbf{V}_6$ and then releasing it into the volume.
11. Close valves **SEBT2:IV3** and **SEBT2:IV4**.
12. Fill out a log sheet.
13. In Labview, change scan interval to 1 s and file-save interval to 1/1.
14. Open $\mathbf{V}_0$ two turns while holding the body of the valve lightly.
15. Move the diffuser into the position marked by the upper right line.
16. Open $\mathbf{V}_2$ slightly (about half a turn).
17. To form the target, open $\mathbf{V}_3$ slightly and monitor **MKS** and **VAC-PM**. $\mathbf{V}_3$ should be open enough so that **MKS** decreases at a rate of ≈ 1 Torr/s. Maintain **VAC-PM** at $1 - 4 \times 10^{-6}$ mbar. Close $\mathbf{V}_3$ when the pressure on **MKS** has decreased by the calculated amount.
18. Close V_0 and move the diffuser to the position marked by the lower red line.
19. Save screenshot of the Labview graphs. Change scan interval and file-save interval back.
20. In Labview, change scan interval to 10 s and file-save interval to 1/30.

4 Warming Process

1. Fill out a log sheet.
2. Close valves **SEBT2:IV3** and **SEBT2:IV4**.
3. Turn off **SEBT2:PNG4**.
4. In Labview, change scan interval to 1 s and file-save interval to 1/1.
5. Turn compressor off. Record time.
6. Wait 10-20 minutes for two peaks to show on the pressure graph. The first peak should occur immediately, and is a consequence of the evaporation of the hydrogen target. The area under the peak is proportional to the mass of the hydrogen target. The second peak corresponds to the contamination release from the heat shield.
7. Save screenshot of the Labview graphs. Change scan interval and file-save interval back.
8. Turn **SEBT2:PNG4** back on and open **SEBT2:IV3** and **SEBT2:IV4**.
9. Allow system to warm to at least 200 K.