

Pressure Test Procedure for SHMS Magnet's He and N2 Circuits

Revision 3

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Description

Pressure and vacuum leak tests are required of the Helium vessel, N2 circuit and the outer vacuum container (OVC) of the final assembled magnet. The following procedure combines the pressure testing of the He and N2 circuits with the internal vacuum leak check of the OVC.

The design pressure of the SHMS magnet's He and LN2 vessels are both 5 atm (75 psig). The Cryo Can reservoir (CCR) design pressure is also 5 atm. The CCRs have been tested at the manufacture, Myer Tooling, to 6.2atm gauge(90 psig) for the He and LN2 vessels with vacuum surrounding the vessels, ie 7.2 atm differential pressure across the vessel boundaries.

The magnet's mechanical reliefs are set at 60 psig (5 atm) for the He and LN2 systems and their rupture disk are set to 75 psig (6 atm).

The relief tree assembly will not be attached to the magnets during testing. The port for the relief tree will be blank off. An relief valve will be utilized on the testing pressure line.

The test pressure of the He and N2 circuits shall be 90 psig with the OVC under a vacuum. This test pressure condition is restricted to the previous maximum pressure test conditions of the cryo-can reservoir (CCR), tested separately.

The helium and N2 circuits are, for the most part, shielded by the thick walled OVC. The exposed components of the pressurized systems are located at the top of the CCR. These components, along with the CCR have been tested previously by its manufacture.

Access to the top of the CCR will be restricted to trained personal wearing hearing protection and safety glasses. Signage will be put in place around magnet during test indicating Magnet is undergoing pressure testing and proper PPE requirements.

Continuous electronic recording of pressure and vacuum is recommended.

The pressure and vacuum test will occur within Hall C, either on the floor of the hall next to the SHMS or on the SHMS itself. There will be no ODH condition related to the pressure test or the release of the test gas. Using the N2 vent line to the outside for gas release after testing is just a consideration.

Equipment

1. Calibrated Pressure Gauge:
Minimum range of 0 to 150 psig.
Preferable with digital/analog output.
2. Test gages: visual, digital or analog.
3. Inline Pressure relief valve:
Preset on bench to set pressure of 93 psig.
4. Gas Sources:
He gas
N2 gas
5. Regulator
6. Throttling valve
7. Isolation and Bleed up valve and lines.
8. Pressure rated hoses, tubing
9. Clamps, fittings. Connectors and valves, venting valve.
10. Vacuum pump
11. Leak detector with digital/analog output
12. JT valve stem retainer caps

Process

1. Install JT valve stem retainer caps on each of the JT ports. Caps should be set such that the valves are partial opened (~50%).
2. Ensure that all U-tube valves are closed and capped off. Blank offs shall be securely tightened on all unused ports, relief tree port, liquid level ports, pressure gage ports, etc.
3. Bench set up and verify inline pressure relief to 85 psig (test pressure plus +3.0 psi).
4. Bench test and verify all test gages to the calibrated gage at the following spacing: 0, 50%, 100% and 150% of test pressure. Record values during charging up and discharge.
5. Calibrate just the leak detector with calibrate leak source. Record and use correction for test.
6. Setup the calibrated leak source at point furthest from leak detector connection. Valve off calibrate leak source.
7. Hook up leak detector to OVC and leak check connecting piping prior to pressure test.
8. Pull vacuum on OVC insulating space. Pump/purge OVC space with N2 gas until leak detector can handle load on its own.
9. Leak detector should be in the high 10E-10 std-cc/sec range or lower.
10. Leak check the external surfaces of the OVC/Cryo-Can.
11. Pull vacuum on He vessel and N2 circuit. Allow circuits to clean up.
12. Valve off pump and measure rate of rise, minimum duration of 15 minutes.
13. Hook up He gas source to magnet's He or LN2 supply port circuit and charge to 1 atm gauge.
This route will charge both sides of any check valve in the system.
14. Hold at 1 atm pressure for minimum of 15 mins, longer if a leak is detected. Monitor and record leak rate on the OVC.
15. Unhook He gas source and connect N2 gas source to charging line.

16. Finish charging circuit to be tested with N₂ gas using the following process:
 - a. Charge to 40 psig (~1/2 of test pressure) and hold for 2 minutes.
 - b. Continue to slowly charge system at 10 psig increments, waiting 2 minutes after each 10 psig step.
 - c. Final increment will be a step of 2 psig to full test pressure of 90 psig.
17. Valve off gas source and monitor test pressure and OVC vacuum for 1 hour.
18. Vent He circuit, preferable to outside of room. Make sure to vent both sides the check valves, two exist in the helium circuit and one check valve is in the LN₂ circuit.
19. Repeat pressure test for N₂ Circuit, steps 11 through 17.
20. Open calibrated leak source to leak detector and record response time and levels.
21. All parties involved in testing shall sign PS-7 forms.