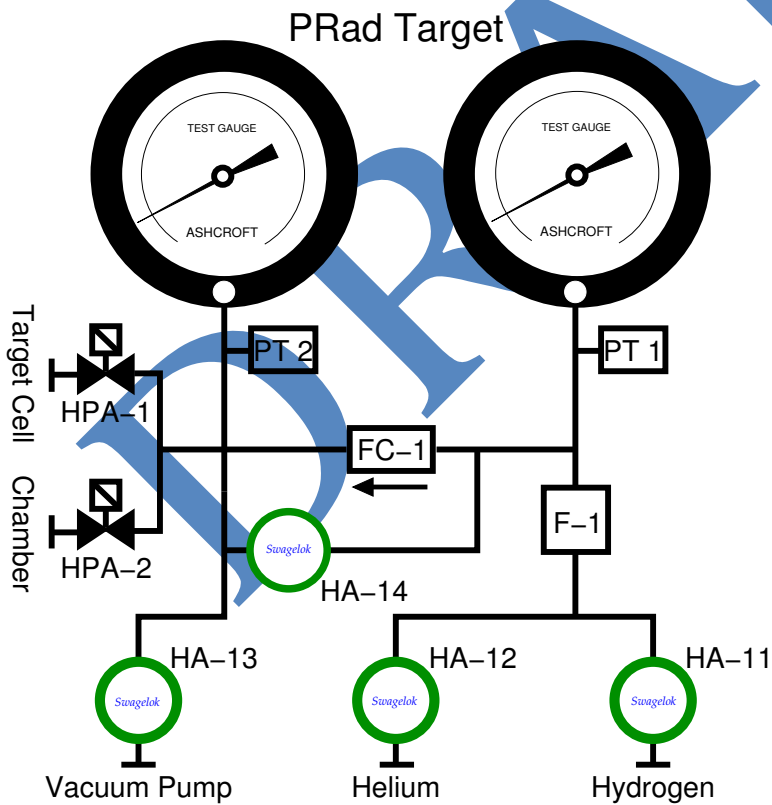


Operation of the PRad Target

Revision 0
Chris Keith, Nov. 2015

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1. Pre-cool down checklist

1. Check that the H₂ supply line between the H₂ cylinder in the Hall B gas shed and target gas panel at HA-11 is properly connected and leak checked;
2. Check that a supply of clean inert gas is connected to the gas panel at the "Helium" valve HA-12 and leak checked;
3. Check that the flexible lines between HPA-1 and HPA-2 on the gas panel are properly connected to the target cell and chamber, respectively;
4. Check that the vent header is being purged with an inert gas (nitrogen or argon);
5. Confirm that all pump exhausts, including the gas panel pump are connected to the vent header.
6. Confirm that the chamber relief valve is connected to the vent header.
7. Check that the Aeroquip coolant lines are connected to the pulse tube refrigerator (PTR) and its compressor;
8. Check that the heater and thermometer cables are properly connected between the target and the Lake Shore 335 and 218 electronics;
9. Check that all readbacks and controls are functioning with the control computer;
10. Check that the water cooling lines are connected between the pulse tube compressor and its water chiller;
11. Check that the compressor pressure gauges read 200 ± 5 psig;
12. Check that the water cooling lines are connected between the target pumps and their water chiller;
13. If necessary perform a pump and purge procedure on the gas panel, supply lines, and target system (see Appendix);
14. Confirm that the Mass Flow Controller FC1 is set to zero;
15. Confirm that all manual and electric valves on the gas panel are CLOSED.

2. Inert Gas Pump and Purge

1. Confirm that all manual and electric valves on the gas panel are CLOSED.
2. Confirm that the H₂ cylinder valve is CLOSED in the gas shed.
3. Confirm that all valves between the hydrogen cylinder and valve HA-12 on the target gas panel are OPEN.
4. Set the flow controller FC-1 to 5000 sccm (this is MAX open).
5. Turn ON the gas panel vacuum pump.
6. OPEN HA-14 and HA-11.
7. OPEN HA-13. Gas panel pressures PT2 and PT1 should decrease to ZERO.
8. When the pirani gauge on the gas panel pump reaches 1 torr, CLOSE HA-13.
9. Slowly OPEN the inert gas supply valve HA-12 until both PI 1 and PI 2 read about 20 psiA.
10. CLOSE HA-12 and OPEN HA-13 to pump the panel down again.
11. Repeat steps 7,8, and 9 for a total of FIVE pump downs.
12. CLOSE HA-13 and HA-14. Set FC1 to ZERO sccm. The piping between the H₂ gas cylinder in the Hall B gas shed and HPA-1/HPA-2 is now clean and ready to be charged with hydrogen gas.

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3. Charge system with Hydrogen

1. Confirm that all manual and electric valves on the gas panel are CLOSED.
2. Confirm that flow controller FC1 is set to ZERO sccm.
3. Confirm that PT2 and PT1 both read ZERO psiA.
4. In the Hall B gas shed, set the hydrogen regulator to ZERO pressure (handle turned counter-clockwise) and close the valve downstream from the regulator.
5. OPEN the valve on the hydrogen gas cylinder. The cylinder pressure should read about 2500 psig.
6. Adjust the regulator until the outlet pressure reads 30 psi.
7. Slowly open the valve downstream of the regulator.
8. Inside experimental Hall B, OPEN HA-11.
9. Confirm that PT1 reads about 45 psiA, while PT2 reads ZERO.
10. The system is now charged with hydrogen and ready to cool down.

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4. Cooling the target

1. Confirm that HPA-1 and HPA-2 are CLOSED and FC1 is set to ZERO.
2. Confirm that HA-13, HA-14, and HA-12 are CLOSED and HA-11 is OPEN.
3. Turn on the water chiller for the vacuum pumps.
4. Start the mechanical fore pumps on the target chamber.
5. When the chamber pressure reaches 0.1 torr or less, start the turbo pumps.
6. Load the appropriate set point for the condenser into the Heater 1 controls of the LS336, and confirm that the other settings for this heater are correct. These values can be found in Section 5.
7. Turn on the water cooling for the compressor.
8. When the chamber pressure reaches 10^{-5} torr or less, start the pulse tube refrigerator.
9. OPEN HPA-1 and set FC1 to 100 sccm. Hydrogen gas is now flowing at a low rate through the target cell. The vacuum gauges on the chamber and target cell should rise accordingly.
10. When the pulse tube refrigerator stabilizes at the desired set point (nominally 25 K), slowly adjust FC1 to provide the desired target cell pressure. Steps of 100 ccm are recommended.

5. Flowing gas into the chamber directly

1. Set FC1 to ZERO.
2. CLOSE HPA-1 and OPEN HPA-2.
3. Slowly adjust FC1 until the desired chamber pressure is reached. Steps of 100 sccm are recommended.
4. To send gas back to the target cell. Set FC1 to ZERO, CLOSE HPA-2 and OPEN HPA-1. Set FC1 to the desired flow.

6. Changing Hydrogen Cylinders

1. Set FC1 to ZERO sccm and CLOSE HPA-1 and HPA-2.
2. In the Hall B gas shed, CLOSE the valve downstream from the hydrogen regulator.
3. CLOSE the valve on the hydrogen gas cylinder.
4. Disconnect the regulator from the empty gas cylinder and connect it to the fresh cylinder.
5. OPEN the valve on the fresh cylinder and confirm the pressure inside it is about 2500 psig.
6. OPEN the valve downstream of the regulator and confirm that the pressure is about 30 psig.
7. Back in the experimental hall, open HA-11. Confirm that PT1 remains at 45 psiA.
8. OPEN either HPA-1 or HPA-2 and set FC1 to the desired flow.

7. System Shutdown

1. CLOSE all manual and pneumatic valves on the gas panel. Set FC1 to ZERO sccm. PT2 should drop to ZERO psiA ,while PT1 should stay near 45 psiA.
2. CLOSE HPA-1 and HPA-2.
3. Connect a source of inert gas to HA-12 on the gas panel and set the source pressure to about 10 psig.
4. In the Hall B gas shed, close the valve on the hydrogen cylinder.
5. Turn ON the gas panel pump, OPEN HA-13 and HA-14. PT1 should drop to ZERO psiA.
6. When the pirani gauge on the gas panel pump reaches 1 torr or less, CLOSE HA-13. Turn OFF the gas panel pump.
7. CLOSE HA-14, set FC1 to 2000 sccm.
8. Slowly OPEN HA-12 until PT2 and PT1 both read about 16 psiA.
9. CLOSE HA-12. OPEN HA-14.
10. CLOSE the upstream and downstream gate valves on the target chamber.
11. Turn OFF the pulse tube refrigerator and the control heater. The system will slowly begin to warm.
12. Allow the target chamber to pump below 10^{-5} and turn OFF all target pumps.
13. If the temperature readings inside the chamber are above 100 K, you may connect a source of inert gas (N₂ or argon) to the chamber bleed-up valve, and bleed gas into the chamber to a pressure of 0-1 psig.
14. Stop the target computer controls and alarm handler.

A1. List of Qualified Personnel

Additional personnel can be added to this list by: Chris Keith.

James Brock
Chris Carlin
Chris Keith
James Maxwell
Dave Meekins

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A2. P & I Diagram

