

Dewar Care & Feeding -- v 0.2

APOGEE

Daily APOGEE Lab Checks

1. Check that the end of the instrument vent line that penetrates the wall of the APOGEE lab (as seen from outside the room) is not covered with debris or iced-up.
2. LN2 level > 85% at noon-time or later each day as indicated on the LN2 level controller in the electronics rack (Fig 1) – verification that the automatic fill occurred in the morning.
3. Pressure < 1.e-6 Torr as indicated by the Pfeiffer vacuum pressure gauge in the electronics rack (Fig 1).



Fig 1. Portion of the Electronics Rack in the Apogee Lab. LN2 level is displayed on Channel 1 of the Liquid Level Controller (95.8% in the picture) and pressure is indicated on the Pfeiffer Gauge (6.9 e-7 Torr in the picture)

4. Check that pneumatic pressure is ~80 psi at the supply-line gauge (not installed yet) in the SW corner of the cleanroom. Both the 3-way cryogenic valve on the west wall and the instrument air legs require pneumatic pressure.

Alarm Descriptions

Vacuum

APOGEE has two pressure gauges. The primary gauge is a Pfeiffer full-range cold cathode gauge and its value is displayed in stui as *Vacuum*. Pressure values from this gauge $\geq 1.5 \text{ e-6 Torr}$ will trigger an alarm. The second gauge is an MKS full-range gauge and its value is displayed in stui as *VacuumAlt*. Pressure values from this gauge do not presently trigger any alarms; it is intended as a back-up.

LN2

The LN2 level in the cryogen tank is measured by an American Magnetics capacitive sensor immersed in the APOGEE LN2 tank. A controller monitors the level and automatically opens a solenoid valve to start a fill when the level is $< 85 \%$. (We will also add a separate hardware timer that only enable fills during the period 8 am – 11 am. Once the timer is in place we will likely raise the setpoint for a fill to 90%. This hardware logic is intended to prevent fills from occurring during evening observing.) The LN2 alarm will trigger for level $< 75\%$.

The LN2 level sensor and controller are the only means for automatic filling -- hence daily checks of the level indication and attention to alarms is critical. That said, the APOGEE instrument hold time is at least 5 days so there is time to address fill issues.

Temperature

While Apogee is instrumented with numerous temperature sensors, *DETPOLE_BASE* $> 83 \text{ K}$ is chosen as an indicator of a high temperature situation. This is the temperature at the base of a copper pole connected to the top of the LN2 tank. This pole provides a direct cooling path from the tank to the detector housing and bypasses the cold plate and large optics. Thus it is sensitive to the LN2 tank temperature.

Alarm Response Matrix

<i>Vacuum Alarm?</i>	<i>LN2 Alarm?</i>	<i>DETPOLE_BASE Alarm?</i>	Actions / Comments
Yes	No	No	<p>Dewar may have a vacuum leak if both of the following are true:</p> <p>1) high pressure condition is sustained¹</p> <p>2) <i>VacuumAlt</i> also reports abnormally high pressure²</p> <p>Perform “Dewar Warming / Vacuum Leak Procedures.”</p> <p>If <i>VacuumAlt</i> shows normal pressures then contact the APOGEE team for guidance.</p>
Yes	Yes	Yes	Dewar is probably warming-up. Perform “Dewar Warming / Vacuum Leak Procedures.”
No	Yes	No	Probably a missed or faulty fill. Check fill plumbing and controller and check that the storage dewar in the apogee lab has sufficient cryogens to sustain fills. If necessary simply fill the instrument manually by connecting the instrument’s dedicated fill hose directly to a storage dewar (see Fig. 4), thus bypassing all automated valves. The instrument has a 5-6 day hold time so there is time to solve fill issues before the instrument starts warming.
No	Yes	Yes	May be a missed or faulty fill that has progressed sufficiently to slightly warm the dewar without tripping the vacuum alarm (will trip eventually as cryopumping effectiveness decreases). Perform “Dewar Warming / Vacuum Leak Procedures.”
No	No	Yes	Are any other temperatures abnormally high? If not, consider a spurious signal or faulty temp sensor. If yes, then the LN2 alarm should have also tripped ... check LN2 levels.

¹ Pressure spikes are periodically seen during fills. We attribute these spikes to temporary displacement of cryo-pumped molecules due to vibration of internal dewar LN2 lines. For instance, transient spikes up to 1.0 e-6 and 1.2 e-6 Torr have been seen during fills.

² Pressures values between the two gauges may differ by 0.5 – 1.0 e-7 but not by much more.

Dewar Warming / Vacuum Leak Procedures

- a) Power-off the Leach power supply (Fig 2a) and auxiliary electronics box (Fig 2b). The latter provides power to the collimator tip-tilt-piston and detector dither motors. Suit-up in clean room garments including smock, hair net, face mask and booties, but not gloves. Put on the anti-static wrist strap (hanging from the NE corner of the instrument) and plug cord into ESD grounding plug. Power-off switches with one (bare) hand on the dewar vessel.

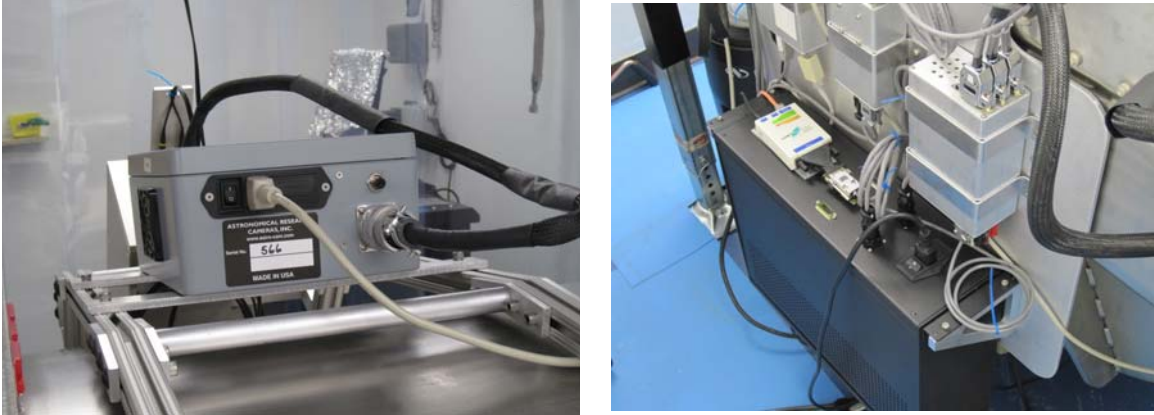


Fig 2. a) Leach Power supply power switch is on the back of the power supply mounted on the rail going over the top of the instrument. (b) Auxiliary electronics box power switch is located on the top panel of the black 19" rack panel hanging on the east end of the instrument.

- b) Connect observatory turbo pump to APOGEE gate valve (Fig 3) and start pump as soon as possible. Remove protective cover from gate valve handle and open instrument gate valve once pump pressure is less than the instrument dewar pressure.



Fig 3. Instrument gate valve with ISO-100 to KF-50 reducer for the observatory vacuum pump. The sheet metal box to the left covers the gate valve handle.

- c) Notify a member of the APOGEE team at UVA – see list of phone numbers at the end of this document.
- d) If all three alarms (Vacuum, LN2, DETPOLE_BASE) have triggered then assume instrument has run out of LN2. Once pump has lowered instrument pressure to approx. 1.0×10^{-5} Torr then cryogenics can be added. If necessary fill APOGEE directly from a storage dewar to the instrument using the dedicated fill hose (Fig 4.) and bypass all wall mounted controls.

If only the Vacuum alarm triggered then we do not want to fill with cryogenics until potential leaks have been investigated and resolved.



Fig 4. The dedicated fill hose for the instrument is just to the right of the GN2 bottle in the SW corner of the apogee lab. If necessary the hose can be disconnected from the solenoid valve (simple flare connection) and connected directly to a 180 liter storage bottle.

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