

Operation of LHO's Convection-heated Vacuum Bake Ovens

Assumed initial conditions

The vacuum chamber has been loaded with parts to be vacuum baked, has its door installed and torqued, is at atmospheric pressure and is isolated from the adjacent vacuum components via closed valves. The scroll backing pump is pumping the foreline and both turbo pumps are running and are exhausting into the foreline. The VS MD30 leak detector is positioned so as to be easily connected to the foreline, is running and has a helium calibration gas bottle connected on a Tee fitting at its test port.

Pump the vacuum chamber

1. Note the foreline pressure.
2. Close the O-ring valve that isolates the RGA Turbo Pump's exhaust from the foreline
3. Close the O-ring valve that isolates the Main Turbo Pump's exhaust from the foreline

(Steps 4. - 5. apply to VBOC only)

4. De-energize the Main Turbo Pump by removing its AC power cord. Observe that the turbo vent valve is audibly admitting air into the Main Turbo Pump
5. Once the audible air admission ceases, the Main Turbo Pump is vented

(Steps 6. - 8. apply to VBOD only)

6. Depress the "STOP" button on the Main Turbo Pump controller followed shortly thereafter by removing the NW16 blank from the vent port located on the side of the pump
7. Once the audible air admission into the vent port ceases, the Main Turbo Pump is vented
8. Re-install the NW16 blank on the vent port

(The remaining steps apply to both VBOs)

9. With the Main Turbo Pump spun down and vented, open the 4" UHV valve to combine the Main Turbo Pump with the vacuum chamber
10. Begin rough pumping the vacuum chamber by opening the O-ring valve at the exhaust of the Main Turbo Pump.
11. Once the foreline pressure falls below 1.5 torr, start the Main Turbo Pump (i.e. plug power cord back in for VBOC or press "START" for VBOD)

12. After the Main Turbo Pump reaches full r.p.m., “final-torque” the chamber door to 130 ft.lbs starting with bolt 1 and then the adjacent bolt to its left, etc. following a clockwise sequence.
- 13.

Leak check the Vacuum Chamber door

(Steps 1. - 6. apply to VBOC only)

1. Close the O-ring valve that isolates the Main Turbo Pump’s exhaust from the foreline
2. Close the O-ring valve that is nearest to the scroll pump.
3. Disconnect the flex line from the scroll pump’s intake isolation valve and install a blank flange to cover the isolation valve.
4. Move the end of the flex line removed from the isolation valve and connect it to the Tee at the Leak Detector’s inlet.
5. Pump the LD’s test port via depressing the “TEST” button.
6. Open O-ring valve that had been closed in 2. Above.

Go to step 11.

(Steps 7. - 10. apply to VBOD only)

7. Close the O-ring valve that isolates the Main Turbo Pump’s exhaust from the foreline.
8. Disconnect the flex line from the scroll pump’s intake isolation valve and install a blank flange to cover the isolation valve.
9. Move the end of the flex line removed from the isolation valve and connect it to the Tee at the Leak Detector’s inlet.
10. Pump the LD’s test port via depressing the “TEST” button.

Calibrate the Leak Detector -

11. Once the indicated test port pressure is $< 5 \times 10^{-3}$ Torr, depress the “TEST” button a second time to switch the LD into the “HOLD” state
12. Open the isolation valve on the helium calibration gas bottle

13. Depress the "TEST" button (third time) to pump the test port and measure the calibration gas
14. Verify that the indicated helium signal agrees within 20% of that shown on the calibration gas bottle (if the measured value differs by more than 20% then TBD)
15. Close the helium calibration gas bottle isolation valve and observe that the displayed helium signal decays to a value $< 5 \times 10^{-10}$ Torr*L/sec

Spray Helium -

10. Start the helium flow and adjust the flow rate to $1 \text{ Lpm} < \text{flow} < 2 \text{ Lpm}$
11. Stop the flow
12. Depress the "TEST" button (fourth time) to switch the LD into the "HOLD" state
13. Open the O-ring valve at the exhaust of the Main Turbo Pump
14. Depress the "TEST" button (fifth time) to switch the LD into the "TEST" state
15. Once the displayed helium signal falls below 5×10^{-8} Torr*L/sec, start the flow and apply helium around the entire periphery of the door flange seal. Hold the helium tubing against the flange seal at a 45 degree angle. Start from the top of the flange and move slowly around while monitoring the helium signal on the LD's display. It should take at least 1 minute to make it around the flange periphery.
16. If the LD responded during the application of helium, go to step 17. If no response was noted, go to step 20.
17. Reduce the flow of helium to $0.1 \text{ Lpm} < \text{flow} < 0.5 \text{ Lpm}$ and reapply around the flange. Try to determine where on the flange seal the maximum helium signal(s) occur(s).

(Note: small leaks $< 1 \times 10^{-7}$ Torr*L/sec will very often "go away" during the bake cycle. Whether or not retorquing or replacing the door gasket should be done for these small leaks is often determined by schedule factors, experience and luck!)
18. If a re-torque is needed, torque all of the door flange bolts to 135 ft*lbs following a clockwise sequence starting with bolt 1
19. Repeat steps 15. thru 16.
20. Stop the helium flow
21. Close the O-ring valve that isolates the Main Turbo Pump's exhaust from the leak detector

22. Depress the "TEST" button on the LD to switch the LD into the "HOLD" state
23. De-energize the LD and disconnect the flex line from the LD's Test Port
24. Remove the blank that was temporarily installed on the scroll pump's isolation valve and reconnect the flex line.
25. Wait for the foreline pressure to fall to less than 1.2 x (the value noted in step 1 of the **Pump the vacuum chamber** section).
26. Open the O-ring valve that isolates the Main Turbo Pump from the foreline
27. Open the O-ring valve that isolates the RGA Turbo Pump from the foreline

Start a Heating Profile

1. Close the convection oven door and confirm that the internal circulating blower is running
2. Use the green "Profile" button and "arrow" buttons to select and then start the appropriate pre-programmed heating profile.
3. Remove (if installed) the RGA electronics and wrap exposed feedthrough with aluminum foil.
4. Energize the variacs

RGA scan

Assumed initial conditions

The RGA variacs have been off and the convection oven door has been open for hours. As such, the vacuum chamber and RGA are near room temperature

1. Connect the RGA electronics to the analyzer
2. Start the RGA software on the computer
3. Open the template
4. Connect (so as to communicate) to the RGA
5. Energize the filament. Allow filament to be on for at least 2 hours before scanning

6. Turn on the multiplier (a.k.a. "CDEM" for SRS RGA or "SEM" for Pfeiffer RGA)
7. Begin scanning
8. Allow scan to make, at least, three passes across AMU scale
9. Observe that the maximum peak heights for the various peaks aren't changing in magnitude between successive scan passes
10. Stop the scan and save file using the established naming convention (this is the RGA Background scan)
11. Open the valve which separates the RGA from the Vacuum Chamber
12. Close the valve which separates the Main Turbo Pump from the Vacuum Chamber
13. Allow the system to come in to pressure equilibrium by waiting 5 minutes or so
14. Begin scanning
15. Observe that the maximum peak heights for the various peaks aren't changing in magnitude between successive scan passes
16. Stop the scan and save file (this is the RGA+OVEN scan)
17. Open the calibration gas isolation valve
18. Wait 5 minutes to allow the pressure to stabilize
19. Begin scanning
20. Observe for multiple passes that the maximum peak height for the AMU 40 is non-changing
21. Stop the scan and save the file (this is the RGA+OVEN+CALGAS scan)
22. Close the calibration gas isolation valve
23. Close the valve which isolates the RGA from the Vacuum Chamber
24. Turn off the multiplier and filament
25. Close the O-ring valve that isolates the RGA Turbo's exhaust from the foreline

Vent the Vacuum Chamber

Assumed initial conditions

The oven is isolated from the Main Turbo pump, the RGA Turbo pump, the calibration gas and the vent line (all four adjacent isolation valves are closed). Also, the OVEN is near room temperature.

1. Verify that the OVEN OVERPRESSURE CHECK VALVE is in place
2. (If not already open) Open the bottle valve on the UHP nitrogen vent gas bottle and confirm that the bottle pressure (gauge on the right) on the pressure regulator indicates > 100 psi internal pressure remaining in the bottle and that the regulator output pressure (gauge on the left) indicates 0 psi output pressure
2. Open the oven vent valve
3. Confirm that the regulator output gauge now is indicating < 0 psi output pressure
4. When the regulator output gauge returns to 0 psi the OVEN is vented
5. Close the oven vent valve