Vacuum Pumpdown and Venting Procedure, CRaTER Thermal Vacuum System

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1. Introduction

1.1. Activity Description
The procedure defined here defines the steps for pumping down and venting the Crater Thermal Vacuum chamber.

1.2. Chamber Components

The chamber and accessory electronics are situated on and around the chamber. The photos below identify the major components as they are described in this procedure.

Figure 1. Chamber Valves and components

Valve #1- Large Chamber Vent Valve
Valve #2- Diffuser Vent Valve
Valve #3, Main Gate Valve
Valve #5- Secondary chamber vent valve. Do Not Touch.
Valve #6- Pump Volume valve, near turbo pump.
TC1- High Pressure Gauge for Large Chamber Volume.
PG1-Low Pressure Gauge for Large Chamber Volume

Figure 2. Dewar Components

Gas Nitrogen Valve- Green Valve to Dewar
Pressure Regulator- Larger Black Knob to adjust pressure of N2. Turn to the right to increase pressure, turn to the left to decrease pressure.
Regulator shut off Valve- A secondary valve to nitrogen line. Leave open.

This Flow Gauge Is not used

Valve #9 Nitrogen Flow Gauge
Figure 3. Flow Gauge, for Vacuum Backfill

Figure 4. Roughing Pump and valve

Figure 5. Pressure Gauge Displays

PM 31
High Vacuum
Pressure Gauge
Display/Controller

TC Gauge
Low Vacuum
Display
2. Procedures

2.1. Pumping Down the Chamber

Note: All pumps should be off. If the roughing pump and Turbo are running and the chamber volume is vented, then the Main gate valve is closed and you need to vent the pump volume per Section 1.5.

2.1.1. After all electrical tests and verifications are completed, close the front door and latch shut.
2.1.2. Ensure all pumps are off. If not refer to section 1.5 before proceeding.
2.1.3. Close “Large Chamber Vent Valve”, valve #1.
2.1.5. Close “Diffuser Vent Valve”, valve #2.
2.1.6. Open “Roughing Pump Valve”, valve #4. (The roughing pump should be unplugged, thus off).
2.1.7. Ensure “main gate valve”, valve #3 is open. (You can open the chamber door also and look down at the internal part of the main gate valve.)
2.1.8. Ensure Valve #5 and “Pump Volume Vent Valve”, valve # 6, are closed.
2.1.9. Set Nitrogen Flow-
   6.1 Open the “Gas” Nitrogen Valve (Green Valve) on Nitrogen Dewar.
   6.2 Open the “flow gauge check valve”, valve #7 to check pressure and flow rate.
   6.3 Adjust pressure to 10-15 psi by turning the larger black knob on the pressure regulator. To the right increases pressure, to the left decreases pressure.
   6.4 Adjust the flow rate to 4-6 SCFH by turning the small black knob on the “Nitrogen Flow gauge”, valve #9.
   6.5 After all adjustments are made close the “Flow Gauge Check Valve”, valve #7.
2.1.10. Plug in the roughing pump in an outlet separate from the outlet that the electronics are plugged into so as not to overload the circuit. Note the date and time started in log book.
2.1.11. After the TC Vacuum Gage reads below 60 millitorr turn on Turbo pump. (The turbo pump power button is at the rear of the controller and the start button is in front of the controller). Note time Turbo pump was started in log book.
2.1.13. Once pressure reaches $5 \times 10^{-5}$ Torr then the Thermal Testing may begin.
2.2. Venting the Large Chamber Volume.

Note. The Chamber is to be vented in two separate volumes. The first volume to be vented is the main chamber. The second volume to be vented is the pumping volume. These two volumes are separated by the MAIN GATE VALVE, valve #4.

1. Shut off the Penning Vac PM31 pressure gauge at the controller by pressing the “HV” button. The controller should then read “Off”. Remove cable from gauge (loosen retaining ring and pull off).
2. The TC vacuum gauge must be at the TC 1 location. If not simply disconnect it from the TC2 position and mate it to the TC1 location. (Note keying position on connector).
3. Ensure there is enough nitrogen in the tank to vent. (1/4 tank min).
4. Ensure Nitrogen is flowing by opening the “Flow gage check valve”, valve #7 on the nitrogen line. Watch the flow gauge ball and ensure it is at 4-6 SCFH. Once flow is set then shut “Flow gage check valve”, valve #7.
5. Close the “Main Gate Valve”, Valve #3.
6. Open the “Diffuser Vent valve”, valve #2, two full turns.
7. Open the “Large Chamber Vent Valve”, valve #1, two full turns.
8. After a few seconds open the Large Chamber Vent valve, valve #1, all the way.
9. After a couple of minutes open “Diffuser Vent valve”, valve #2 all the way.
10. Increase flow in “Nitrogen Flow gauge”, valve #9 to 9-10 SCFH. The chamber will take 3 1/2 hours to vent. Release the two door latches and install C’block between front door and Rib on chamber. The front door will pop open when venting is complete and the C’block will prevent it from opening more than necessary.
11. If you hear a loud noise something bad happened.
2.3. Venting the Pumping Volume.

Note. The Chamber is to be vented in two separate volumes. The first volume to be vented is the main chamber. The second volume to be vented is the pumping volume. These two volumes are separated by the MAIN GATE VALVE. Before pumping the chamber down the Pumping volume must also be vented.

1. The Penning Vac PM31 pressure gauge controller should read “Off”.
2. The TC vacuum gauge must be at the TC 2 location. If not simply disconnect it from the TC1 position and mate to the TC2 location. (Note keying position on connector)
3. The “Main Gate Valve”, valve #3, is closed. **Do not touch it.** Do not try to verify that it is closed. If you open it even slightly it will damage the pumps!
4. Ensure there is enough nitrogen in the tank to vent. (1/4 tank min).
5. Ensure Nitrogen is flowing by opening the “Flow gauge check valve”, valve #7 on the nitrogen line. Watch the flow gauge ball and ensure it is at 4-6 SCFH. Once flow is set then shut “Flow gauge check valve”, valve #7.
6. Shut off the Turbo pump by pressing the “Stop” button on the Turbo pump controller.
7. After 10 minutes, close the “Roughing pump valve”, valve #4.
8. Open the “Diffuser Valve”, valve #2, two full turns.
9. Open the “Large Chamber Vent Valve”, Valve #1 for a couple of minutes to purge the lines. Close the “Large Chamber Vent Valve”, Valve #1.
10. After another 5 minutes, or preferably when the turbo reaches xxx rpms, open “Pump Volume Vent Valve”, Valve # 6, 1/4th of a turn.
11. After a 30 seconds open the “Pump Volume Vent Valve”, valve # 6, 1-2 full turns.
12. After two minutes open the “Pump Volume Vent Valve”, valve # 6, all the way.
13. The Pumping Volume will take about 1 hour to vent.
2.4. Temperature Control
2.4.1. Components for the Thermal Operation

Figure 6. Vacuum Chamber Temperature Controller

On/Off - Turns power on (up) and off (down)
Temperature Cycle PID Controller - adjusts and sets the temperature for thermal tests.
Over Temperature PID Controller - sets the over temperature protection in case of a run away condition. Set to 10 degrees C above Max. temperature of thermal test.
Figure 7. Liquid Nitrogen Dewar, Blue Knob

Figure 8. Vacuum Feedthrus for CraTER and Shroud, 25 pin D-Sub Male
2.4.1.1. Temperature Monitors

There are 8 RTD’s in the chamber, model #___________. The RTDs are wired thru the 2 25 Pin D-subs towards the back end of the chamber wall. There is a 6 inch extender cable from the vacuum flange to the inside of the chamber where the RTDs are wired to.

2.4.1.2. Base plate

The base plate is gold plated copper. The baseplate is isolated from the chamber by Teflon rails. There are 2 RTD’s on this plate separate from the chamber RTDs. One RTD monitors the plate for controlling temperature. The second RTD provides overtemperature protection.

2.4.1.3. Temperature Control Box

The temperature control box has simply an on/off button. To start temperature cycle, set the E-Z PID controller temperature to the desired temperature. Also set the overtemperature PID Controller to 10 degrees higher than the high temperature. This only needs to be set to one temperature for the Unit Under Test.

2.4.1.4. Nitrogen lines

A large Dewar of Liquid Nitrogen is required to supply cooling to the chamber. Connect the vacuum jacketed nitrogen line to the Liquid valve stem
on the dewar and the other end onto the Solenoid Valve on the input tube of the chamber. Exhaust the exit stem to the room vent pipe.

Open the Blue valve on the Dewar to supply Nitrogen to the system. NOTE: The system REQUIRES cooling even during the heating steps. When the heaters over run their set points in an under or slightly damped system the controller calls for nitrogen and opens the solenoid valve. The system will then cool down below the set point temperature and call for heat. This happens a few times until it settles in on the temperature.

2.4.1.5. Automatic temperature cycling
The chamber can be automatically programmed to run temperature cycles. Read PID operation manual to set program.

2.5. Electrical Failure
In the event of an electrical failure or power outage, all the electronics will shut off. When this happens there is a solenoid on the turbo pump that will open and nitrogen will vent the system. If someone is there when it happens, perform the following steps.

1. Shut off Main power to Vacuum chamber Temperature Controller. See Figure 6.
2. Shut off LIQUID Nitrogen at the dewar, blue knob. See figure 7.
3. Unplug the Roughing pump, see figure 4.
4. Shut off High Vacuum gauge controller and unplug cable from the gauge head (PG1 or PG2). See figures 1 and 5.
5. Shut off power on the turbo located at the rear of the turbo controller.

2.6. Pump down procedure after electrical outage.
When the power returns, all the electrical units should be off. Open the front door to verify that no damage was done to the UUT. Also this verifies that the chamber is vented. Follow procedure for pump down per section 2.1.