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Vacuum Pump Down and Venting Procedure, CRaTER Thermal Vacuum System

Dwg. No. 32-06003.05

Revision 04
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1. Introduction

1.1. Activity Description

The procedure defined here in 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.

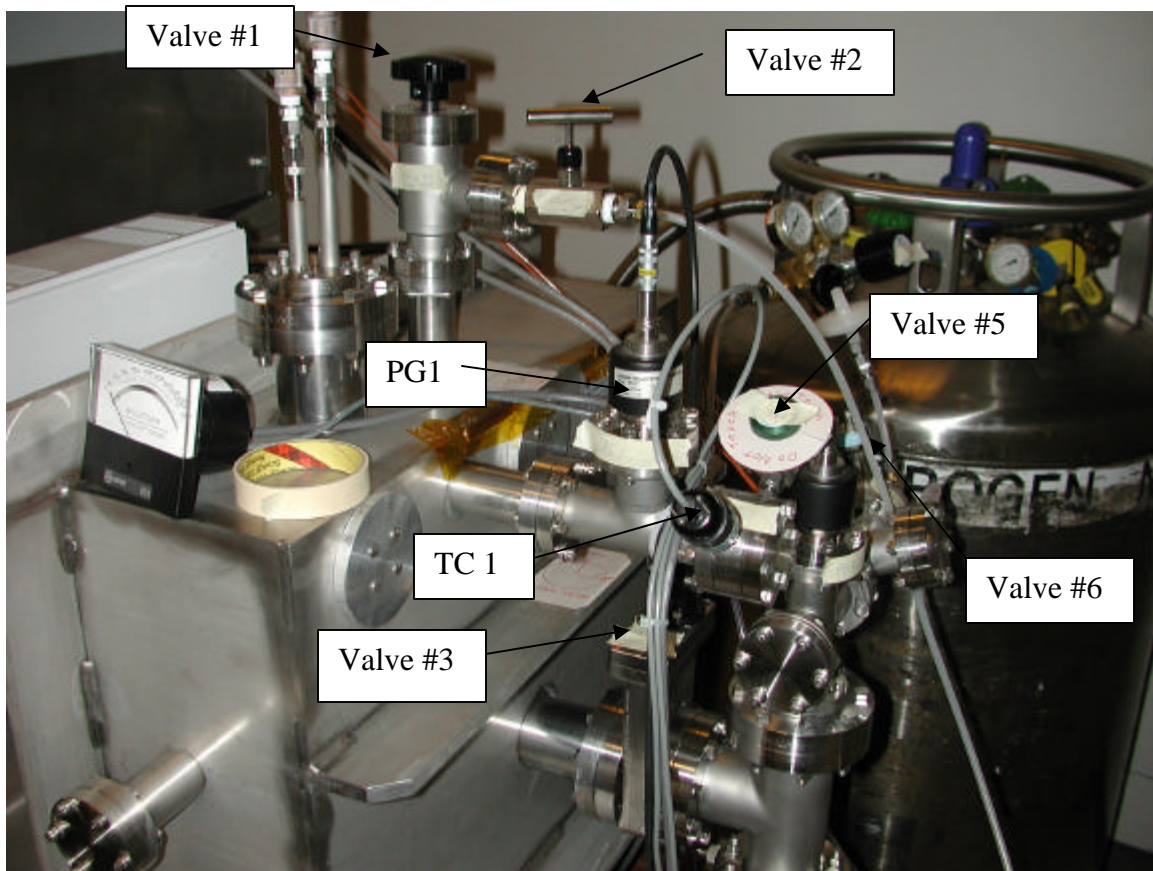


Figure 1. Chamber Valves and components

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 Vent Valve, near turbo pump.

TC1- High Pressure Gauge for Large Chamber Volume.

PG1-Low Pressure Gauge for Large Chamber Volume

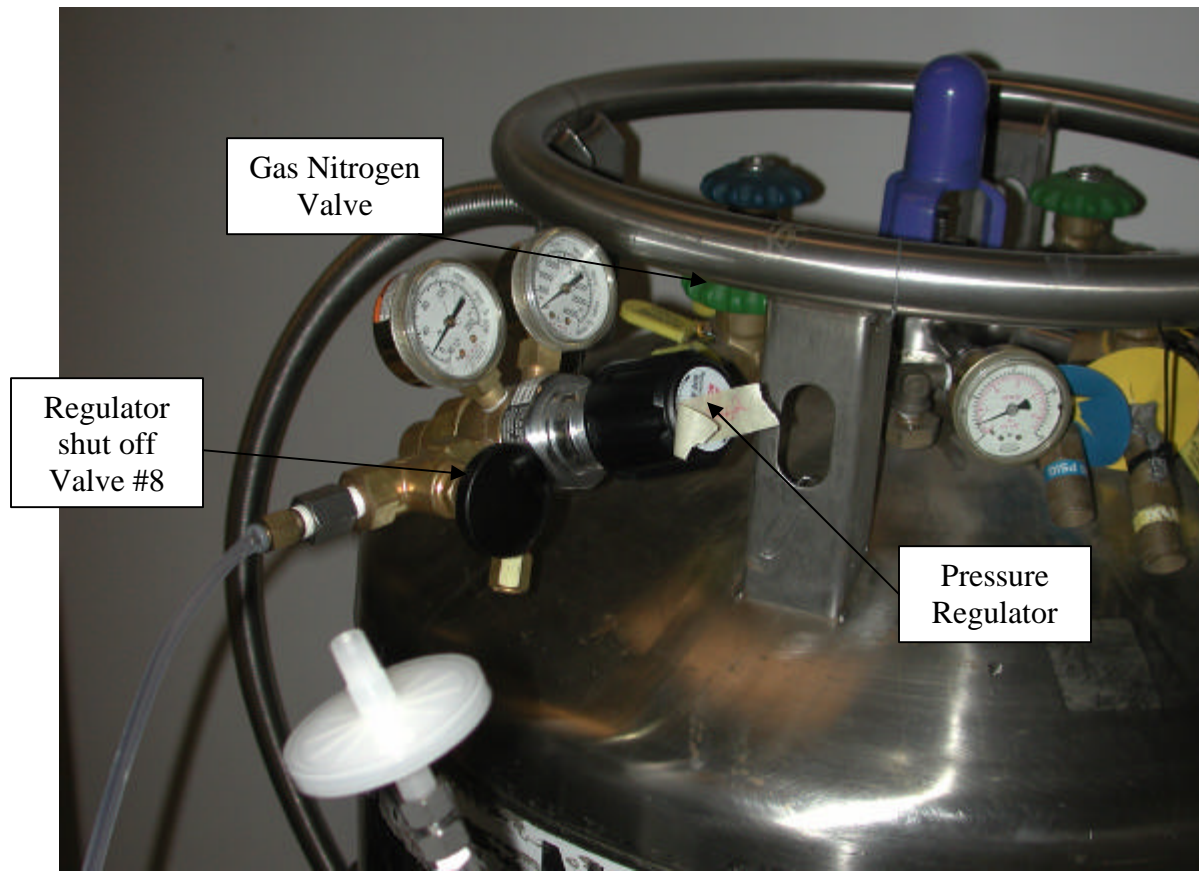


Figure 2. Dewar Components

Gas Nitrogen Valve- Green Valve to Dewar

Pressure Regulator- Larger Black Knob to adjust pressure of N₂. Turn clock wise to increase pressure, turn counter clockwise to decrease pressure.

Regulator Shut off Valve #8- A secondary Valve to nitrogen line.

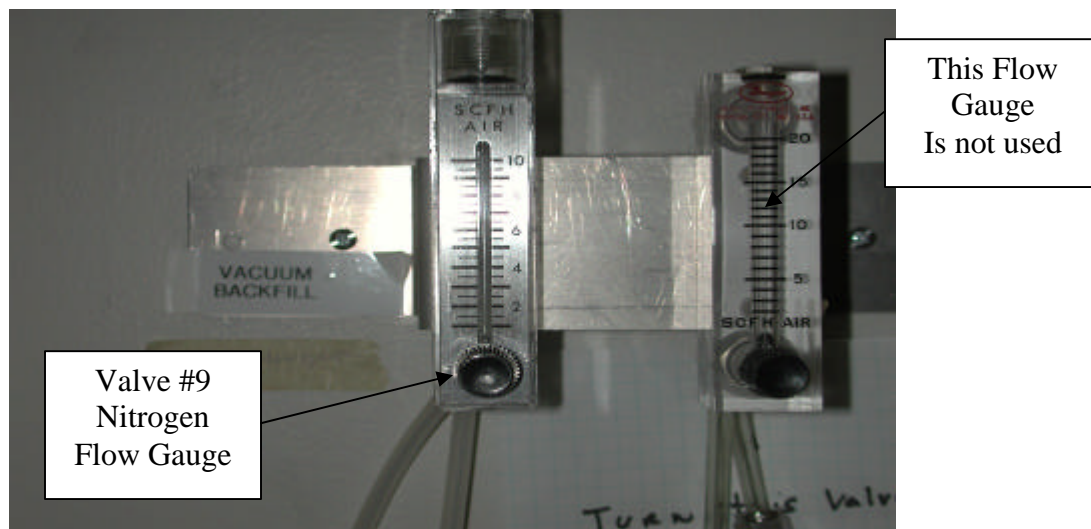


Figure 3. Flow Gauge, for Vacuum Backfill



Figure 4. Roughing Pump and Valve

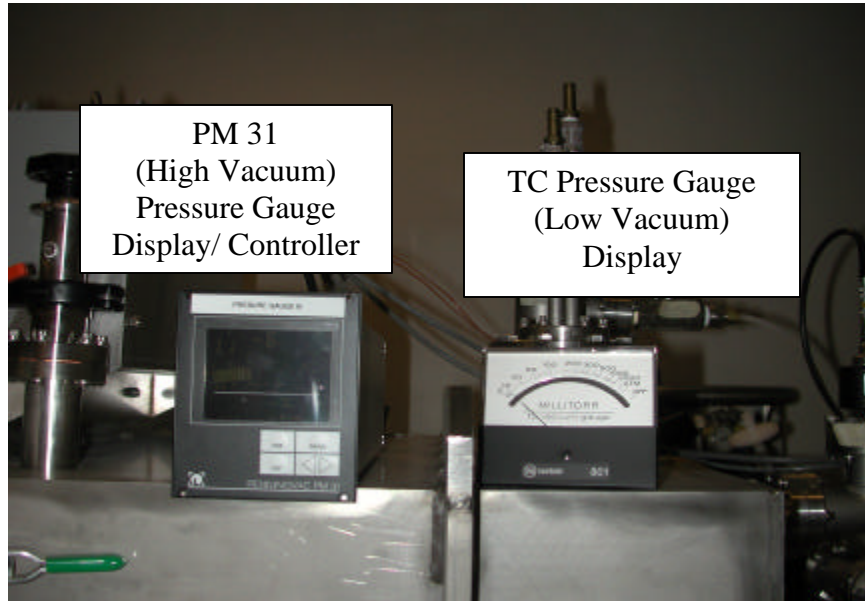


Figure 5. Pressure Gauge Displays

2. Procedures

2.1. Pumping Down the Chamber

- 2.1.1. Verify that both the chamber volume and pump volumes are vented. Ensure that all pumps are off.
- 2.1.2. Ensure that the “Main Gate Valve” is open. Look through the chamber to see that it is open.
- 2.1.3. After all electrical tests, pictures are taken, and verifications are completed, inspect gasket on door and wipe with clean dry Alpha 10 wipe. (Proper clean room attire must be worn. Clean gloves and wipes are required.). Close the front door and latch shut.
- 2.1.4. Close “Large Chamber Vent Valve”, Valve #1.
- 2.1.5. Close the “Pump Volume Valve”, Valve #6.
- 2.1.6. Close “Diffuser Vent Valve”, Valve #2.
- 2.1.7. Open “Rough pump Valve”, Valve #4.
- 2.1.8. Set Nitrogen Flow-
 1. Open the “Gas” Nitrogen Valve (Green Valve), on Nitrogen Dewar, all the way and open Regular Shut off Valve #8, on the pressure regulator, all the way.
 2. Open the “Nitrogen Flow Gauge Valve”, Valve #9, 1 full turn (close first then open 1 full turn). Open the “Flow Rate Check Valve”, Valve #7.
 3. Adjust pressure to 5-7 psi by turning the larger black knob on the pressure regulator. Turn Clockwise to increase pressure; turn Counter Clockwise to decreases pressure.
 4. Adjust the flow rate to 6-8 SCFH by turning the small black knob on the “Nitrogen Flow Gauge Valve”, Valve #9.
 5. After all adjustments are made close the “Flow Rate Check Valve”, Valve #7.
- 2.1.9. The roughing pump does not have its own on/of switch The pump is plugged into an electrical power strip. Start the roughing pump by turning on the power switch on the electrical power strip with the roughing pump plugged in.. Note the date and time started in log book.
- 2.1.10. After the TC Vacuum Gage reads below 100 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.
- 2.1.11. When the TC Vacuum Gage reads below 10 millitorr, turn on the Neslab Chiller and set the temperature to +10.5C. Turn on the TQCM power and set the TQCM temperature to +65C. The TQCM should be toggled to Thermo Sensor NOT Cryo Sensor.

2.2. Venting the Main 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 Chamber. These two volumes are separated by the MAIN GATE VALVE, Valve #4.

1. Change TQCM Temperature to +30 C.
2. Set the Neslab chiller to +30C. Leave the chiller running. **Do not proceed** until the TQCM Heat Sink temperature reads +25 C minimum at the readout on the computer. Shut off Neslab Chiller.
3. Turn off the power to the TQCM.
4. Shut off the Penning Vac PM31 pressure gauge at the controller by pressing the "HV" button. The controller should then read "Off". Unplug the power cord.
5. Ensure there is enough nitrogen in the tank to vent. (1/4 tank min).
6. Ensure Nitrogen is flowing by opening the "Flow Rate Check Valve", Valve #7. Watch the flow gauge ball and ensure it is at 6-8 SCFH. Once flow is set then shut "Flow Rate Check Valve", Valve #7.
7. Close the "Main Gate Valve", Valve #3.
8. Open the "Diffuser Vent Valve", Valve #2, two full turns.
9. Open the "Large Chamber Vent Valve", Valve #1, two full turns.
10. After a few seconds, open the "Large Chamber Vent Valve", Valve #1, all the way.
11. After a couple of minutes open "Diffuser Vent Valve", Valve #2 all the way.
12. Increase flow in "Nitrogen Flow gauge", Valve #9 to 9-10 SCFH. The chamber will take 2-3 hours to vent. Release the two door latches. The front door will pop open when venting is complete.
13. Shut off the Neslab Chiller.

2.3. Venting the Pumping Chamber Volume.

Note. The Chamber is to be vented in two separate volumes. The first to be vented is the Main Chamber Volume. The second to be vented is the Pumping Chamber Volume. These two volumes are separated by the MAIN GATE VALVE, Valve #3. Before pumping the chamber down the Pumping Chamber Volume must also be vented.

1. The Penning Vac PM31 pressure gauge controller should read “Off”. If a pressure is being displayed then press the “HV” button on the controller. Unplug the power cable.
2. 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!
3. Ensure that there is enough nitrogen in the tank to vent. (1/4 tank min).
4. Ensure Nitrogen is flowing by opening the “Flow Rate Check Valve”, Valve #7 on the nitrogen line. Watch the flow gauge ball and ensure it is at 6-8 SCFH. Once flow is set then shut “Flow Rate Check Valve”, Valve #7.
5. Shut off the Turbo pump by pressing the “Stop” button on the Turbo pump controller.
6. After 10-15 minutes, close the “Roughing Pump Valve”, Valve #4.
7. Open the “Diffuser Valve”, Valve #2, two full turns.
8. Open “Pump Volume Vent Valve”, Valve # 6, 1/4 of a turn.
9. After a 30 seconds, minimum open the “Pump Volume Vent Valve”, Valve # 6, 1 full turn.
10. After 60 more seconds, open the “Pump Volume Vent Valve”, Valve # 6, all the way.
11. The Pumping Volume will eventually pressurize to 5 psi when the Nitrogen Flow Gauge ball falls to 0 SCFH. After it falls to 0 SCFH, close valve #10(Black knob on the pressure regulator), then slowly open valve #7, 1/4 turn. (The flow gauge ball should show signs of flow.)Slowly continue to open valve #7 1/4 turn at a time until it is opened 2 full turns min. The system will depressurize until the Flow gauge ball falls to 0 SCFH again in about 10 minutes.
12. Open then close the Roughing Pump Valve, Valve #4, to verify the pumping chamber volume is vented.

2.4. Temperature Control

2.4.1. Components for the Thermal Operation

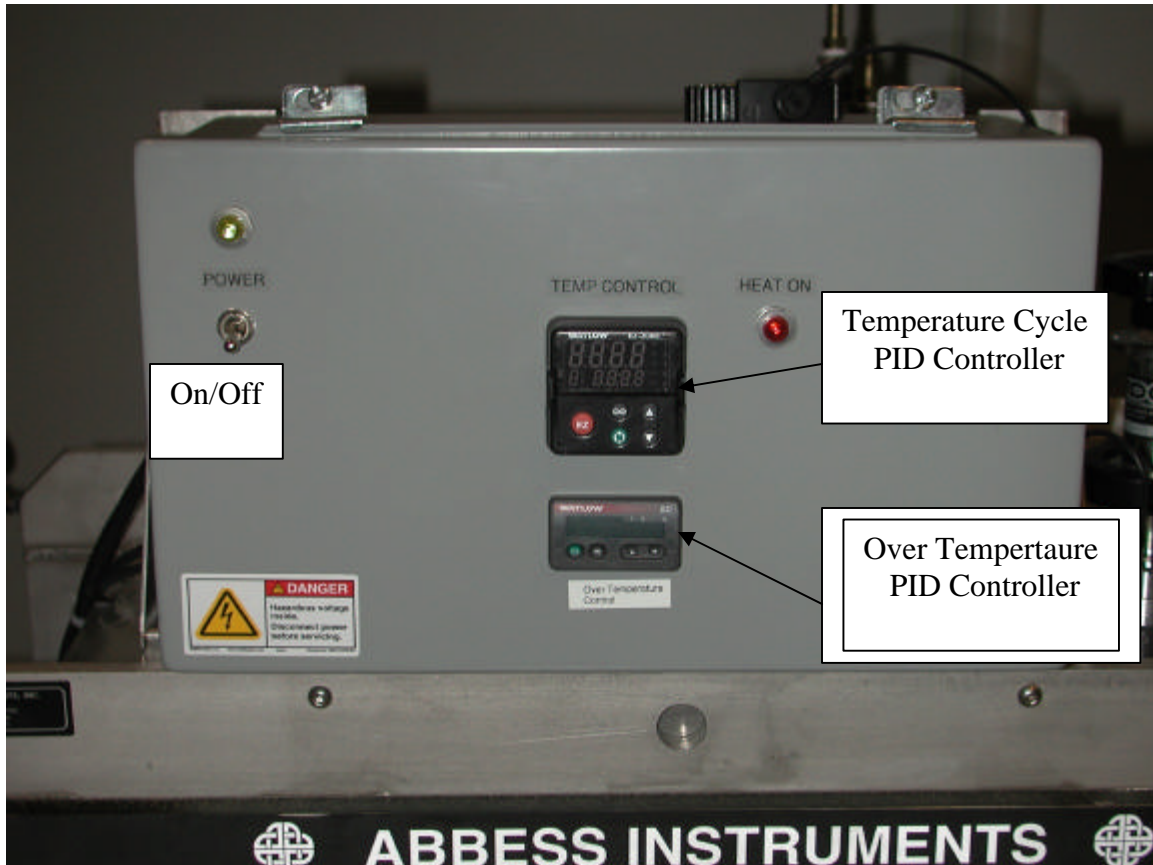


Figure 6. Vacuum Chamber Temperature Controller

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 runaway condition. Set to 10 degrees C above Max. temperature of thermal test.

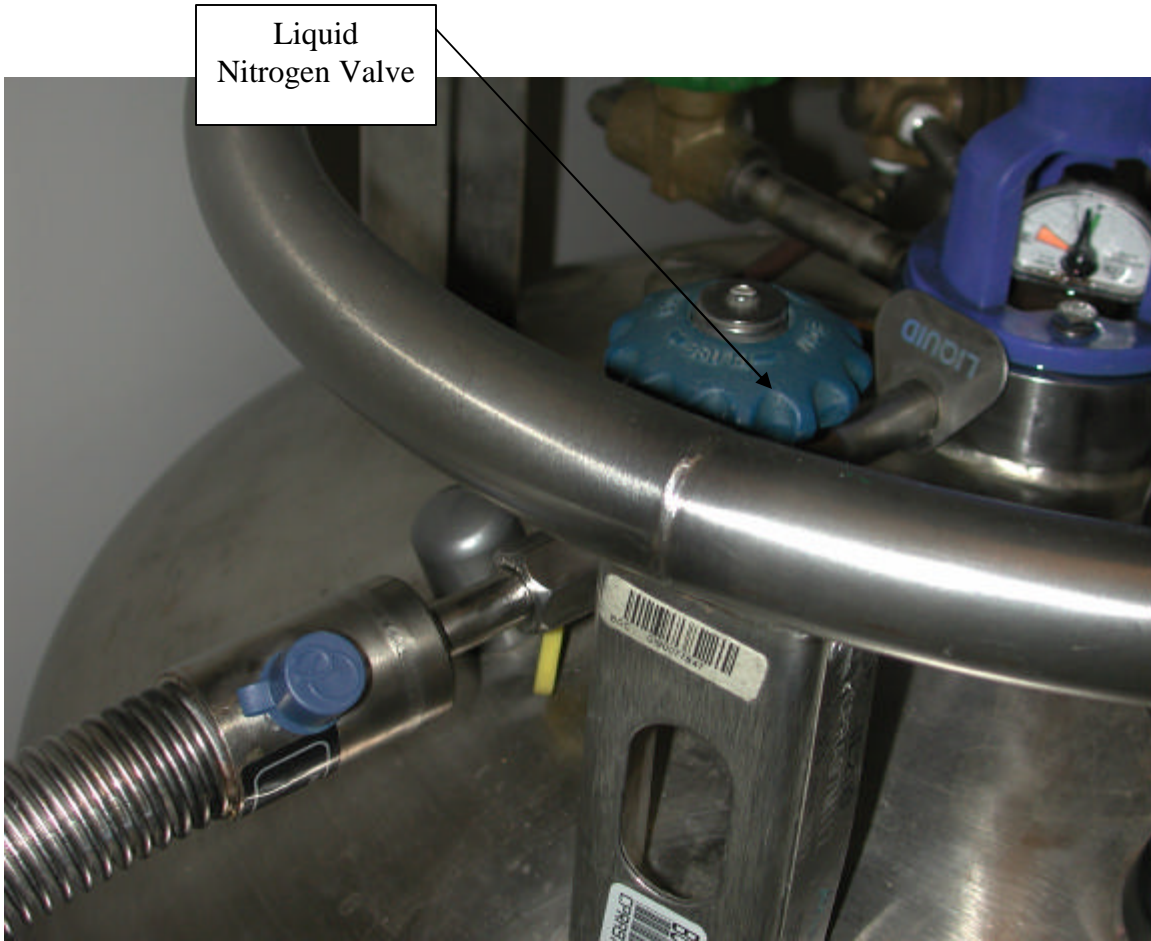


Figure 7. Liquid Nitrogen Dewar, Blue Knob



Figure 8. Vacuum Feedthrus for CRaTER and Shroud, 25 pin D-Sub Male



Figure 10. Temperature Monitoring RTDs. 25 pin D-sub, Male.

2.4.1.1. Temperature Monitors

There are 10 RTD's wired into the chamber. The RTDs are wired thru the two 25 Pin D-sub connectors towards the back end of the chamber wall. There are extender cables from the vacuum flange to the inside of the chamber where the RTDs are wired.

2.4.1.2. Base plate

The base plate is gold plated copper. The base plate is isolated from the chamber by Teflon rails. There are 2 K type Thermocouples on this plate. One TC monitors the plate for controlling temperature. The second TC provides over temperature 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 over temperature 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 dewar of nitrogen is required to supply liquid and gaseous nitrogen 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 liquid 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 on the temperature.

2.4.1.5. Automatic temperature cycling

The chamber can be programmed to run temperature cycles automatically.

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 a solenoid on the turbo pump 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 and close valve #4.
4. Shut off High Vacuum gauge controller and unplug cable from the gauge head(PG1 and PG2). See figures 1 and 5.
5. Shut off power on the turbo located at the rear of the turbo controller.
6. Notify cognizant Contamination Engineer of failure. If failure occurs during FLIGHT Hardware testing, inform cognizant Mechanical, Contamination and Project Engineering as well as Quality Assurance.

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