



THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY

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HALL D PROCEDURE NO.:  
D00000-10-05-P001 Rev -

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TITLE: Hall D Beam Line Vacuum Procedures

DATE: 18Jun2014

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## **1. Scope - Hall D Beam Line Vacuum Procedures**

The purpose of this procedure is to define how to safely pump down and bleed-up the various portions of the Hall D beam line. Hazards to personnel and equipment along with the actions to mitigate the hazards are addressed in each section.

The Hall D Beam Line extends from the Tagger Hall (bldg. 204) to the Photon Beam Dump in Hall D (bldg. 203). Most of the Beam Line is under vacuum ranging in pressure from 1mTorr in the section on the Forward Calorimeter (FCAL) Platform to 1e-6Torr inside the Goniometer box. Separate sections of the Beam Line need specific procedures to ensure equipment is not damaged when either pumping down or bleeding up that section. Additionally there are several thin windows along the beam line which require PPE and covers while under vacuum. Finally, radiation hot spot could occur from beam operations creating Radiological hazards which also will be addressed.

## **2. Tagger Hall, Building 204**

**Hazards:** Radiation, ODH, and noise (from thin windows rupture under vacuum).

The Tagger building is a Radiation area and ***a dosimeter is required for entry***. The radiation areas are the shielding blocks for the electron beam dump and the shield walls along the south wall and truck ramp door. Additionally there maybe radiation hot spots along the beam line which should be avoided to minimize any exposure. The floor of the Tagger Hall is an ODH 0 area however, ***the North East stub coming from the Accelerator is ODH1 as is the area 9' above the Hall floor; in both cases a "buddy" is required*** to work in those areas. Finally, the large thin window on the Tagger vacuum box is a potential noise hazard if it were to fail while under vacuum. ***Hearing protection is required while in the Hall or the NE stub***. Additionally, the window shutter should be closed if working around the thin window while it is under vacuum.

## **Bleed-up/pump down procedures**

The beam line in the Tagger Hall can be divided into four separate sections. Bleed-up or pump down as well as changing the valve status requires close coordination and approval from MCC.

**Section 1:** From valve VBV5C11B to valve VBVAD00. This section consists of the Goniometer and the Amorphous Radiator assembly. **Caution**, bleed up and initial pump down are only done using valve VRV5C11B which has a small orifice (0.0625" hole) in the conflat gasket to prevent damage to the thin foils in this region.

### **Bleed-up**

- Call MCC (7405) and request they shut valves VBV5C11B and VBVAD00. Verify the valves are shut and then remove the electrical connection to prevent accidental opening of the valves.
- Remove the HV cable from the Cold Cathode to prevent contamination of the head and attach readout to the convectron gauge near the Cold Cathode to monitor the pressure in this section. Close VRV5C11C to the Turbo pump cart and turn off the pump.

- Attach a GN2 line (with a 1 PSI relief and regulator set to 5psi) to the VRV5C11B KF40 port and ease open this valve. Bleed this section up to atmosphere by monitoring the pressure on the convectron gauge. Once this section is up to atmosphere, close VRV5C11B and remove the GN2 line and blank off the KF40 port on VRV5C11B.

### **Pump Down**

- Ensure valves VBV5C11B, VBVAD00, and VRV5C11C are closed and the electrical cables are removed to prevent accidental opening from remote locations. Attach a convectron gauge controller to the convectron gauge in this section.
- Attach a roughing pump to the KF40 port on VRV5C11B, turn on the pump and fully open valve VRV5C11B.
- Monitor the pressure in this section using the convectron gauge. When the pressure has fallen below 500 mTorr, turn on the turbo pump cube and open VRV5C11C. Close VRV5C11B, turn off and remove the roughing pump and blank off the KF40 port on VRV5C11B.
- Continue monitoring the pressure until it drops below 20 mTorr. Attach a local Cold cathode controller to the Cold Cathode gauge and monitor the pressure until it falls below  $5 \times 10^{-5}$  mTorr. Remove the local HV cable on the Cold Cathode Gauge and reattach the remote HV cable.
- Call MCC (7405) and have them verify there is equal or better vacuum in the beam line upstream and downstream of this section. If the vacuums are good, reconnect the electrical cable to valves VBV5C11B and VBVAD00 and request they remotely open and close these valves to verify proper operation.

**Section 2:** From valve VBVAD00 to valves VBVAD00A on the Electron beam line and VBV5H00 on the Photon Beam line. This section includes the Tagger Magnet vacuum box as well as both the electron beam line leading to the Electron Dump and the Photon beam line heading east towards Hall D.

### **Bleed-up**

- Call MCC (7405) and request they shut valves VBVAD00, VBVAD0A and VBV5H00. Verify the valves are shut and then remove the electrical connection to prevent accidental opening of the valves.
- Remove the HV cable from the Cold Cathode in this section to prevent contamination of the head and attach readout to the convectron gauge near the Cold Cathode (5H00) to monitor the pressure in this section. Close VRVAD00B to the Turbo pump cart and turn off the pump.
- Attach a GN2 line (with a 1 PSI relief and regulator set to 5psi) to the VRVAD00C KF40 port and ease open this valve. Bleed this section up to atmosphere by monitoring the pressure on the convectron gauge. Once this section is up to atmosphere, close VRVAD00C, remove the GN2 line, and reinstall the blank on the KF40 port.

### **Pump Down**

- Ensure valves VBVAD00, VBVAD0A, and VBV5H00 are closed and the electrical cables are removed to prevent accidental opening from remote locations. Attach a convectron gauge controller to the convectron gauge near VBV5H00 on the Photon beam line.
- Open valve VRVAD00B atop of the Turbo Pump Cart and turn on the pump. Monitor the pressure in this section (using the convectron gauge) until it drops below 20 mTorr. Attach a local Cold cathode controller to the Cold Cathode gauge and monitor the pressure until it falls below  $5 \times 10^{-5}$  mTorr. Remove the local HV cable on the Cold Cathode Gauge and reattach the remote HV cable.
- Call MCC (7405) and have them verify there is equal or better vacuum in the beam line upstream and downstream of this section. If the vacuums are good, reconnect the electrical cable to valves VBVAD00, VBVAD0A, and VBV5H00 and request they remotely open and close these valves to verify proper operation.

**Section 3:** From valve VBV5H00 on the Photon beam line to thin window on the end of the pipe entering the Collimator Cave in Hall D.

### **Bleed-up**

- Call MCC (7405) and request they shut valve VBV5H00. Verify the valve is shut and then remove the electrical connection to prevent accidental opening of the valve.
- Close VRV5H00A to the Turbo Pump Cart for this section and turn off the pump.
- Proceed to Hall D, put on safety glasses and hearing protection and enter the Collimator Cave. Once in the Cave install the tin window shield onto the thin window at the end of the beam pipe, remove the HV cable from the Cold Cathode in this section to prevent contamination of the head, and attach a controller to the convectron gauge near the Cold Cathode to monitor the pressure in this section.
- Using a CVI valve adapter, attach a GN2 line (with a 1 PSI relief and regulator set to 5psi) to the CVI valve on the gauge cluster and ease open this valve. Bleed this section up to atmosphere by monitoring the pressure on the convectron gauge. Once this section is up to atmosphere, close the CVI valve, remove the adapter and GN2 line and reinstall the cap on the CVI valve.

### **Pump Down**

- Ensure VBV5H00 is closed and the electrical cable is removed to prevent accidental opening from remote locations.
- Attach a convectron gauge controller to the convectron gauge at the end of the beam pipe in the Collimator Cave. Ensure the thin window cover is installed on the end of the beam pipe.

- In the Tagger Hall open valve VRV5H00A going to the Turbo Pump Cart and turn on the pump.
- In the Collimator Cave monitor the pressure until it drops below 20 mTorr. Attach a local Cold cathode controller to the Cold Cathode gauge and monitor the pressure until it falls below 5e-5 mTorr. Remove the local HV cable on the Cold Cathode Gauge and reattach the remote HV cable.
- Call MCC (7405) and have them verify there is equal or better vacuum in the beam line upstream of this section. If the vacuums are good, reconnect the electrical cable to valves VBV5H00 and request they remotely open and close this valve to verify proper operation.

**Section 4:** From valve VBVAD00A to the Electron Beam Dump. This section is maintained by the Accelerator Vacuum Group and is not covered here.

### 3. Hall D, Building 203

**Hazards:** Radiation, Magnetic field, and noise (from thin window rupture under vacuum)

The Upstream Platform is a Radiation area and *a dosimeter is required for entry*. The radiation area is for the shielding blocks downstream of the Pair Spectrometer Detectors. Additionally there may be radiation hot spots along the beam line which should be avoided to minimize any exposure. The second sweep magnet and the PS magnet both produce magnetic fields when powered. The sweep magnet has a low fringe field and personnel will not work within 1 foot while the red beacon is flashing. The PS magnet must be powered down and power supply locked out before personnel can work closer than 2 feet of the ends of the magnet. There are large thin windows in the Collimator Cave and on the beam pipe downstream of the Forward Calorimeter (FCAL), and small thin windows on the downstream end of the Pair Spectrometer (PS) vacuum box. These windows are potential noise hazards if they were to fail while under vacuum. *Hearing protection is required while in the Collimator Cave or the FCAL platform when these areas are under vacuum.* Additionally, the window covers will be installed prior to personnel working around the thin windows while they are under vacuum.

### Bleed-up/pump down procedures

The beam line in Hall D can be divided into three separate sections. Bleed-up or pump down as well as changing the beam line valve status requires close coordination and approval from MCC.

**Section 1:** Is from the small thin window on the upstream end of the permanent sweep magnet in the Collimator Cave to valve VBV5H06 just downstream of the Pair Converter. This section consists of the two sweep magnets, the second collimator, the Polarimeter, and the Pair Converter. **Caution**, bleed up and initial pump down are only done using valve VRV5H03, which has a small orifice (0.0625" hole) in the conflat gasket to prevent damage to the thin foils in this region. Additionally, bleed up and pump downs will not be performed unless the Pair Converter is fully retracted from the beam line to prevent damage to its thin foils.

### **Bleed-up**

- **Caution:** Valve VBV5H06 is 2 feet from the upstream end of the PS magnet which is near the edge of the 600 Gauss field at full power. The PS magnet should be off and the power supply locked out before personnel and tools are brought into this area.
- Call MCC (7405) and request they shut VBV5H06. Verify the valve is shut and then remove the electrical connection to prevent accidental opening of the valve.
- Enter the Collimator Cave (hearing protection required) and remove the HV cable from the Cold Cathode to prevent contamination of the head and attach a controller to the convectron gauge near the Cold Cathode to monitor the pressure in this section. Ensure that the Pair Converter is fully retracted to prevent damage to its thin foils.
- Attach a GN2 line (with a 1 PSI relief and regulator set to 5psi) to the bleed-up/pump down valve VRV5H03 KF40 port and full open this valve. Bleed this section up to atmosphere by monitoring the pressure on the convectron gauge. Once this section is bled up to atmosphere, close VRV5H03 and remove the GN2 line. Reinstall blank

### **Pump Down**

- **Caution:** Valve VBV5H06 is 2 feet from the upstream end of the PS magnet which is near the edge of the 600 Gauss field at full power. The PS magnet should be off and the power supply locked out before personnel and tools are brought into this area.
- Ensure valves VBV5H06 and VRV5H06 are closed and the electrical cable is removed to prevent accidental opening from remote locations. Attach a convectron gauge controller to the convectron gauge in this section. Ensure that the Pair Converter is fully retracted to prevent damage to its thin foils.
- Attach a roughing pump to the KF40 port on the bleed up/pump down valve VRV5H03, turn on the pump and ease open valve VRV5H03.
- Monitor the pressure in this section using the convectron gauge until the pressure has fallen below 100 mTorr.
- Final pump down of Section 1 will be done with the turbo pump cart attached to section 2. If Section 2 is not under vacuum leave the roughing pump running and monitor the pressure often enough to verify there are not any vacuum problems in this section.
- Once vacuum is established in Section 2 (the turbo pump for this section should be valved in and running), open valve VBV5H06 and continue to monitor the pressure until it drops below 20 mTorr. Close VRV5H03, turn off and remove the roughing pump, and blank off the KF40 port..
- Attach a local Cold Cathode controller to the Cold Cathode gauge and monitor the pressure until it falls below  $5 \times 10^{-5}$  mTorr. Remove the local HV cable on the Cold Cathode Gauge and reattach the remote HV cable.
- Reconnect the electrical cable to valve VBV5H06. Call MCC (7405) and request they remotely open and close this valve to verify proper operation.

**Section 2:** Is from valve VBV5H06 to the Cryo Target. This section includes the PS magnet and vacuum box and the beam line to the Cry0 (or commissioning) Target Assembly. NOTE: The downstream end of the beam pipe has a thin window to separate the Cryo Target Assembly shield vacuum from the beam line vacuum. There are also 2 thin windows on the Pair Spectrometer vacuum chamber.

**Hazards:** Radiation, Magnetic Fields, and noise (from thin window rupture under vacuum)

The Upstream Platform is a Radiation area and *a dosimeter is required for entry*. The radiation area is for the shielding blocks down stream of the Pair Spectrometer Detectors. Additionally there maybe radiation hot spots along the beam line which should be avoided to minimize any exposure. The PS magnet produces a magnetic field when powered. The PS magnet must be powered down and power supplies locked out before personnel can work closer than 2 feet of the ends of the magnet. There are small thin windows on the downstream end of the Pair Spectrometer (PS) vacuum box as well as downstream of the green shielding wall. These windows are potential noise hazards if they were to fail while under vacuum. *Hearing protection is required while working between these windows and the PS counters when this section is under vacuum.* Additionally, the window covers will be installed prior to personnel working around the thin windows.

### **Bleed-up**

- **Caution:** Valve VBV5H06 is 2 feet from the upstream end of the PS magnet which is near the edge of the 600 Gauss field at full power. The PS magnet should be off and the power supply locked out before personnel and tools are brought into this area.
- Call MCC (7405) and request they shut VBV5H06. Verify the valve is shut and then remove the electrical connection to prevent accidental opening of the valve.
- Close VRV5H06 Going to the turbo pump cart and turn off the pump, remove the HV cable from the Cold Cathode in this section to prevent contamination of the head, and attach a controller to the convectron gauge near the Cold Cathode to monitor the pressure in this section.
- Using a CVI valve adapter, attach a GN2 line (with a 1 PSI relief and regulator set to 5 psi) to the CVI valve on the gauge cluster and ease open this valve. Bleed this section up to atmosphere by monitoring the pressure on the convectron gauge. Once this section is up to atmosphere, close the CVI valve, remove the adapter and GN2 line and reinstall the cap on the CVI valve.

### **Pump Down**

- **Caution:** Valve VBV5H06 is 2 feet from the upstream end of the PS magnet which is near the edge of the 600 Gauss field at full power. The PS magnet should be off and the power supply locked out before personnel and tools are brought into this area.
- Ensure valves VBV5H06, and VRV5H06 are closed and the electrical cable is removed to prevent accidental opening from remote locations. Attach a convectron gauge controller to the convectron gauge in this section.

- Open VRV5H06 and turn on the turbo pump cart. Monitor the pressure in this section with the local convectron gauge. When the pressure has dropped below 20 mTorr attach a local Cold Cathode Controller to the Cold Cathode Gauge and monitor the pressure until it falls below 5e-5 mTorr.
- Enter the Collimator Cave (hearing protection required) and attach a local convectron gauge controller to the gauge in Section 1 and verify the vacuum is better than 20 mTorr. If the vacuum in Section 1 is better than 20 mTorr attach a local controller box to valve VBV5H06 and open the valve. Remove the HV cable from the Cold Cathode Gauge in Section 1 and attach a local cable and controller.
- When the vacuum in both Section 1 and Section 2 has dropped below 5e-5 Torr remove the local HV cables on the Cold Cathode Gauges and reattach the remote HV cables.
- Call MCC (7405) and have them verify there is equal or better vacuum in the beam line upstream of this section. If the vacuum is good, reconnect the electrical cable to valve VBV5H06 and request they remotely open and close the valve to verify proper operation. Request they leave this valve open so the turbp pump can continue to pump on both Sections.

**Section 3:** This section resides on the FCAL platform consists of an 8" beam line almost 12' long suspended between the electronic racks with thin windows on each end.

**Hazards:** Radiation and noise (from thin window rupture under vacuum)

The FCAL Platform is not in a Radiation area however there maybe radiation hot spots along this section of beam line and a dosimeter would then be required for working in this area. There are thin windows on both ends of the beam line which are potential noise hazards if they were to fail while under vacuum. ***Hearing protection is required while working between these windows when this section is under vacuum.*** Additionally, the window covers will be installed prior to personnel working on this platform.

### **Bleed-up**

- Call MCC (7405) and notify them that you will be bleeding up this section of beam line.
- Wearing safety glasses and hearing protection install window covers on both ends of the beam pipe.
- Close VRV5H10 going to the rotary vane pump and turn off the pump and attach a controller to the convectron gauge to monitor the pressure in this section.
- Using a CVI valve adapter, attach a GN2 line (with a 1 PSI relief and regulator set to 5psi) to the CVI valve on the gauge cluster and ease open this valve. Bleed this section up to atmosphere by monitoring the pressure on the convectron gauge. Once this section is up to atmosphere, close the CVI valve, remove the adapter and GN2 line and reinstall the cap on the CVI valve.

### **Pump Down**



- Wearing safety glasses and hearing protection install window covers on both ends of the beam pipe.
- While wearing hearing protection open valve VRV5H10 on top the rotary vane pump and turn on the pump.
- Attach a convectron gauge controller to the gauge located at the upstream end of the pipe and monitor the pressure.
- When the pressure has dropped below 50 mTorr, call MCC and notify them that the vacuum has been restored in this section.