

Brookhaven National Laboratory/ LIGHT SOURCES DIRECTORATE			
Subject:	VACUUM PROCEDURES FOR BEAMLINE U4B		
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The following procedures must be followed when bleeding up different sections and when returning these sections to operation (refer to Beamline Layout Drawing SLS-96.49-001-5 Revision A)

I. FRONT-END (PROCEDURE TO BE PERFORMED BY NSLS VACUUM GROUP ONLY)

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Refer to Front-End Vacuum Procedures (SLS-07.19-13-1).

B. Return to Operation

1. Notify the Coordinator (Beeper 5824).
2. Refer to Front-End Vacuum Procedures (SLS-07.19-13-1).

II. SECTION BETWEEN VALVE 1B AND VALVE 2B, M0B; M1B MIRROR CHAMBER

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Close and seal Valve 1B and the Front-End HV Valve.
3. Hook up turbo pump to this section and isolate turbo.
4. Coordinator places Yellow Tags on Valve 1B and the Front-End HV Valve.
5. Slowly bleed-up with boil-off N₂ while Coordinator monitors Front-End pressure.

B. Return to Operation

1. Bake and pump to $< 2 \times 10^{-9}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Open Valve 1B into Front-End provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
5. Perform RGA scan. *
6. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 1B and the Front-End HV Valve.
7. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

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III. SECTION BETWEEN VALVE 2B AND VALVE 3B, S0B ENTRANCE SLIT

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Close and seal Valve 2B and Valve 1B.
3. Hook up turbo pump to this section and isolate turbo.
4. Coordinator places Yellow Tags on Valve 2B and Valve 1B.
5. Slowly bleed-up with boil-off N₂ while Coordinator monitors pressure in M0B, M1B Mirror Chamber.

B. Return to Operation

1. Bake and pump to $< 2 \times 10^{-9}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Open Valve 2B into M0B, M1B Mirror Chamber provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
5. Open Valve 1B into the Front-End provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 2B and Valve 1B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

IV. SECTION BETWEEN VALVE 3B AND VALVE 4B, GRATING CHAMBER and M2B, M3B DEFLECTING MIRROR CHAMBERS

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Close and seal Valve 3B and Valve 2B.
3. Hook up turbo pump to this section and isolate turbo.
4. Coordinator places Yellow Tags on Valve 3B and Valve 2B.
5. Slowly bleed-up with boil-off N₂ while Coordinator monitors pressure in the S0B Entrance Slit Section.

B. Return to Operation

1. Bake and pump to $< 2 \times 10^{-9}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Open Valve 3B into the Entrance Slit section provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
5. Open Valve 2B into the M0B, M1B Mirror Chamber provided pressure $< 2 \times 10^{-9}$ Torr downstream the valve.
6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 3B and Valve 2B.

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8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

V. SECTION BETWEEN VALVE 4B AND VALVE 5B, S1B EXIT SLIT

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Close and seal Valve 4B and Valve 3B.
3. Hook up turbo pump to this section and isolate turbo.
4. Coordinator places Yellow Tags on Valve 4B and Valve 3B.**
5. Slowly bleed-up with boil-off N₂ while Coordinator monitors pressure in the Grating Chamber and M2B, M3B Deflecting Mirror Chambers section.

B. Return to Operation

1. Bake and pump to $< 2 \times 10^{-9}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Open Valve 4B into the Grating Chamber provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
5. Open Valve 3B into the S0B Entrance Slit section provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 4B and Valve 3B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

VI. SECTION BETWEEN VALVE 5B AND VALVE 6B, I₀ CHAMBER

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Close and seal Valve 5B and Valve 4B.
3. Hook up turbo pump to this section and isolate turbo.
4. Coordinator places Yellow Tags on Valve 5B and Valve 4B.***
5. Slowly bleed-up with boil-off N₂ while Coordinator monitors pressure in the S1B Exit Slit section.

B. Return to Operation if I0 Chamber is Ultra High Vacuum (UHV) type

1. Bake and pump to $< 2 \times 10^{-9}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Open Valve 5B into the S1B Exit Slit section provided pressure $< 2 \times 10^{-9}$ Torr downstream of the Valve.

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5. Open Valve 4B into the Grating Chamber and M2B, M3B Deflecting Mirror Chambers provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 5B and Valve 4B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve.**

C. Return to Operation if I0 Chamber is non-UHV type

1. Pressure interlock to Valve 5B must be in place and operating at a trip point $\leq 2 \times 10^{-5}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Temporarily open Valve 5B into S1B Exit Slit section with window isolation valve WV5B closed. Valve 5B can remain open **ONLY** if pressure in S1B Exit Slit section $< 2 \times 10^{-7}$ Torr.
5. Open Valve 4B into the Grating Chamber and M2B, M3B Deflecting Mirror Chambers section provided pressure $< 2 \times 10^{-7}$ Torr downstream of the valve.
6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 5B and Valve 4B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

VII. SECTION BETWEEN VALVE 6B AND VALVE 7B, EXPERIMENTAL CHAMBER #1

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Close and seal Valve 6B and Valve 5B.
3. Hook up turbo pump to this section and isolate turbo.
4. Coordinator places Yellow Tags on Valve 6B and Valve 5B.***
5. Slowly bleed-up with boil-off N_2 while Coordinator monitors pressure in the I0 Chamber.

B. Return to Operation if Experimental Chamber #1 is Ultra High Vacuum (UHV) type

1. Bake and pump to $< 2 \times 10^{-9}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Open Valve 6B into the I0 Chamber provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
5. Open Valve 5B into the S1B Exit Slit section provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.

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6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 6B and Valve 5B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

C. Return to Operation if Experimental Chamber #1 is non-UHV type

1. Pressure interlock to Valve 6B must be in place and operating at a trip point $\leq 2 \times 10^{-5}$ Torr.
2. Notify the Coordinator (Beeper5824).
3. Prepare for RGA scan. *
4. Open Valve 6B into the I0 Chamber provided pressure $< 2 \times 10^{-5}$ Torr downstream of the valve.
5. If pressure in I0 Chamber $< 2 \times 10^{-9}$ Torr, open Valve 5B into the S1B Exit Slit section. However, if pressure in I0 Chamber $> 2 \times 10^{-9}$ Torr, temporarily open Valve 5B into S1B Exit Slit section with window isolation valve WV5B closed. Valve 5B can remain open **ONLY** if pressure in S1B Exit Slit section $< 2 \times 10^{-7}$ Torr.
6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 6B and Valve 5B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

D. Bleed-up of Sample Preparation Section Only

1. Sections A, B and C above apply
 - ❖ As if the entire Experimental Chamber #1 were being bled up and returned to operation, with the following exception: Valve 6B and Valve 5B may be opened to allow beam to pass through to Experimental Stations downstream *provided* pressure in the Sample Preparation Section $< 1 \times 10^{-6}$ Torr. In this case, pressure interlock to Valve 6B must be in place and operating at a trip point $\leq 2 \times 10^{-5}$ Torr, and the valve between the Sample Preparation Section and the main section of Experimental Chamber #1 must be Yellow Tagged. ***
 - ❖ This tag may be removed when the conditions in either section B or section C are met when this valve is opened.
 - ❖ N.B.: for the Sample Preparation Section only, Coordinator notification and Yellow Tagging are **NOT** required for the following U4B PRT members: Dario Arena (NRL) and Joe Dvorak (MSU).

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VIII. SECTION BETWEEN VALVE 7B AND VALVE 8B, BEAM TRANSPORT SECTION

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Close and seal Valve 7B and Valve 6B.
3. Hook up turbo pump to this section and isolate turbo.
4. Coordinator places Yellow Tags on Valve 7B and Valve 6B.***
5. Slowly bleed-up with boil-off N₂ while Coordinator monitors pressure in Experimental Chamber #1.

B. Return to Operation

1. Bake and pump to $< 1 \times 10^{-8}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan.*
4. Open Valve 7B into Experimental Chamber #1 provided pressure $< 1 \times 10^{-8}$ Torr downstream of the Valve.
5. Open Valve 6B into the I0 Chamber provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 7B and Valve 6B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

IX. SECTION BETWEEN VALVE 8B AND VALVE 9B, EXPERIMENTAL CHAMBER #2

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Close and seal Valve 8B and Valve 7B.
3. Hook up turbo pump to this section and isolate turbo.
4. Coordinator places Yellow Tags on Valve 8B and Valve 7B.***
5. Slowly bleed-up with boil-off N₂ while Coordinator monitors pressure in Beam Transport section.

B. Return to Operation if Experimental Chamber # 2 is Ultra High Vacuum (UHV) type

1. Bake and pump to $< 2 \times 10^{-9}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Open Valve 8B into Beam Transport section provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
5. Open Valve 7B into Experimental Chamber #1 provided pressure $< 1 \times 10^{-8}$ Torr downstream of the valve.
6. Perform RGA scan. *

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7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tag from Valve 8B and Valve 7B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

C. Return to Operation if Experimental Chamber #2 is non-UHV type

1. Temporarily close valve 5B.
2. Pressure interlock to Valve 6B must be in place and operating at a trip point $\leq 2 \times 10^{-5}$ Torr.
3. Notify the Coordinator (Beeper5824).
4. Prepare for RGA scan. *
5. Open valve 8B into Beam Transport section provided pressure $< 2 \times 10^{-5}$ Torr downstream of the valve. Open valve 7B into Experimental Chamber #1 provided pressure $< 2 \times 10^{-5}$ Torr downstream of the valve. Open valve 6B into the I0 Chamber provided pressure $< 2 \times 10^{-5}$ Torr downstream of the valve.
6. If pressure in I0 Chamber $< 2 \times 10^{-9}$ Torr, open Valve 5B into the S1B Exit Slit section. **However**, if pressure in I0 Chamber $> 2 \times 10^{-9}$ Torr, temporarily open Valve 5B into S1B Exit Slit section with window isolation valve WV5B closed. Valve 5B can remain open **ONLY** if pressure in S1B Exit Slit section $< 2 \times 10^{-7}$ Torr.
7. Perform RGA scan. *
8. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valves 8B and Valve 7B.
9. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

X. SECTION BETWEEN VALVE 9B AND VALVE 10B, REFOCUSING MIRROR CHAMBER

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Close and seal Valve 9B and Valve 8B.
3. Hook up turbo pump to this section and isolate turbo.
4. Coordinator places Yellow Tags on Valve 9B and Valve 8B.***
5. Slowly bleed-up with boil-off N₂ while Coordinator monitors pressure in Beam Transport Section.

B. Return to Operation

1. Bake and pump to $< 2 \times 10^{-9}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Open Valve 9B into Experimental Chamber #2 provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
5. Open Valve 8B into Beam Transport Section provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.

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6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 9B and Valve 8B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

XI. SECTION DOWNSTREAM OF VALVE 10B, EXPERIMENTAL CHAMBER #3

A. Bleed-Up

1. Notify the Coordinator (Beeper 5824).
2. Close and seal Valve 10B and Valve 9B.
3. Hook up turbo pump to this section and isolate turbo.
4. Coordinator places Yellow Tags on Valve 10B and Valve 9B.***
5. Slowly bleed up with boil-off N₂ while Coordinator monitors pressure in the Refocusing Mirror Section.

B. Return to Operation if Experimental Chamber # 3 is Ultra High Vacuum (UHV) type

1. Bake and pump to $< 2 \times 10^{-9}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Open Valve 10B into Refocusing Mirror Chamber provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
5. Open Valve 9B into Experimental Chamber #2 provided pressure $< 2 \times 10^{-9}$ Torr downstream of the valve.
6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve 10B and Valve 9B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

C. Return to Operation if Experimental Chamber # 3 is non-UHV type

1. Either the pressure downstream of Valve V10B must be $< 2 \times 10^{-8}$ Torr or a pressure interlock to Valve V10B must be in place and operating at a trip point $\leq 2 \times 10^{-5}$ Torr.
2. Notify the Coordinator (Beeper 5824).
3. Prepare for RGA scan. *
4. Open Valve V10B into the Refocusing Mirror Chamber provided pressure $< 2 \times 10^{-8}$ Torr downstream of valve or provided the pressure is $< 2 \times 10^{-5}$ Torr and window isolation valve VW10B is closed.
5. If pressure in the Refocusing Mirror Chamber is $< 2 \times 10^{-9}$ Torr, open Valve V9B into the Beam Transport section. **However, if** pressure in the Refocusing Mirror Chamber is $> 2 \times 10^{-9}$ Torr, temporarily open Valve V9B into the Beam Transport section with window isolation valve VW10B closed. Valve V9B can remain open **ONLY** if pressure in the

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Refocusing Mirror chamber is $< 2 \times 10^{-9}$ Torr and the pressure in the Beam Transport section is $< 2 \times 10^{-9}$ Torr.

6. Perform RGA scan. *
7. If RGA scan or pressure reading (if no RGA scan required) is satisfactory, Coordinator removes Yellow Tags from Valve V10B and Valve V9B.
8. Remove any unprotected turbo pump from this section or valve off the turbo pump and place a Yellow Tag on the valve. **

*** NSLS POLICY FOR RGA SCANS (24 HOUR NOTICE REQUIRED)**

An RGA scan is required before returning to operation if there is a major change of hardware in the vacuum system, i.e. changing of samples, mirrors, windows, monochromator crystals or gratings, manipulators, detectors, etc., **with the following two exceptions:**

1. After UHV sample chambers have been bled up for replacing components, an RGA scan will not be required if the chamber pressure is returned to $< 2 \times 10^{-9}$ Torr and the Front End pressure remains $< 2 \times 10^{-9}$ Torr when vacuum sections upstream of the chamber are opened into the Front End.
2. If any vacuum section upstream of the bled-up section remains at a pressure of $< 9 \times 10^{-10}$ Torr as read using a hot-filament ion gauge, when the entire beamline is opened into the Front End, and the Front End pressure does not increase, no RGA is required.

**** NSLS TURBO PUMP POLICY**

An unprotected turbo pump is one not separated from the Front End by a beamline valve which automatically closes in the event of a power loss or a pressure increase at the turbo pump. **No unprotected turbo pump can share a contiguous vacuum with the Front End.**

***** NOTE REGARDING USE OF U4B AUXILIARY MASK:** the purpose of this mask is to provide thermal protection of valves V1B, V2B, and V3B, which could be thermally damaged under illumination by the synchrotron beam for more than a few minutes. However, valves V4B, V5B, V6B, V7B, V8B, V9B, and V10B will never be subject to significant thermal loading by the synchrotron beam and may be closed with the auxiliary mask open. This state is desired in order to maintain thermal stability of the U4B beamline optics, which are all located upstream of valve V4B.

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Document Review Frequency

3 Years

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Rev	Description	Date
B	Initial release in to the Controlled Document System.	5/31/2002
C	Addition of Section 1X C. Changed title of Section 1X B	6/20/2003
D	Addition of procedure allowing Aux. Mask to remain open for optics stabilization.	4/15/2010