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| **L2HE Downstream Shipping Configuration of the beamline (WS6)** |
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# Purpose

The purpose of this document is to describe the L2HE downstream beam pipe reconfiguration for Shipping Procedure.

# Scope

The work begins after LERF Testing has completed and the Cryomodule has been transported back to the Test Lab WS5. Preparation activities include beamline reconfiguration, followed by numerous in-situ RF and Alignment measurements. Work ends once all steps are completed in the Traveler and the unit is deemed ready for shipment to SLAC.

# Terms and Definitions

The following terms have specific meanings within this procedure.

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| **Term** | **Definition** |
| LERF | Low Energy Recirculation Facility- location where Cryomodule is tested, outfitted with Cryogens and SSA’s |
| Downstream | Is intended to denote a particular end of the Cryomodule for various assembly and preparation activities. |
| Clean Assembly | Tightly controlled assembly activities to maintain particulate free beam line surfaces, performed by trained Technical Staff only. |

# Roles and Responsibilities

The following actions are to be performed by knowledgeable, authorized Technicians only. Consult the Group Lead or designee for details.

# Procedure

**This Procedure is for configuring the downstream end and installing the shipping gauges on an L2HE CM. This work is to be performed using clean assembly practices. Using a manifold that has been pre-assembled inside the cleanroom.**

1. Record Beamline vacuum reading at the Ion Pump.
2. Gather all associated parts to be cleaned and sent into the main clean room
3. Pre-assemble the gauge manifold in the cleanroom using standard clean assembly practices.
* Note: When assembling the Aluminum Magnesium seal flange, install 4 bolts perpendicular and lightly torque as this will function as a dust seal until final installation.
1. After pre-assembly is completed in the cleanroom, have the manifold double bagged and placed on the parts shelf.
2. Close the Downstream cold valve and torque to 20-nm.
3. Begin setting up the laminar flow hood over the downstream end of the Cryomodule.
* **During clean beam pipe work the following steps are to be followed!**
* Position the laminar flow hood over the work area.
* Wipe Down then tape the curtains to eliminate leaks into the hooded area.
* Cover all other exposed surfaces in the flow hood with plastic sheeting
* Allow the flow hood to run continuously.
* Wipe down all surfaces with Alcohol and then blow off with Ionized N2.
* Set up the particle counter and begin monitoring the particle count.
* Stage all supplies and tools inside the flow hood, on a perforated work surface.
* **MAKE SURE DOWNSTREAM COLD VALVE AND RIGHT ANGLE GATE VALVES ARE CLOSED BEFORE BEGINNING WORK.**
* Once you have verified the valves are closed and the particle count is stabilized at zero (.03 micron scale), you are ready to gown up for work.
1. Slow pump/bleed up system hook up.
* **Verify the cold valve on the cavity string is closed.**
* Shut down the ion pump
* Verify the turbo pumping system is bled up with filtered N2
* Enter the flow hood using standard protocols
* Install the bleed up diffuser to the ion pump manifold using clean assembly practices. Align the flanges and torque down in a star pattern to achieve a uniform seal.
* Fast pump down the turbo and slow bleed up lines up to the right angle valve on the ion pump and leak check the connection.
* Open the right angle valve on the ion pump to achieve a common vacuum.
* Once common vacuum has been established in the space between the right angle valve and the cold valve, close the right angle valve connecting the turbo hose to the slow bleed up manifold.
* Begin the slow bleed up of the chamber to be removed.
* Monitor the gauging on the slow bleed up manifold and stop the slow bleed up at 780 Torr.
* Close the right angle valve on the ion pump and recondition the turbo system for the next phase.
* Re-enter the flow hood and remove the slow bleed up diffuser from the manifold that will be removed in the following steps.
1. **Remove the downstream ion pump.**
* Remove the ion pump magnet and support bracket
* Carefully remove the ion pump tee and blank off the open ports with clean blanks and gaskets.
* Break down the flow hood.
1. **Remove the end cap**
* Remove the end cap instrumentation port and verify the G-10 beam pipe hanger hardware is in place and is carrying the spool weight.
* Remove the nuts, fender washers, and studs that secured the beam pipe to the end cap.
* Using the crane and multiple people, remove the end cap.
* Remove the MLI, Lower half of 50k shielding, thermal strapping, and unhook the instrumentation.
* Install the beam pipe bellows support piece
* Install the tooling tripod required to support and remove the beam pipe.
* Remove the top half of the 50K shielding, cryogenic jumpers, and the GHRP Cap.
* Set up the flow hood again in preparation of the beam pipe removal .
1. **Remove the beam line spool, install the gauge tee**
* Unbag the gauge tee that will be installed, wipe it down with pre-soaked iso-towels then blow down the entire surface while monitoring particle counts until they read zero.
* Lay the assembly on the wire cart, flange side down onto a clean iso-towel.
* Remove all but 4 staggered nuts and washers holding the beam pipe spool to the cold valve. *DISCARD THE NUTS AND WASHERS!*
* Blow down the surface of the spool flange until the particle counts read zero.
* Remove the remaining 4 nuts and washers.
* Slide the beam pipe spool back gently using the tooling, separating it from the cold gate valve.
* Blow down the interior of the cold gate valve until the counts read zero.
* Remove the dust cover from the gauge tee and blow down.
* Install the AL-Mag seal into the cold gate valve, blow down.
* Slide the assembly over the existing studs on the CGV. **Do not to drag the studs on the through holes in the flange.** Center the assembly on the gate valve flange.
* Install the nuts and washers in the 3 and 9 o’ clock positions and snug.
* Install the remaining hardware, then Torque to 15 ft/lbs in a star pattern.
* Repeat the process at 31 ft/lbs, continue as necessary until the hardware no longer turns.
* Attach the slow pump system,
* Open the right angle valve on the gauge tee, pump down the space and leak check.
* Once the connections are verified to be leak tight, leave the turbo actively pumping on the gauge tee. The Turbo should be on the emergency power supply with a battery back up in line.
* Turn on the shipping gauges. **Wait for the readings on the first gauge to stabilize before turning on the second gauge.**
* Pump on the assembly overnight.
* When you arrive on the following day, record the pressure readings on the two shipping gauges.
* Slowly open the downstream cold gate valve making the beam line vacuum common with the gauge manifold. Wait for the readings on the two gauges to stabilize.
* Continue pumping the beam line through your shift.
* At the end of your shift, close the upstream cold gate valve and torque to 20 nm and then close the right angle valve on the gauge tee, isolating the Turbo pump from the assembly.
* Allow the pressure to stabilize overnight.
* When you arrive the next day, close the turbo isolation valve and begin backfilling the hose with filtered N2. Continually monitor the vacuum gauges during the bleed up, if the vacuum level fluctuates, **STOP! PUMP BACK DOWN!** **NOTIFY THE SUPERVISOR**.
* Remove the turbo hose from the right angle valve, cover the openings with clean blanks.
* Break down the flow hood.
* The beam line configuration is now complete.

# References

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| **Document No.** | **Title** |
| SRF-01-ML-001 | SRF Quality Manual |
| F10127865 | [CM Cavity String Rev E](https://misportal.jlab.org/jlabDocs/documents/versions/185834/download) |
| F10127864 | [Cold Mass Dwg](https://misportal.jlab.org/jlabDocs/documents/versions/184613/download) |
| F10127855 | [Cryomodule Assy dwg](https://misportal.jlab.org/jlabDocs/documents/versions/184612/download) |

# Release and Revision History

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| **Rev #** | **Major Changes** | **Effective Date:** |
| 1 | Initial version | DD Mmm YYY |
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# Approvals

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