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| **Desk Top Instruction for Dry Turbo Pump hookup prior to Removing a Cryomodule and**  **Removal/Replacement of Girder/Beam Line Component.** | | | |
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| **Document Owner:** | Gregory P Marble | **Department Owner:** | SRF Operations |

# Purpose

The purpose of this document is Instruction/Process of setting up Dry Vacuum Turbo Pump Cart for the Removal of a Cryomodule and Warm Region Girder or Beamline Component.

This procedure supports the Quality Management System as described in SRF-01-ML-001 Quality Manual.

# Scope

These instructions define the process for setting up Dry VacuumTurbo Pump Cart for the Removal of a Cryomodule/Girder or Beamline component replacement. This Procedure assumes the Cryomodule is Warm.

# Terms and Definitions

The following terms have specific meanings within this procedure.

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| **Term** | **Definition** |
| ALARA | As Low As Reasonably Achievable |
| N2 | Nitrogen |
| He | Helium |
| H2O | Hydrogen 2 Oxygen = Water |
| Isopropyl Alcohol | Solvent |
| CF | Conflat |
| VAT F-01 | Style: Beamline Valve |
| VCV | Vacuum Cold Valve (Internal Cryomodule) |
| VBV | Vacuum Beamline Valve (External Cryomodule) |
| Convectron Gauge | Pressure Gauge |
| SRS/RGA | Stanford Research System/ Residual Gas Analysis |
| Micron | Unit of Measure |
| Torr | Unit of Measure |

# Roles and Responsibilities

The following roles have responsibilities described in this document.

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| **Role** | **Responsibility** |
| Vacuum Technician | Ability to Correctly install Vacuum Pumps for the Installation or Deinstallation of Accelerator Beamline Components. |
| Sr Vacuum Technician/Coordinator | Give Job Briefing to Vacuum Technicians for Work done in the Accelerator. |
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# Procedure

## 5.1 Setup

The Initial Set-up ensures a clean delivery system for the Nitrogen/Helium Purge.

* Remove or relocate all Exterior Components, Wiring and Magnets associated with Girder that can be removed to accommodate the Installation of the Two-part Cleanroom.
* Use water and clean rags to pre-clean all of the Non-beamline Components associated with the Girder i.e. Girder Stand and Floor Area in Work Zone.
* The Two-part Cleanroom will encompass the entire Girder and Connections-points for both ends of the Cryomodule.
* Perform a preliminary wipe down of the Flange(s) that are coming apart with Isopropyl Alcohol and clean room wipes. Flush the joint area with Isopropyl Alcohol and blow down using Ionized N2 gun.
* Use large Cleanroom Nylon Bagging material to cover the entire Girder and Beamline up to Connection -points. The Nylon Bagging material will drape down to the floor and cover entire floor area out to ~ 1ft perimeter outside of the Two-part Cleanroom Floor footprint.
* The edges of the Nylon Bagging shall be taped down around Girder and Components in such a manner as to protect the “Clean” Surface/Space from being contaminated with New Dust or Dirt Particles.
* After the bagging is complete, the only exposed area shall be the area immediately around the Connection-points and at the Cryomodule Isolation Gate Valve.
* Immediately position a Two-part Cleanroom over the Girder, turn Cleanroom Fan on and let it run.
* Roll Turbo Vacuum Pump Cart to outside left of (Section 2) Work Zone and slide Vacuum Pump Manifold/Hose through pre-cut hole in (Section 2) curtain. Note: Vacuum Pump Manifold/Hose will have Nylon Bag around it during Cleaning and Set-up of (Section 2) Work Zone.
* Place Sticky Mats outside of Cleanroom entrance. Step on outside Sticky Mat then Don on Shoe Covers, and then step into (Section 1) Gowning Room and Don on Cleanroom Attire. This will include Suit, Hair- net, Facemask and Gloves.
* Wipe down (Section 1) Interior Gowning Room Curtains with Isopropyl Alcohol premoistened wipes; then continue tape in of (Section 2) Work Zone and also a wipe down of (Section 2) Interior Curtains with Isopropyl Alcohol pre-moistened wipes + add Nylon Bagging to Turbo Manifold/Hose and clean end of Hose Exterior 2 ¾” CF Flange Connection-point.
* Clean all accessible Beamline Components, Bagged Surfaces and Hand Tools (within Cleanroom) with Isopropyl Alcohol pre-moistened wipes. Then Blow-out Area with Clean Ionized N2. Wait a couple of minutes for Airborne Particles to be evacuated from the Cleanroom.
* Set-up Particle Counter inside of the (Section 2) Work Zone and turn on fan and leave running for the entire Work Process.
* Cleanroom can now Continually Run until the Work is Complete.

## Prepare to Enter Cleanroom

* Step on Sticky Mat outside of the Gowning Section of Cleanroom. Place Shoe Cove over shoe and immediately place that Leg into the Gowning Area of Cleanroom.
* Repeat for other Foot.
* Place Face mask over Face and Hairnet on Head.
* Don a pair of class 100 gloves.
* Put on Cleanroom Head-hood.
* Step into Cleanroom Suit, ensuring that the Hood is fully tucked in on the back side of the Neck.
* You are now Ready to Enter the Cleanroom Work Zone (Section 2).

## Dry Turbo/Manifold hook-up/particle counter/ Ionized N2 set up/ N2 slow purge manifold.

* Blank removal from Right Angle Ion Pump Isolation Valve shall be performed as follows:
* Set Particle Counter Nozzle under Component being disconnected.
* Remove Four Bolts leaving Two Bolts tight. Spray Bolt Holes with High Pressure N2 (bottle) though Filtered Ionizer (N2) Gun until you get ALARA < (20) .3-micron particles.
* Spray the Entire Flange again while Watching the Particle Counter until the Particle Counts are ALARA possible. Record the counts of 0.03-micron particles that was achieved before spray stopped.
* Remove the last two bolts while holding the flange in place so as to avoid any movement of the flange.
* Carefully slide the blank flange away from the valve.
* Wipe out open flange of right-angle isolation valve located on the ion pump. Purge with alcohol if necessary to help clean any visible dirt. Spray into open end of valve with ionized N2 while monitoring the back-spray with a particle counter. Again, keep spraying until the particle counts are ALARA.
* Record the 0.03-micron Particle Counts at the time the spray was stopped.
* Purge/Bleed-up Manifold shall be pre-assembled in Class 10 Cleanroom and transported in Cleanroom Bag to Work Zone. Spray off Cleanroom Bag Exterior with Ionized N2.
* Record the 0.03-micron Particle Count at the Time the Spraying was Stopped.
* Connect Purge/Bleed-up Manifold to the Open-end of the Right-angle Isolation Valve.
* Remove the Vacuum Turbo Pump Manifold/Hose 2 ¾" CF Blank and Connect the Vacuum Turbo Pump Manifold/Hose to the 2 ¾” CF Tee using the same cautions as used in the Previous Steps.
* Isolate the Manifold with the Manifold Needle Valve and the Ion Pump Isolation Valve. Pump down the Manifold with the Vacuum Turbo Pump Cart.
* Using SRS RGA Perform a Leak Check of the Manifold/Hose and Connection at the Rightangle Ion Pump Isolation Valve. Repair any leaks.
* Using SRS RGA capture an Analog Scan of the Manifold/Hose Connection Point and record the data.
* Note: If Beamline Isolation VBV’s leak through (**on** associated Cryomodule’s) or are known to leak through a decision will be made to either Open or Keep Closed VBV’s **during the Slow Bleed-up Process.**
* Close the Cryomodule Internal Cold Isolation Gate Valves on both ends (VCV1Lxx1 & VCV1Lxx8). Ensure the Warm Cryomodule (VBV1LxxA and VBV1LxxB) Isolation Valves are Closed.
* Ensure the internal cold isolation valve VCV1Lxx8 on Adjacent Cryomodule just Upstream and VCV1Lxx1 on Adjacent Cryomodule just Downstream to be Closed; and also, the most Downstream VBV1LxxB to be Open; this will allow VIP1LxxB and VIP1LxxA

to Monitor Vacuum Pressure Level of these Adjacent Cryomodule’s during the Slow Bleed-up Process.

* Slowly Open the Ion Pump Right-angle Isolation Valve, allowing the Purge/Bleed-up Manifold Pressure to Equalize with the Beamline Pressure in the Girder and Cryomodule.
* Girder Manifold is now Ready for Bleed-up.

## Slow Bleed-Up procedure

* Connect the available Cryogenic 3 Atmosphere Helium line (at Cryomodule Return Endcan spigot) to the Bleed-up Manifold and Purge up-to the Needle Valve (the other side of the Valve is under Vacuum Pressure).
* Open the Needle Valve approximately 10 microns past the “Click” while Watching the Convectron Gauge Readout. This Valve will probably not be opened at this point. Slowly

Increase the amount the Valve is Open until there is a Response on the Convectron Gauge. The Bleed-up Rate shall be less than 7.6 Torr per Minute throughout the Entire Process.

* The Needle Valve can slowly be Opened further to Allow the Bleed-up Process to Move Along while staying under the Maximum Rate of 7.6 Torr per Minute.
* Shortly after the Convectron Gauge reaches 760 Torr, the Relief Valve will Pop-off and the Helium will be flowing through and out of Pop-off Valve.
* The Girder is Ready for Disconnecting at this point.

## Disconnecting the Girder

* Remove the ¼-28 Nuts from 4 of the ¼-28 Studs leaving Two 1/4-28 Nuts on the Sides of the 2 ¾” CF Flange tight) located at the Connection between the Girder bellow CF and the Cryomodule Isolation Valve (VBV).
* Spray the Entire 2 ¾” CF Flange Area around the Exposed ¼-28 Studs with Ionized N2 gun; Watching the Particle Counter and waiting until the 0.03-micron Particle Counts are ALARA. Record the 0.03-micron Particles that was Achieved just before Ionized N2 Spraying Stopped.
* Prepare the 2 ¾"CF Blank Flanges (2 ¾" Blank Flanges should be pre-cleaned and bagged) that will be placed on the VAT F-01 Valve and 2 ¾" CF of Bellow. This includes Blowing these Parts Down with Ionized N2 until the 0.03- micron Particle Counts are ALARA.
* Remove the Last Two ¼-28 Nuts while Holding the 2 ¾” Bellows CF Flange to keep it from moving.
* Slowly and carefully remove the 2 ¾" Flange off of the ¼-28 Studs. Place a 2 ¾" CF Blank on the 2 ¾" Bellow Flange.
* Repeat these Steps to the Girder Connection other end.
* Once Complete leave Girder at Static He/N2; Valve out Equipment, Remove Equipment, Remove Cleanroom to allow for Removal of Girder Beamline and Relocate to Test Lab.
* Move to 2nd Girder and Perform same Process.
* **Note: Radiation Survey must be done before Girder Beamline can be removed from Accelerator Tunnel.**
* Girder removal complete, SRF Cryomodule removal process can start.

## Equipment needed

* 2 Technician’s
* Rags, Bucket, H2O
* Portable 2 Room Cleanroom = 1 Gowning Area and 1 Work Area
* Cleanroom Lg. Nylon Bagging Material
* Tape
* Cleanroom (Full) Attire = Suit, Hair net and Hood, Face Mask, Gloves, Shoe Covers
* Cleanroom Pre-moistened Isopropyl Wipes
* Tacky Mat
* Sm. Rollaround Wire Rack Cart
* High Pressure N2 Bottle
* N2 Ionizer Spray Gun
* Solair 3100E Particle Counter
* Slow Bleed/Pumpdown Manifold
* Dry Vacuum Pump Cart w/RGA
* Fluorescent Lighting
* Clean 2 ¾” CF Blanks
* Clean 2 ¾” CF Gaskets
* Clean 2 ¾” CF Hardware
* Misc Tools: Scissor, Driver’s, Particle Collection Tools if needed.

# Release and Revision History

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| **Rev #** | **Major Changes** | **Approval Date:** |
| 1 | Initial version | 26 Jul 2024 |
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# Approvals

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