

8.4.6 Rotating Instrument Vertically For Main Bench Removal

1. Description

This section describes the procedures to rotate the instrument to the vertical orientation in preparation of removing the main optical bench from the external dewar structure (bulkhead). Prior to rotating instrument, handling fixtures are attached. This procedure must be conducted in a Class 10,000 clean room environment.

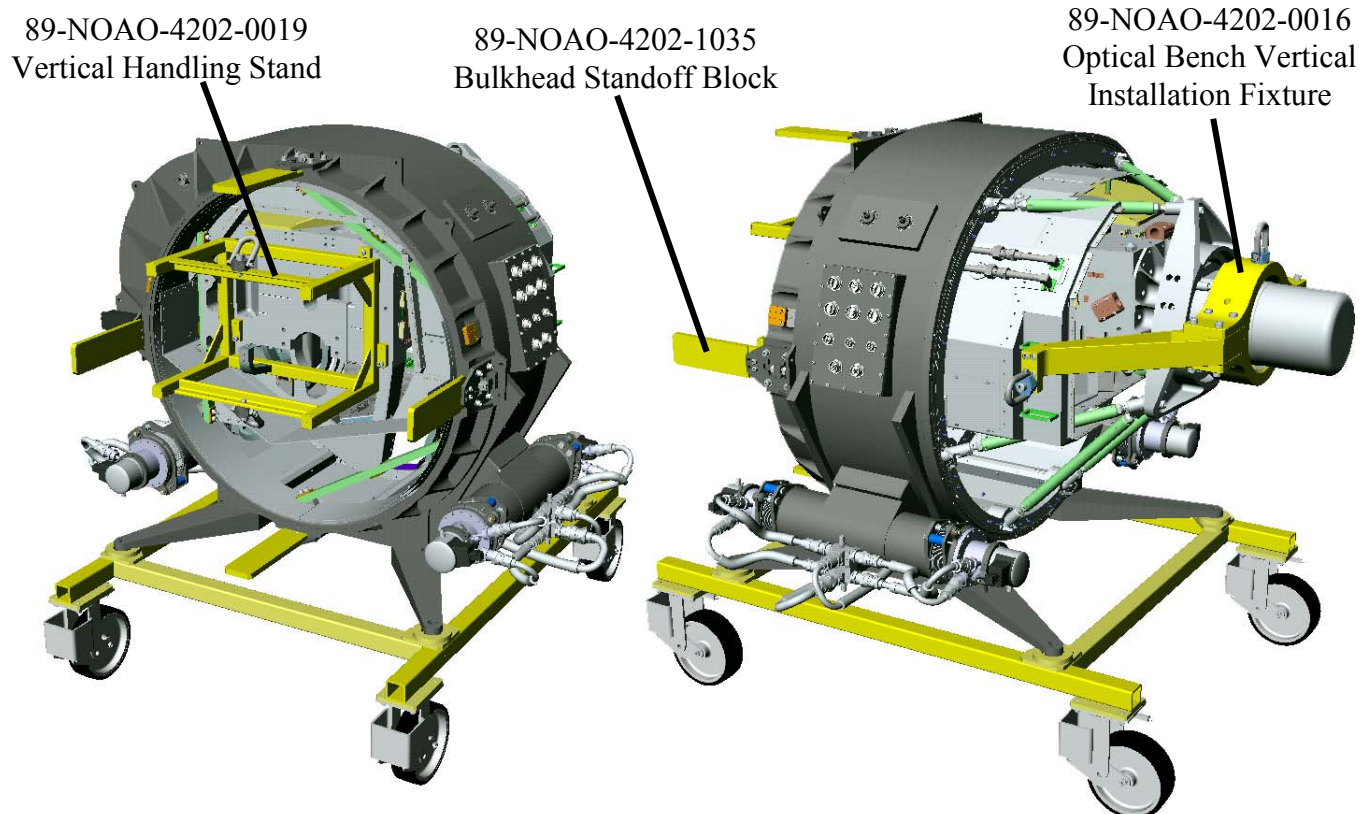


Figure 8.4.6.1. Install Handling Fixtures.

2. Nomenclature

89-NOAO-4202-0016	Optical Bench Vertical Installation Fixture
89-NOAO-4202-0019	Vertical Handling Stand
89-NOAO-4202-1035	Bulkhead Standoff Block

3. Safety Precautions

Fragile optical components: Use extreme caution when handling components.

Clean room environment: Use gloves when handling components. Observe guidelines for clean room attire and conduct.

4. Special Tools / Fixtures

89-NOAO-4202-0016	Optical Bench Vertical Installation Fixture
89-NOAO-4202-0019	Vertical Handling Stand
89-NOAO-4202-1035	Bulkhead Standoff Block
2 Cranes	

Lifting Straps



Figure 8.4.6.2. Lift Instrument from Handling Cart.

5. Personnel Recommended/Required To Complete Task

The required number of personnel to complete this task is 2. The recommended number is 2.

6. Procedures

- A. Remove R307, R308 resistors, and TD30 temperature sensor from aft section of optical bench.
- B. Attach 89-NOAO-4202-0016 Optical Bench Vertical Installation Fixture to aft section of optical bench. Ensure that fixture is oriented as shown in Figure 8.4.6.1.
- C. Attach 89-NOAO-4202-1035 Bulkhead Standoff Block (Qty – 4) to Bulkhead.
- D. Attach 89-NOAO-4202-0019 Vertical Handling Stand to front face of Optical Bench.
- E. Lift instrument off of handling cart using straps and crane at lift points on handling fixtures (See Figure 8.4.6.2).
- F. Lower forward end of instrument while raising aft end to rotate instrument until forward strap becomes slack (See Figure 8.4.6.3).

- G. Remove slack strap on forward end and attach to opposite side of aft end on 89-NOAO-4202-0016 Optical Bench Vertical Installation Fixture. Lift that strap until instrument is oriented vertically.
- H. Lower instrument until it rests on floor.
- I. Remove straps.

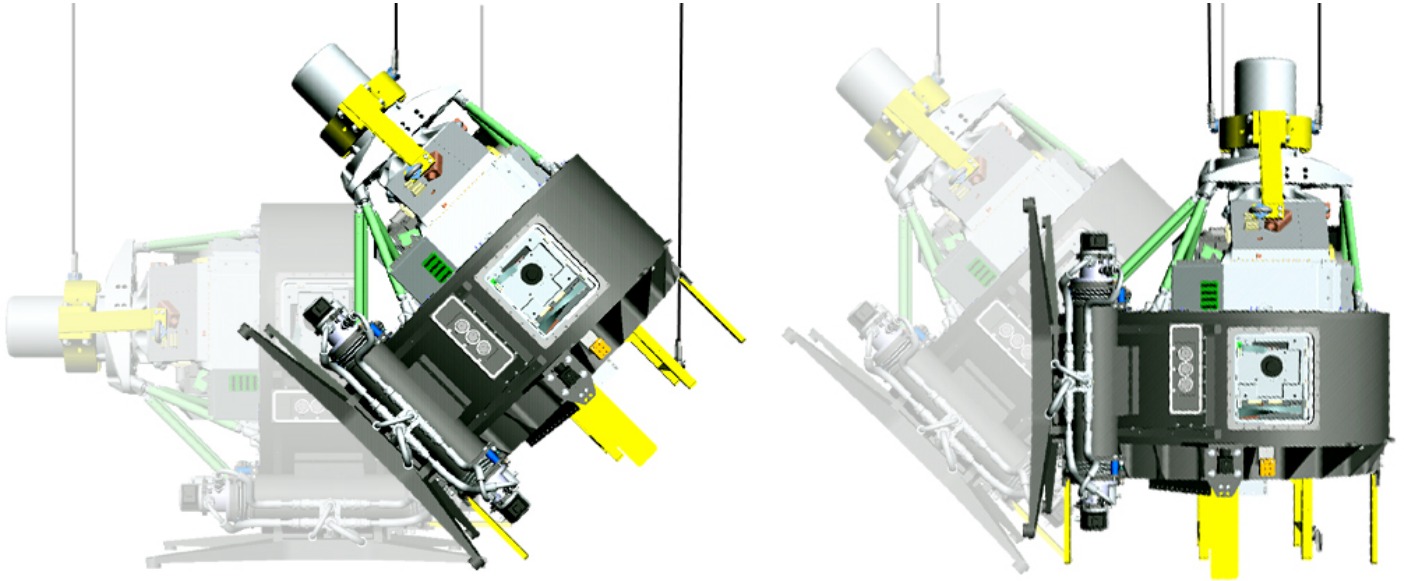


Figure 8.4.6.3. Rotate instrument to vertical position: Lower forward end while raising aft end until forward strap becomes slack. Remove strap on forward end and attach to opposite side of 89-NOAO-4202-0016 Optical Bench Vertical Installation Fixture. Continue rotating instrument until vertical. Lower instrument until it rests on floor.

7. **Special Reassembly Procedures**

- A. Follow removal procedures in reverse order.

8. **Summary**

This section outlined the procedures to remove the Main Bench from the instrument. This procedure is conducted in a Class 10,000 clean room.

This task completes the instrument structure removal procedures. After completion of this task, proceed to Section 8.4.7 to continue with mechanism removal procedures.

8.4.7 Cryogenic Cooler Module Removal

1. Description

This section describes the procedures to remove the port and starboard cryogenic cooler modules from the external dewar structure (bulkhead). This procedure must be conducted in a Class 10,000 clean room environment.

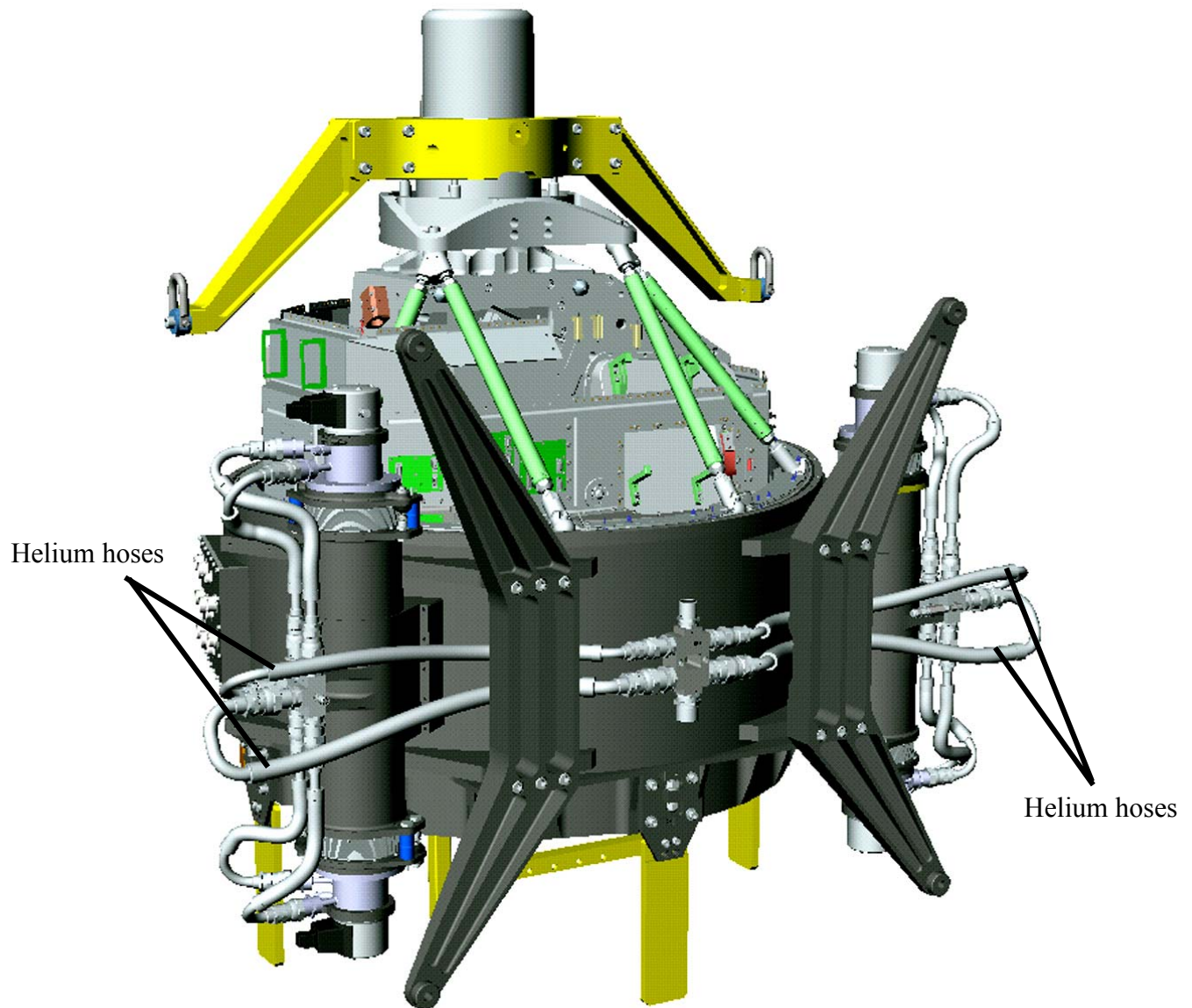


Figure 8.4.7.1. Remove cryogenic cooler helium hoses.

2. Nomenclature

89-NOAO-4200-0012	Port Cryogenic Cooler Module Assembly
89-NOAO-4200-0019	Starboard Cryogenic Cooler Module Assembly

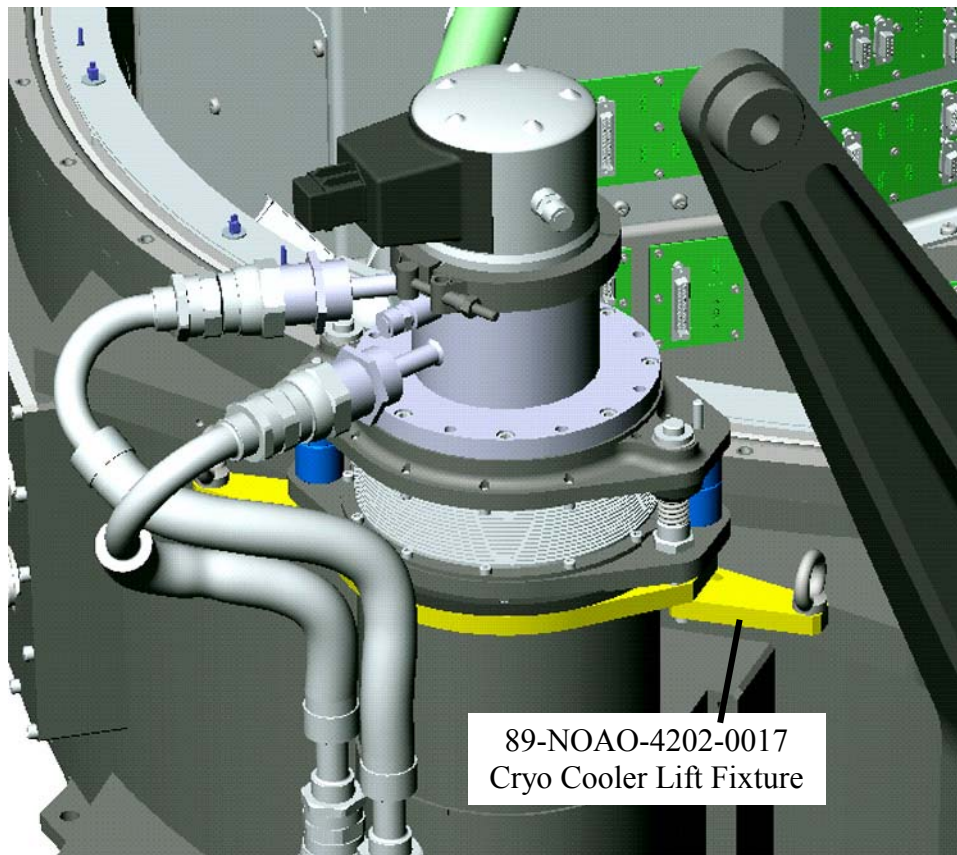


Figure 8.4.7.2. Install 89-NOAO-4202-0017 Cryo Cooler Lift Fixture.

3. Safety Precautions

Clean room environment: Use gloves when handling components. Observe guidelines for clean room attire and conduct.

4. Special Tools / Fixtures

89-NOAO-4202-0017 Cryo Cooler Lift Fixture
 Crane
 Lifting Strap
 Cryo Cooler Port Cover Plate (port and starboard)

5. Personnel Recommended/Required To Complete Task

The required number of personnel to complete this task is 2.

6. Procedures

- A. Remove 4 Cryo Cooler helium lines. Use Isopropyl Alcohol to lubricate threads on Helium connectors when removing Helium lines.
- B. Install protective covers to Helium line connectors.
- C. Attach 89-NOAO-4202-0017 Cryo Cooler Lift Fixture to Cryogenic Cooler Module Assembly.
- D. Attach straps to lift fixture and crane.
- E. Lift crane until sufficient preload on straps to support weight of component is achieved.
- F. Remove fasteners that attach Cryogenic Cooler Module Assembly to bulkhead.

- G. Pull Cryogenic Cooler Module Assembly away from Bulkhead to access temperature sensor wiring.
- H. Disconnect TD52, TD53, & TD54 Starboard side temperature sensor connectors.
- I. Disconnect TD55, & TD56 Port side temperature sensor connectors.
- J. Remove fasteners that attach Cryogenic Cooler Module Assembly to cold strap lug.
- K. Remove Cryogenic Cooler Module Assembly.
- L. Install the Cryo Cooler Port Cover Plate to protect the o-ring surface.

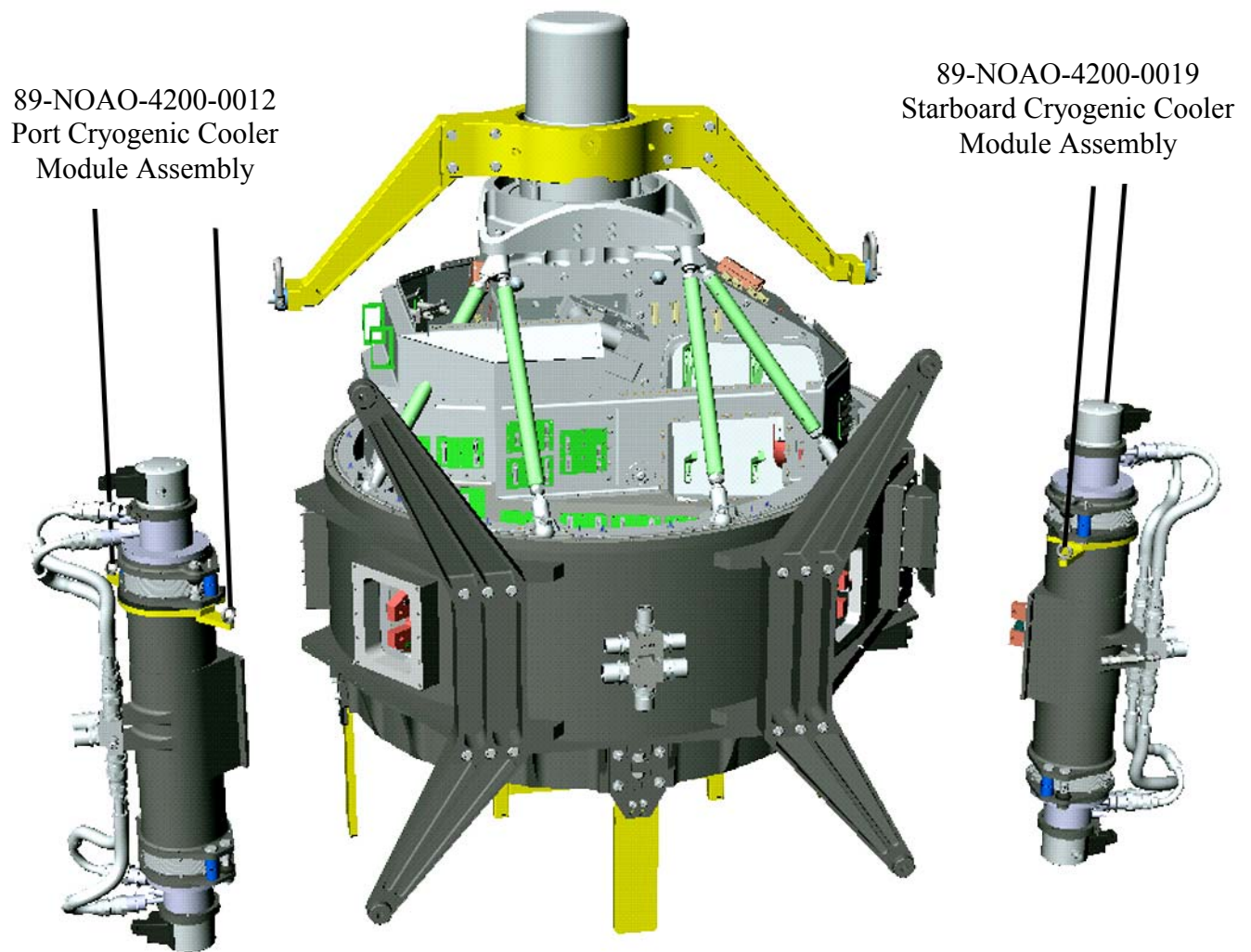


Figure 8.4.7.3. Remove Cryogenic Cooler Module.

7. **Special Reassembly Procedures**

Follow removal procedures in reverse order.

Use Isopropyl Alcohol to lubricate threads on Helium connectors when installing Helium lines.

8. **Summary**

This section outlined the procedures to remove the cryogenic cooler modules from the dewar. This procedure is conducted in a Class 10,000 clean room.

This task completes the instrument structure removal procedures. After completion of this task, proceed to Section 8.4.8 to continue with mechanism removal procedures.

8.4.8 Main Bench Removal

1. Description

This section describes the procedures to remove the main bench from the external dewar structure (bulkhead). This procedure must be conducted in a Class 10,000 clean room environment.

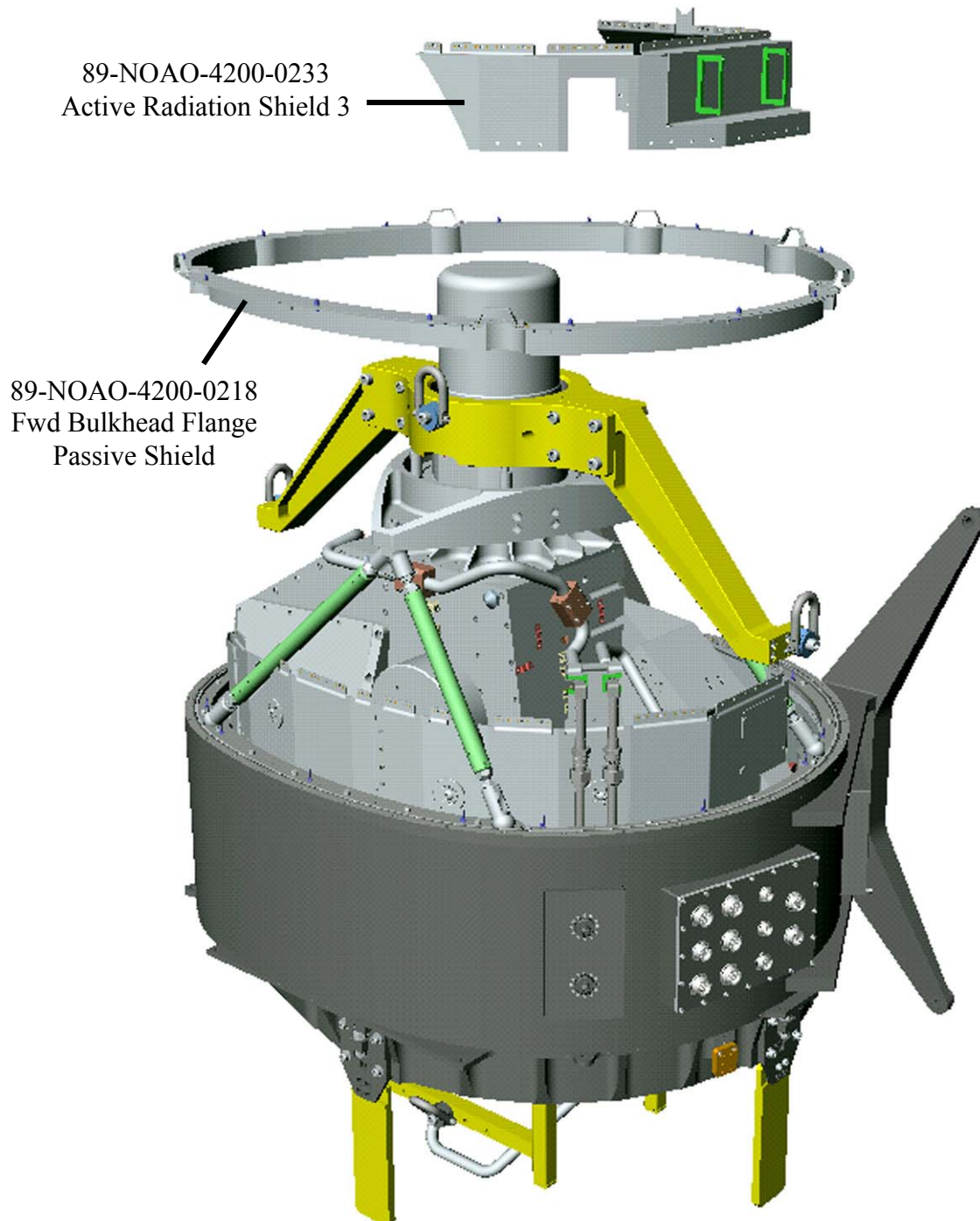


Figure 8.4.8.1. Remove Passive Shield assemblies and loosen LN2 pre-cool hose connectors.

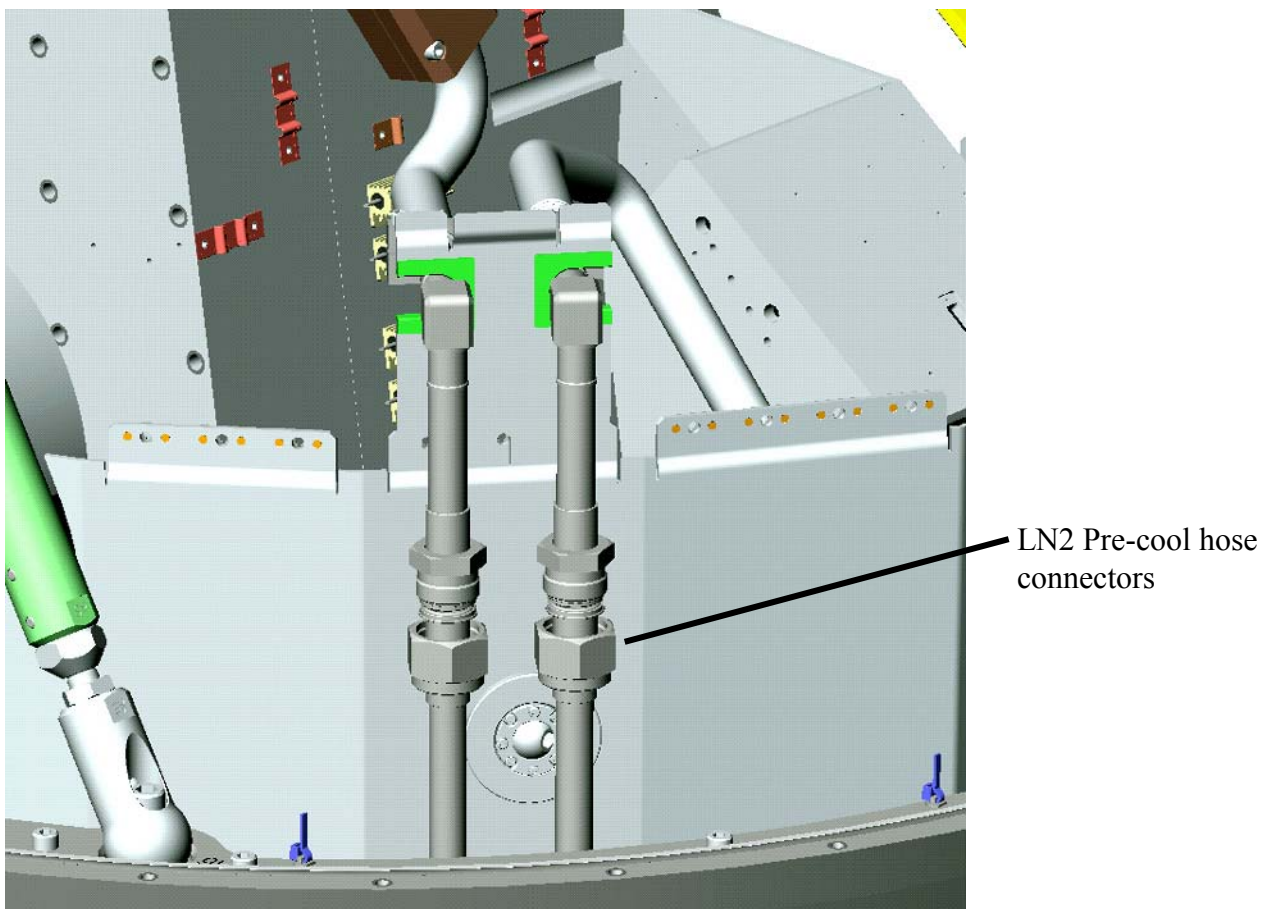


Figure 8.4.8.2. Disconnect LN₂ pre-cool hose connectors.

2. **Nomenclature**

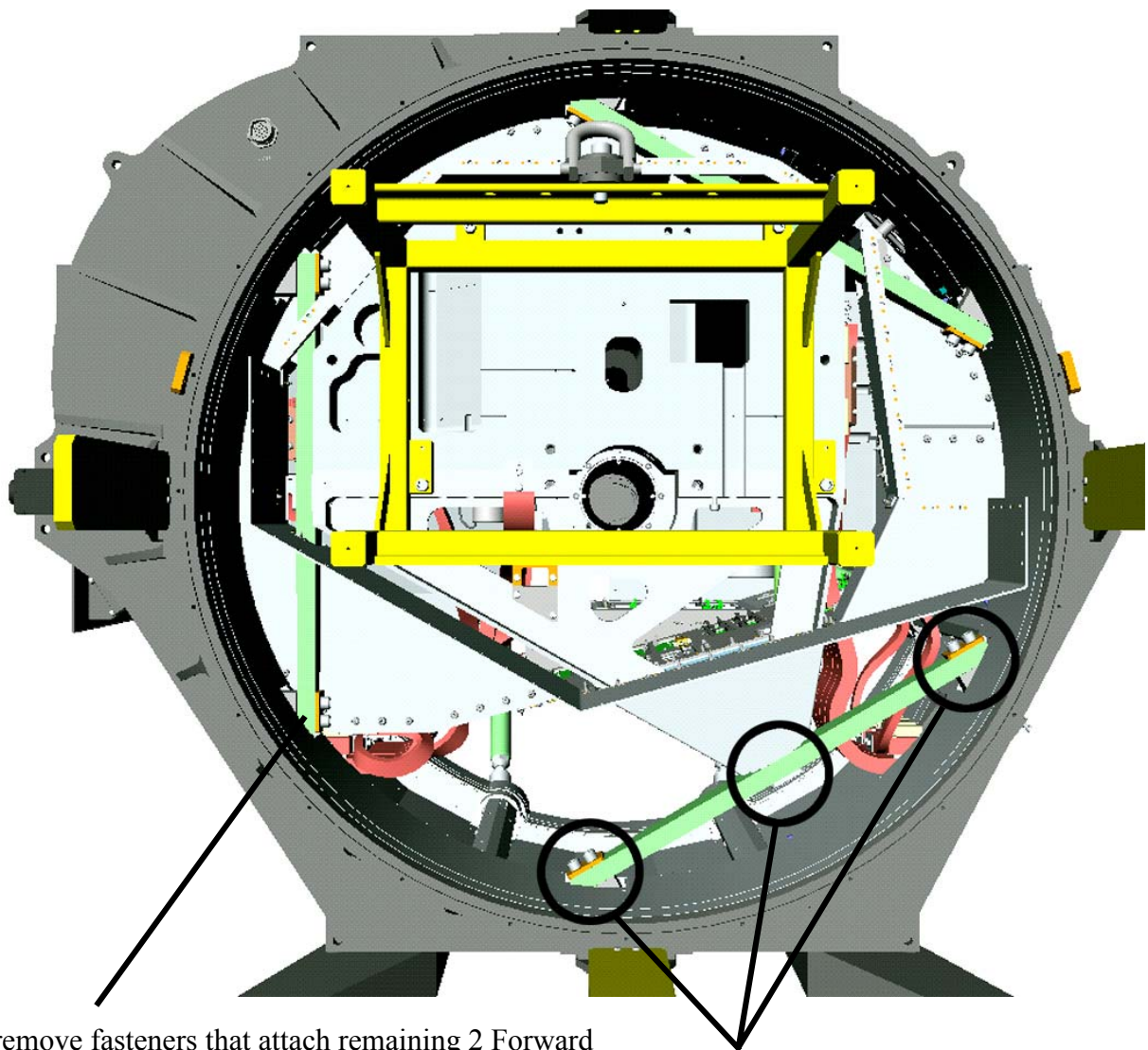
89-NOAO-4200-0016	Main Optical Bench Assembly
89-NOAO-4200-0020	Forward Bulkhead Assembly
89-NOAO-4200-0150	Aft Bench Truss Assembly 1
89-NOAO-4200-0151	Aft Bench Truss Assembly 2
89-NOAO-4200-0152	Aft Bench Truss Assembly 3
89-NOAO-4200-0218	Fwd Bulkhead Flange Passive Shield Assembly
89-NOAO-4200-0233	Active Radiation Shield Assembly 3
89-NOAO-4200-1195	Forward Tangent Bar

3. **Safety Precautions**

Clean room environment: Use gloves when handling components. Observe guidelines for clean room attire and conduct.

4. **Special Tools / Fixtures**

Crane
Lifting Strap
89-NOAO-4202-0053 OIWFS Detector Bench Connector Grounding Assembly
89-NOAO-4202-1128 LN₂ Pre-Cool Fitting Go/No-Go Gauge



Next remove fasteners that attach remaining 2 Forward Tangent Bars to Bulkhead but leave Tangent Bars attached to bench.

First remove fasteners and 89-NOAO-4200-1195 Forward Tangent Bar

Figure 8.4.8.3. View looking up from below. First remove (1) 89-NOAO-4200-1195 Forward Tangent Bar. Next remove fasteners that attach remaining 2 Forward Tangent Bars to Bulkhead but leave Tangent Bars attached to bench.

5. Personnel Recommended/Required To Complete Task

The required number of personnel to complete this task is 2.

6. Procedures

- A. Ensure that the Bulkhead is properly grounded.
- B. Attach lift straps to 89-NOAO-4202-0016 Optical Bench Vertical Installation Fixture and slightly preload straps with crane.
- C. Remove (6) 89-NOAO-4200-1743 Fwd Bulkhead Flange Passive Shield Internal Brackets on 89-NOAO-4200-0218 Bulkhead Flange Passive Shield Assembly.
- D. Cut zip ties and remove 6 Bulkhead Flange Passive Shields. Note: Do not cut ties that hold shields together.
- E. Unplug J740 connector on OIWFS and install 89-NOAO-4202-0053 OIWFS Detector Bench Connector Grounding Assembly. Attach the alligator clip to the grounding Lug on the OIWFS bench.
- F. Disconnect the J714, J715, J716, and J717 outer cold station connectors. Unscrew and move the detector access port active split shield halves together to gain access to these connectors if necessary.
- G. Disconnect the J718, J719, J730, J731, J740, J741, J742, J743, J744, J760, J761, and J762 outer cold station connectors..
- H. Loosen 4 G-10 wire clamps on 89-NOAO-4200-0233 Active Radiation Shield 3 and remove all wire harnesses.
- I. Cover wire harness ends with a plastic bag and close bag with a wire tie. Drape bag over bulkhead near connector panel to get wire harness ends out of the way.
- J. Disconnect heater wire connectors for thermal distribution lugs from the J718 cold station..
- K. Remove thermal distribution bus bars from cold straps.
- L. Bunch together the ends of cold straps on port and starboard sides using wire and pull port and starboard sides together and secure with wire.
- M. Remove 89-NOAO-4200-0233 Active Radiation Shield 3.
- N. Disconnect LN₂ pre-cool connectors and discard copper compression disks between connectors. Install blue protective caps over connectors.
- O. At re-assembly, wipe mating surfaces of connector with methanol or ethanol (do not use isopropyl alcohol). Visually inspect seal surfaces for scratches or other damage. If damaged, surfaces must be repaired to insure vacuum integrity. Install new copper compression disks.
- P. Remove 89-NOAO-4200-0305 LN₂ Pre-cool Hose Feed-Thru Shield.
- Q. Remove temperature sensor wires on 89-NOAO-4200-1195 Forward Tangent Bar.
- R. Remove (1) 89-NOAO-4200-1195 Forward Tangent Bar.
- S. Remove fasteners that attach remaining 2 Forward Tangent Bars to Bulkhead but leave Tangent Bar attached to 89-NOAO-4200-0016 Main Optical Bench.
- T. Remove fasteners that attach the 3 Aft Bench Truss Assemblies.
- U. Using crane, carefully lift Main Optical Bench out of 89-NOAO-4200-0020 Forward Bulkhead using caution not to damage components. Remove Aft Bench Trusses when they become free from the bench and bulkhead.
- V. When Main Optical Bench is removed from Forward Bulkhead, lower bench onto floor. If crane does not lift high enough to clear 89-NOAO-4202-0019 Vertical Handling Stand when

lifting optical bench out of bulkhead, first loosen captive screws on Vertical Handling Stand so that Vertical Handling Stand remains on floor when bench is lifted out.

7. Special Reassembly Procedures

- A. Follow removal procedures in reverse order.
- B. Use new copper compression disks on LN₂ Pre-Cool Fittings.
- C. Tighten fittings until 89-NOAO-4202-1128 LN₂ Pre-Cool Fitting Go/No-Go Gauge indicates GO by sliding gauge between fitting nuts.

8. Summary

This section outlined the procedures to remove the main bench from the dewar. This procedure is conducted in a Class 10,000 clean room.

This task completes the instrument structure removal procedures. After completion of this task, proceed to Section 8.4.9 to continue with mechanism removal procedures.

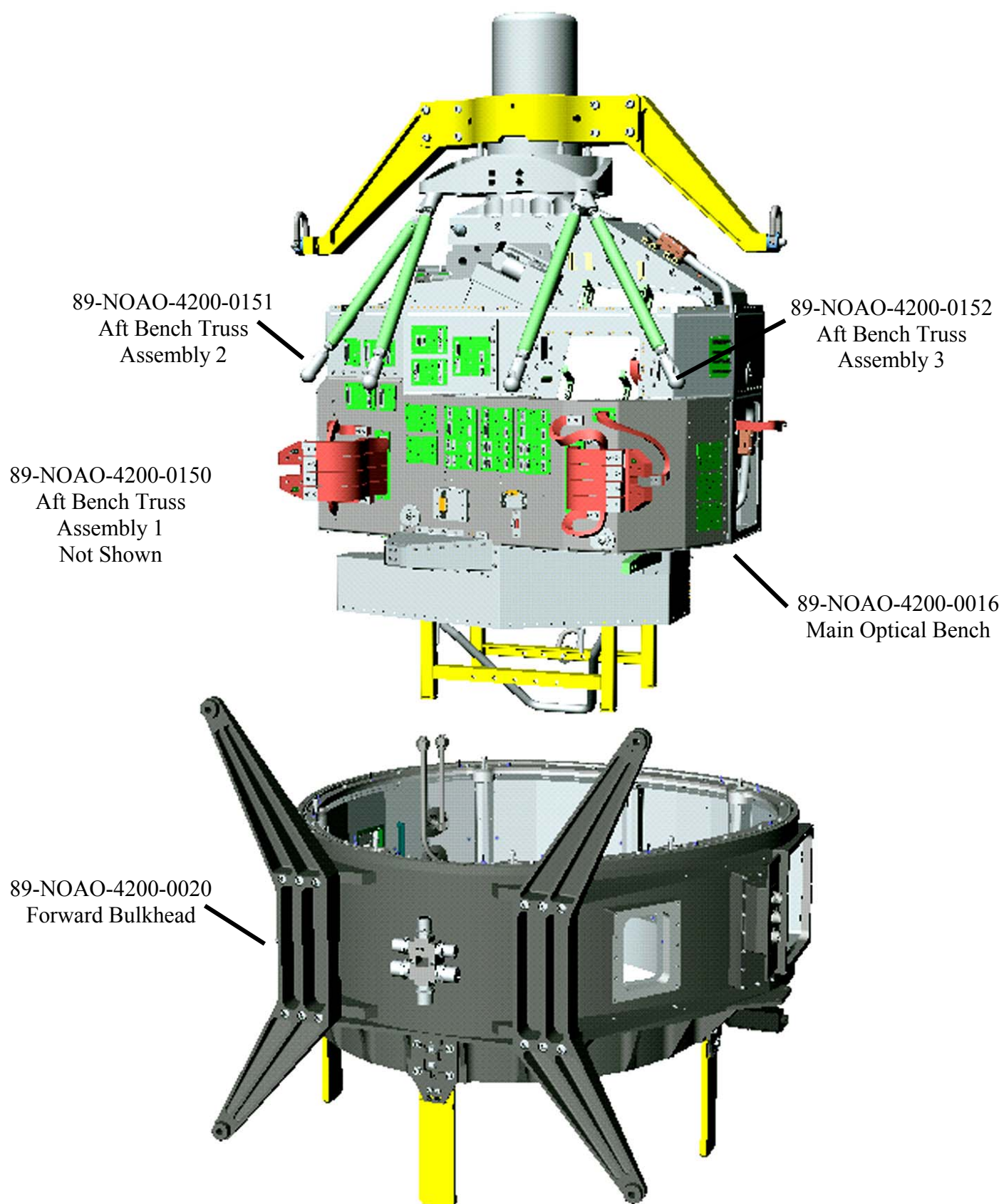


Figure 8.4.8.4. Remove Aft Bench Truss Rods and lift Main Bench from Bulkhead.

8.4.9 Main Bench Active Shield Removal

1. Description

This section describes the procedures to remove the active shields from the Main Optical Bench. This procedure must be conducted in a Class 10,000 clean room environment.

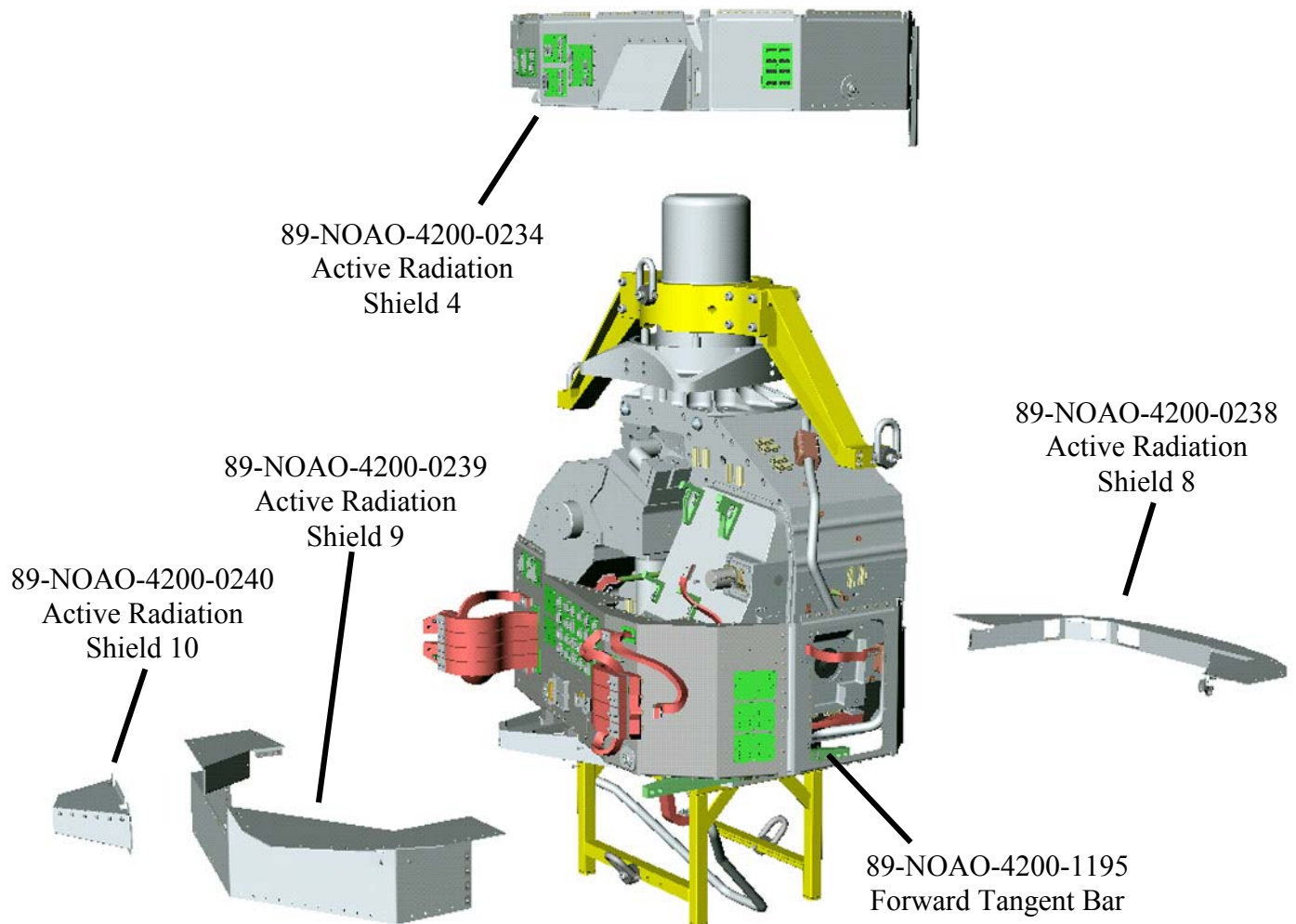


Figure 8.4.9.1. Remove Active Shields and Tangent Bars (2).

2. Nomenclature

89-NOAO-4200-0234	Active Radiation Shield 4 Assembly
89-NOAO-4200-0235	Active Radiation Shield 5 Assembly
89-NOAO-4200-0236	Active Radiation Shield 6 Assembly
89-NOAO-4200-0238	Active Radiation Shield 8 Assembly
89-NOAO-4200-0239	Active Radiation Shield 9 Assembly
89-NOAO-4200-0240	Active Radiation Shield 40 Assembly
89-NOAO-4200-0124	Port Cryo Cooler Cold Strap Assembly
89-NOAO-4200-0172	Starboard Cryo Cooler Cold Strap Assembly

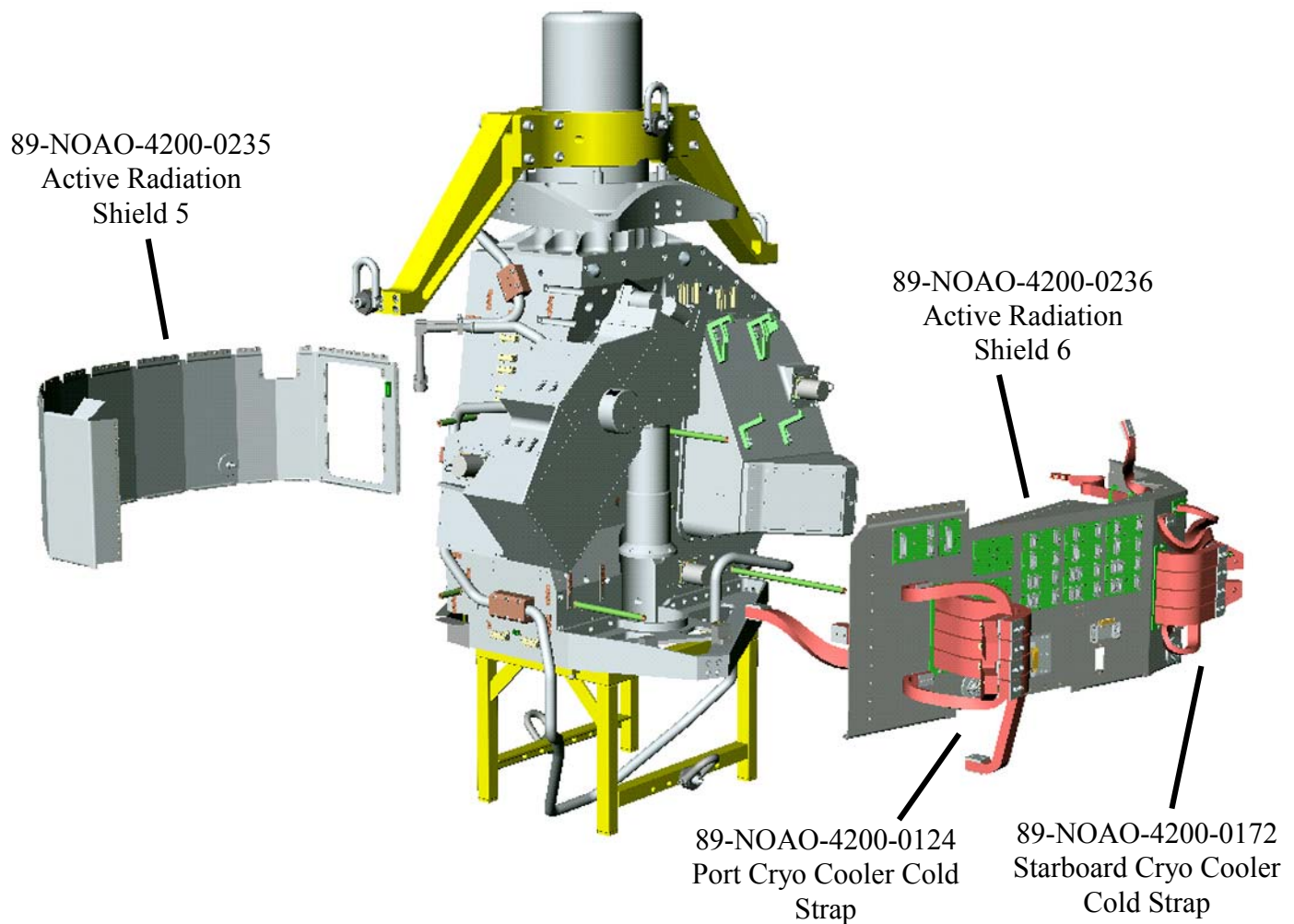


Figure 8.4.9.2. Remove Active Shields and Cold Straps

3. Safety Precautions

Clean room environment: Use gloves when handling components. Observe guidelines for clean room attire and conduct.

4. Special Tools / Fixtures

Crane
Lifting Strap

5. Personnel Recommended/Required To Complete Task

The required number of personnel to complete this task is 1.

6. Procedures

- A. Keep a slight preload on lifting straps during shield removal.
- B. Remove remaining (2) 89-NOAO-4200-1195 Forward Tangent Bars.
- C. Remove 89-NOAO-4200-0238 Active Radiation Shield 8 Assembly.

- D. Remove 89-NOAO-4200-0239 Active Radiation Shield 9 Assembly.
- E. Remove 89-NOAO-4200-0240 Active Radiation Shield 10 Assembly.
- F. Remove 89-NOAO-4200-0124 Port Cryo Cooler Cold Straps and 89-NOAO-4200-0172 Starboard Cryo Cooler Cold Straps and feed them through openings on 89-NOAO-4200-0236 Active Radiation Shield 6 Assembly.
- G. Remove the Grating Turret, Acquisition Mirror, and Slit Motor Cold Straps from 89-NOAO-4200-0235 Active Radiation Shield 5 Assembly.
- H. Remove 89-NOAO-4200-0235 Active Radiation Shield 5 Assembly. Note: First loosen ball mount plates and unscrew balls to remove shield.
- I. Disconnect all cold station connectors from the inside of the J741, J742, J743, and J744 cold stations on the 89-NOAO-4200-0234 Active Radiation Shield 4 Assembly.
- J. Remove 89-NOAO-4200-0234 Active Radiation Shield 4 Assembly.
- K. Remove the Prism Turret Motor Cold Strap from 89-NOAO-4200-0236 Active Radiation Shield 6 Assembly.
- L. Disconnect all cold station connectors from the inside of the J714, J715, J716, J717, J719, J730, J731, J760, J761, and J762 cold stations on the 89-NOAO-4200-0236 Active Radiation Shield 6 Assembly.
- M. Remove 89-NOAO-4200-0236 Active Radiation Shield 6 Assembly.
- N. Remove the J714, J715, and J716 Preamp bulkhead connector feed thru panel from the Forward Bulkhead and install 89-NOAO-4202-0033 Preamp Connector Access Fixture Assembly onto the Forward Bulkhead.
- O. Remove Active Shield Standoffs (11).

7. **Special Reassembly Procedures**

- A. Follow removal procedures in reverse order.
- B. Once Active shields are installed check and adjust active shield alignment at engraved measurement locations on the active shields.
- C. Ensure that the Active shields do not thermally short to the main Optical Bench.

8. **Summary**

This section outlined the procedures to remove the active shields from the main bench. This procedure is conducted in a Class 10,000 clean room.

This task completes the instrument structure removal procedures. After completion of this task, proceed to Section 8.4.10 to continue with mechanism removal procedures.

8.4.10 Mounting Main Bench on Handling Cart

1. Description

This section describes the procedures to mount the main bench onto the handling cart. The main bench can be mounted onto the handling cart in either of two orientations depending on what components are to be accessed. The two orientations will be referred to as orientation “A” and “B”. Some components can be accessed/removed with the main bench in either orientation on the cart but others can only be accessed/removed when the main bench is mounted onto the cart in a specific orientation and are listed below.

Orientation “A” will enable access to the following components:

89-NOAO-4200-0030	On Instrument Wave Front Sensor Bench Assembly
89-NOAO-4200-0093	Long Camera Fold Mirror Mount Assembly

Orientation “B” will enable access to the following components:

89-NOAO-4200-0038	Camera Turret Assembly
89-NOAO-4200-0033	Prism Turret Assembly
89-NOAO-4200-0034	Grating Turret Assembly
89-NOAO-4200-0036	Acquisition Mirror Assembly

All other components can be accessed/removed with the main bench in either orientation. This procedure must be conducted in a Class 10,000 clean room environment.

2. Nomenclature

89-NOAO-4202-0006	Optical Bench Handling Cart
89-NOAO-4202-0016	Optical Bench Vertical Installation Fixture
89-NOAO-4202-0019	Vertical Handling Stand

3. Safety Precautions

Clean room environment: Use gloves when handling components. Observe guidelines for clean room attire and conduct.

Heavy components: Do not attempt to lift components manually. Use proper lifting equipment.

Item	Weight
Main Optical Bench Assembly	~1380 Lbs (625 Kg)

4. Special Tools / Fixtures

Crane
Lifting Strap

5. Personnel Recommended/Required To Complete Task

The required number of personnel to complete this task is 2.

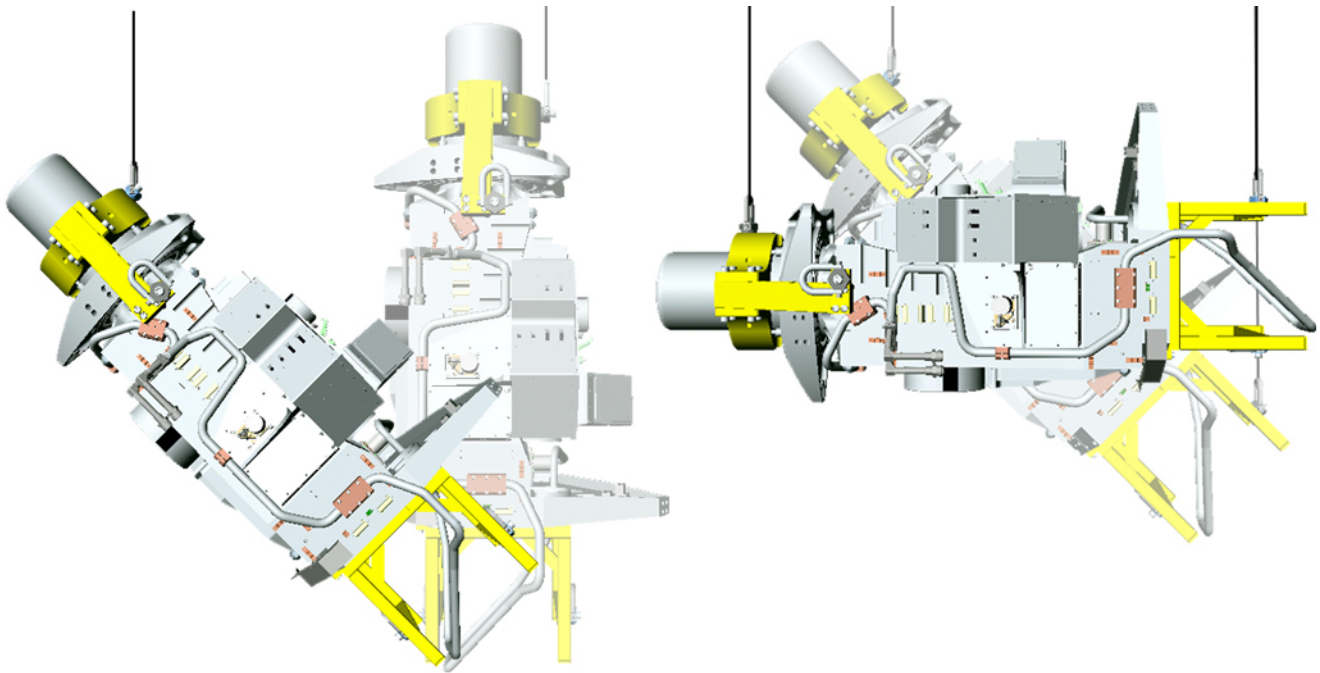


Figure 8.4.10.1. Rotating Main Optical Bench to horizontal orientation “A”. (Left) Attach (1) Strap to 89-NOAO-4202-0016 Optical Bench Vertical Installation Fixture and lift until Optical Bench begins to rotate. (Right) Attach second strap to 89-NOAO-4202-0019 Vertical Handling Stand and lift until Optical Bench is horizontal.

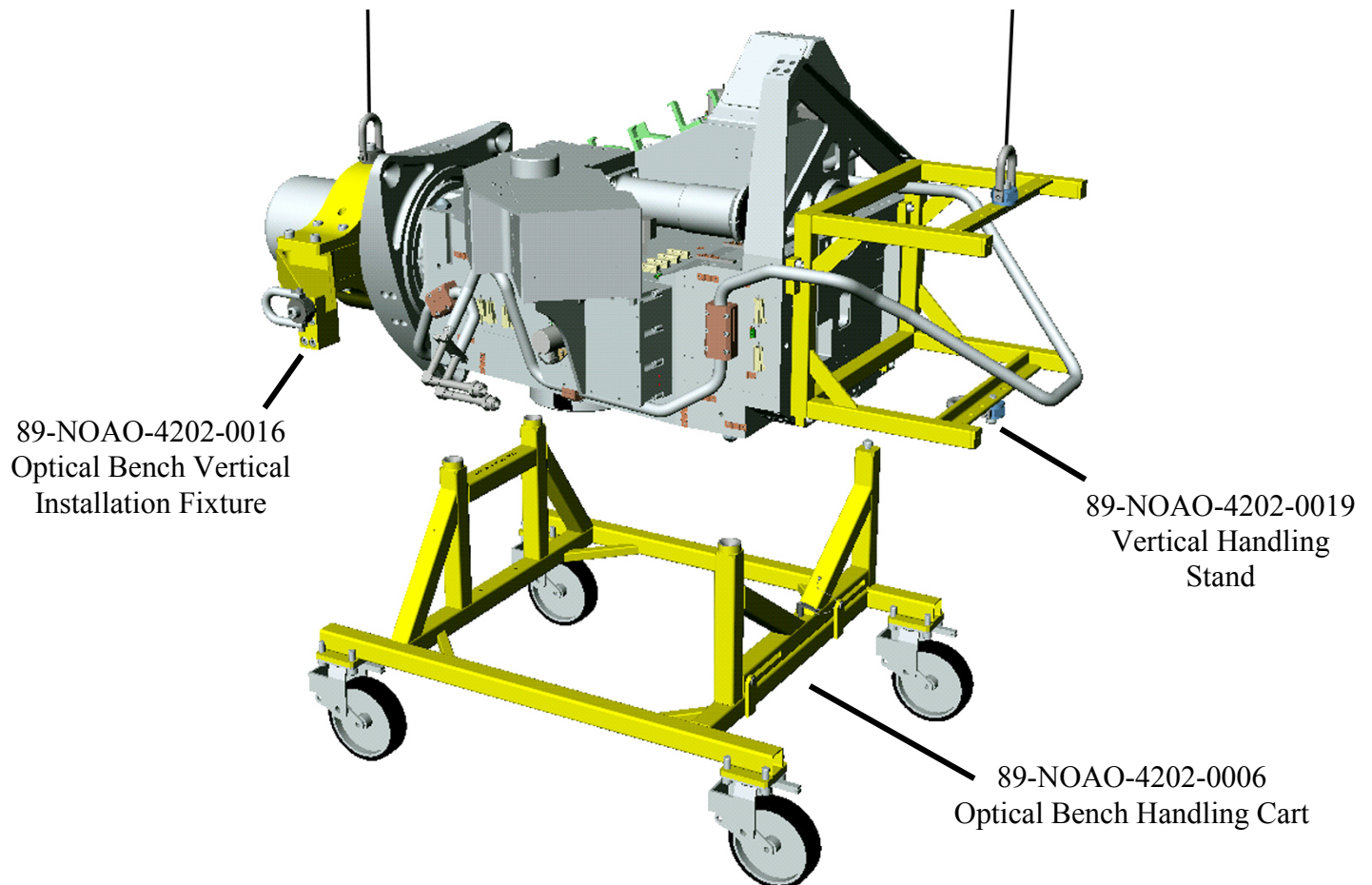


Figure 8.4.10.2. Horizontal orientation “A”. After rotating Main Optical Bench, lower onto 89-NOAO-4202-0006 Optical Bench Handling Cart.
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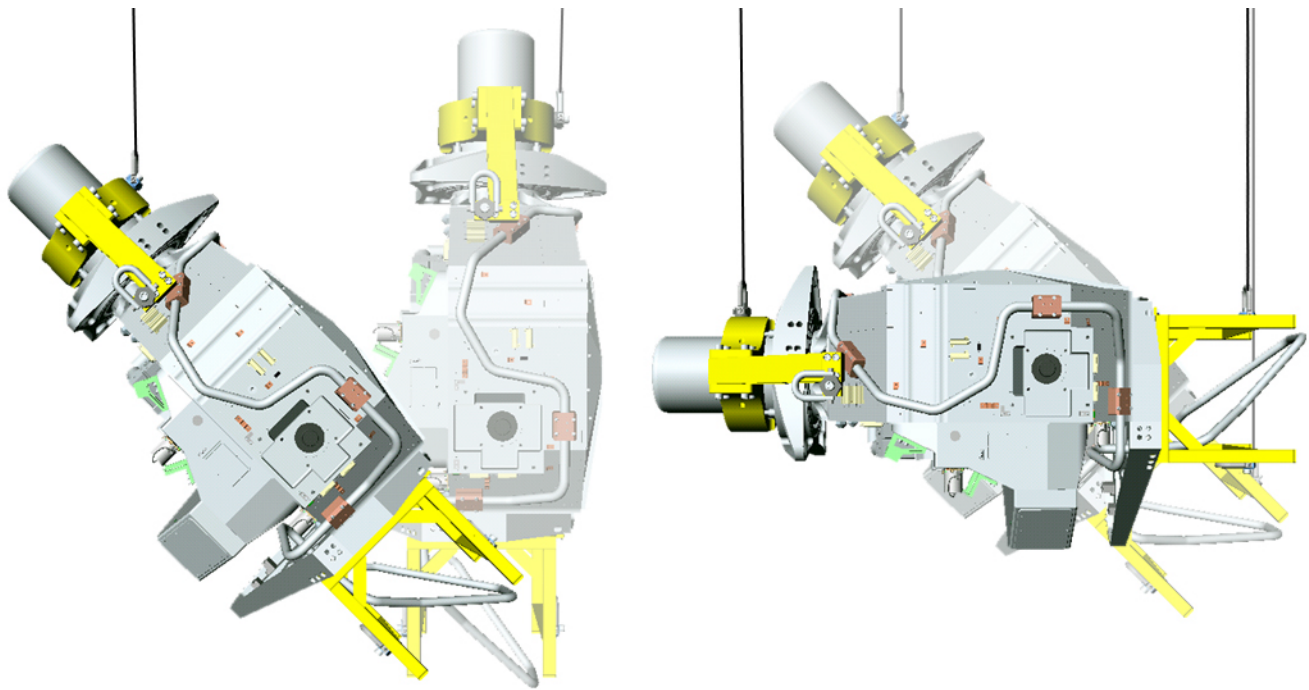


Figure 8.4.10.3. Rotating Main Optical Bench to horizontal orientation “B”. (Left) Attach (1) Strap to 89-NOAO-4202-0016 Optical Bench Vertical Installation Fixture and lift until Optical Bench begins to rotate. (Right) Attach second strap to 89-NOAO-4202-0019 Vertical Handling Stand and lift until Optical Bench is horizontal.

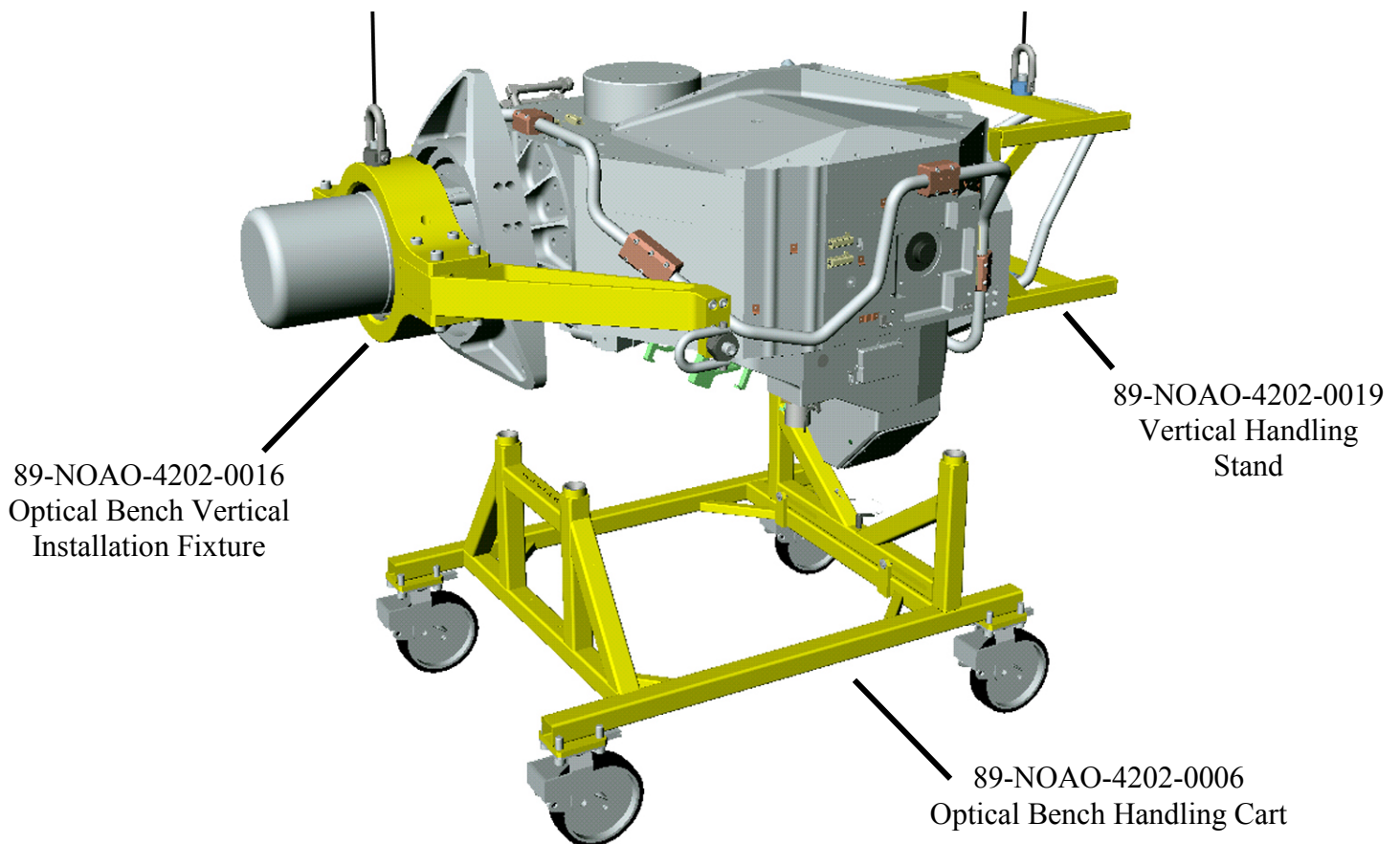


Figure 8.4.10.4. . Horizontal orientation “B”. After rotating Main Optical Bench, lower onto 89-NOAO-4202-0006 Optical Bench Handling Cart.

6. Procedures

- A. First determine which components are to be accessed/removed. Refer to description section above (8.4.10.1) to determine which orientation to rotate main optical bench.
- B. If orientation “A” is selected, refer to figures 8.4.10.1 and 8.4.10.2.
- C. If orientation “B” is selected, refer to figures 8.4.10.3 and 8.4.10.4.
- D. Attach (1) Strap to 89-NOAO-4202-0016 Optical Bench Vertical Installation Fixture and lift until Main Optical Bench begins to rotate.
- E. Attach second strap to 89-NOAO-4202-0019 Vertical Handling Stand and lift until Main Optical Bench is horizontal.
- F. Lower Main Optical Bench onto 89-NOAO-4202-0006 Optical Bench Handling Cart. Note: It may be necessary to slide adjustable frame on 89-NOAO-4202-0006 Optical Bench Handling Cart to align mounting hard points on optical bench with corresponding hard points on cart.
- G. Remove straps.
- H. Remove 89-NOAO-4202-0016 Optical Bench Vertical Installation Fixture.
- I. Remove 89-NOAO-4202-0019 Vertical Handling Stand.

7. Special Reassembly Procedures

- A. Follow removal procedures in reverse order.

8. Summary

This section outlined the procedures to mount the main optical bench onto the optical bench handling cart. This procedure is conducted in a Class 10,000 clean room.

This task completes the instrument structure removal procedures. After completion of this task, proceed to Section 8.5.1 to continue with mechanism removal procedures.

8.4.11 Summary of Installation Procedures

This section summarizes the individual installation procedures outlined in the preceding sections (8.4.1-10). A copy of this checklist is found in Appendix A. It is recommended that the assembly be done using a copy of the checklist, in order to ensure that no steps are overlooked. This checklist *does not* include the checklists for detector installation, which are found in section 8.8.

The assembly procedures start assuming that all sub-systems (mechanisms, optics) have been installed in the main bench. It ends with the dewar assembled, but does not include installation of external structures and electronics (see section 8.3). The checklist is organized according to the instrument/bench configurations, and comprises 6 phases.

- A. Optical bench on cart, OIWFS side down
- B. Optical bench on cart, OIWFS side up
- C. Optical bench vertical on stand/installed in bulkhead
- D. Cryocooler installation
- E. Dewar horizontal, pre-slit bench installation
- F. Electrical checkout
- G. Dewar shield/shell installation

GNIRS ASSEMBLY CHECK LIST \ BRIEF PROCEDURE

A. MAIN OPTICAL BENCH ON CART OIWFS SIDE DOWN ACCESS COVER REMOVED AND TURRETS INSTALLED

- 1) _____ Torque clamp bolts for grating, prism, and camera turrets inside main optical bench.
- 2) _____ Connect home switch internal wiring for grating, prism, and camera turrets.
- 3) _____ Using a meter, verify proper actuation and adjustment of home switches for each turret.
- 4) _____ Torque bolts for light baffles inside main optical bench.
- 5) _____ Torque bolts for acquisition mirror stop plate inside main optical bench.
- 6) _____ Inspect interior of main optical bench for foreign debris (dust, chips) and remove with a vacuum.
- 7) _____ Install access cover onto main optical bench and torque all access cover bolts.
- 8) _____ Using a meter, verify proper actuation and adjustment of acquisition mirror limit switches.
- 9) _____ Install acquisition mirror assembly into access cover on bench, torque acquisition mirror bolts.
- 10) _____ Connect acquisition mirror wiring to acquisition mirror motor and limit switch connectors.
- 11) _____ Install acquisition mirror wire harness retainers and torque retainer bolts.
- 12) _____ Use appropriate (40 mm) spacer fixture to ensure grating turret drive shaft position is correct.
- 13) _____ Install grating turret housing cover and torque housing cover bolts.
- 14) _____ Install grating turret motor drive assembly and torque motor drive bolts.
- 15) _____ Connect the grating turret wiring to grating turret motor and home switch connectors.

B. MAIN OPTICAL BENCH ON CART OIWFS SIDE UP

- 1) ____ Install OIWFS bench assembly onto main optical bench and torque OIWFS bench bolts.
- 2) ____ Remove protective cover and install OIWFS field lens tube inner half and torque tube bolts.
- 3) ____ Connect 2 OIWFS temp sensors to bench temp sensor wiring harness.
- 4) ____ Install OIWFS wire harness retainers and torque retainer bolts.
- 5) ____ Install prism turret motor drive assembly and torque motor drive bolts.
- 6) ____ Connect prism turret wiring to prism turret motor and home switch connectors.
- 7) ____ Install camera turret motor drive assembly and torque motor drive bolts.
- 8) ____ Connect camera turret wiring to camera turret motor and home switch connectors.
- 9) ____ Install vertical installation yoke fixture onto main bench collimator housing and torque yoke bolts.
- 10) ____ Install bench vertical stand fixture onto slit face of main bench and torque stand bolts.

C. MAIN OPTICAL BENCH IN VERTICAL ORIENTATION

- 1) ___ Torque all LN₂ pre-cooler copper clamp blocks on main bench.
- 2) ___ Install all active shield G10 stand offs into main bench.
- 3) ___ Install active shield part #'s _____, _____, _____,
_____, _____.
- 4) ___ Adjust the active shields to the predetermined position and distance from the main bench.
- 5) ___ Torque the shield ball clamps.
- 6) ___ Install motor cold straps for the camera, prism, grating, slit, and acquisition mirror into the active shield.
- 7) ___ Install the two “back side” tangent bars onto the main bench and torque bolts, install active shield covers over tangent bar access holes in active shield.
- 8) ___ Connect all main optical bench and OIWFS bench wiring to the appropriate coldstations.
- 9) ___ Install and torque all cold straps onto the main bench and OIWFS bench for both the port and starboard sides of the instrument in the appropriate locations. Be sure to install the appropriate belleville washers.
- 10) ___ Tie the port and starboard coldstrap groups together towards the middle of the bench outside of the active shield with a length of large gauge bus wire.
- 11) ___ Un-bolt the bench vertical stand fixture from the slit face of the main bench while the bench is safely supported from above by the swivel clevis on the vertical installation yoke fixture.
- 12) ___ Lift the main bench off of the vertical stand fixture to a suitable height which clears the top of the main bulkhead assembly.
- 13) ___ Remove the vertical stand fixture from underneath the main bench and place it inside the perimeter of the main bulkhead.
- 14) ___ Install the detector access port active shield halves into the main bulkhead.
- 15) ___ Move the bench assembly over the bulkhead and lower the bench into the bulkhead until the tangent bar end mounting holes line up with the mounting knuckles in the bulkhead.
- 16) ___ Install and torque the tangent bar bolts into the bulkhead.
- 17) ___ Install and torque the “front” tangent bar to the tangent bar frame (bench side) and the bulkhead.
- 18) ___ Install and torque the A1-A2, A3-A4, and A5-A6 strut rod sets between the aft collimator support and the appropriate locations in the bulkhead.
- 19) ___ Use a carpenters level and level the “rim” of the bulkhead.
- 20) ___ Adjust the length of the A1-A2, A3-A4, and A5-A6 strut rod pairs to bring the slit face of the main optical bench level and thereby parallel to the main bulkhead rim. Tighten the lock nuts on all strut rods, there should be a ~nominal~ 1/4” gap of thread showing at each end of the strut rods.
- 21) ___ Connect the LN₂ precool system fill and vent flex lines from the main bench to the ridged bulkhead pipes. Ensure that each time the connection is made a new copper gasket is installed and the fittings are tightened until the GO/NO-GO gauge indicates GO.
- 22) ___ Connect the dewar shell temp sensor, passive shield temp sensor, and front tangent (three) temp sensors to the appropriate locations on the coldstations.
- 23) ___ Connect the two bulkhead wiring harnesses coming from the components controller connector panel to the appropriate locations on the coldstations. Fasten the wiring harnesses into the retaining clamps on the active shield above the connector panel.
- 24) ___ Slide the detector access port active shield halves together to gain access to the detector wiring.
- 25) ___ Connect the two J717 ribbon cables to the appropriate locations on the J717 coldstation.
- 26) ___ Remove the O-ring saver plate from the J714, J715, and J716 connector opening in the main bulkhead.
- 27) ___ Wipe the J714, J715, and J716 connector port O-ring surface with a lint free wipe dampened with alcohol.
- 28) ___ Inspect the O-ring in the J714, J715, and J716 connector panel for damage and foreign debris.
- 29) ___ Connect the cable harness for the J714, J715, and J716 connector panel to the appropriate locations on the J714, J715, and J716 coldstations.
- 30) ___ Seat the J714, J715, and J716 connector panel on the O-ring surface and torque the panel bolts.
- 31) ___ Slide the detector access port active shield halves back apart and fasten them to the main bench active shield. Seal the small gap between the shield halves with foil tape at the top and bottom.
- 32) ___ Install the detector mount cold strap into the G10 standoff clamps in the detector access port active

- shield.
- 33)___ Install the focus mechanism onto the main bench. Ensure it is seated against the locator blocks on the main bench. Torque the four focus mechanism and four baffle bolts.
 - 34)___ Install the focus motor cold strap into the detector access port active shield.
 - 35)___ Connect the focus motor and home switch wiring harnesses to the appropriate connectors on the focus mechanism.
 - 36)___ Connect the detector mount wiring to the appropriate connectors on the detector mount.
 - 37)___ Install and torque the detector mount cold strap to the detector mount. Be sure to install the appropriate belleville washers.
 - 38)___ Use a meter to verify electrical isolation between the detector mount and the main bench, the detector coldstrap, and the dewar shell.
 - 39)___ Install the detector port active shield cover plate.
 - 40)___ Remove the detector access port O-ring saver from the detector access port.
 - 41)___ Wipe the detector access port O-ring surface with a lint free wipe dampened with alcohol.
 - 42)___ Inspect the detector access port cover O-ring for damage and foreign debris.
 - 42)___ Install the detector access port cover and torque all bolts
 - 43)___ Lift the bench vertical stand fixture up to the main bench slit face and torque bolts.

D. CRYO COOLER ASSEMBLY INSTALLATION

- 1) ___ Remove the port and starboard side dewar shell feet from the dewar shell.
- 2) ___ Remove the port and starboard side cryo cooler opening covers from the dewar shell.
- 3) ___ Remove the length of large gauge bus wire tying the port and starboard cold straps together.
- 4) ___ Locate the port and starboard cold strap groups so that they are inside of the cryo cooler openings.
- 5) ___ Bolt the port and starboard cold strap groups to the thermal distribution bus bar plates respectively, torque all cold strap bolts on the bus bars. Be sure to install the appropriate belleville washers.
- 6) ___ Connect the port and starboard bench temperature control heater wire harnesses to the appropriate cold stations.
- 7) ___ On the starboard side, locate the 2nd stage cold strap (for the detector and molecular sieve) in the middle of the thermal distribution bus bar so that it can be bolted to the 2nd stage of the starboard cryo cooler assembly.
- 8) ___ Suspend the starboard side cryo cooler assembly in the CCA installation fixture and position it into the starboard cryo cooler bulkhead opening .
- 9) ___ Bolt the starboard side thermal distribution bus bar plate to the starboard side cryo cooler assembly and torque. Be sure to install the appropriate belleville washers.
- 10) ___ Bolt the starboard side 2nd stage cold strap to the center 2nd stage bar in the starboard side cryo cooler assembly. Be sure to install the appropriate belleville washers.
- 11) ___ Connect the starboard side temp sensors for cold heads 1 & 2 1st stage, common 2nd stage, and thermal distribution bus bar to the appropriate wiring harness and coldstation.
- 12) ___ Bolt the starboard side active shield cooling straps to the active shield and torque.
- 13) ___ Wipe the starboard side cryo cooler bulkhead O-ring surface with a lint free wipe dampened with alcohol.
- 14) ___ Inspect the starboard side cryo cooler assembly O-ring for damage and foreign debris.
- 15) ___ Seat the starboard side cryo cooler assembly on the O-ring surface and torque the bulkhead bolts.
- 16) ___ Suspend the port side cryo cooler assembly in the CCA installation fixture and position it into the port cryo cooler bulkhead opening .
- 17) ___ Bolt the port side thermal distribution bus bar plate to the port side cryo cooler assembly and torque. Be sure to install the appropriate belleville washers.
- 18) ___ Connect the port side temp sensors for cold heads 3 & 4 1st stage, and thermal distribution bus bar to the appropriate wiring harness and coldstation.
- 19) ___ Bolt the port side active shield cooling straps to the active shield and torque.
- 20) ___ Wipe the port side cryo cooler bulkhead O-ring surface with a lint free wipe dampened with alcohol.
- 21) ___ Inspect the port side cryo cooler assembly O-ring for damage and foreign debris.
- 22) ___ Seat the port side cryo cooler assembly on the O-ring surface and torque the bulkhead bolts.
- 23) ___ Install the port and starboard side dewar shell feet from the dewar shell and torque the bolts.

E. SLIT AND OFFNER INSTALLATION / DEWAR SHELL UPRIGHT

- 1) _____ Install active shield part #'s _____, _____.
- 2) _____ Using a meter, verify proper actuation and adjustment of home and limit switches for the slit and decker mechanisms.
- 3) _____ Install the slit lifting fixture onto the slit assembly and suspend the slit in front of the dewar shell at the same height as the slit mounting face of the main bench.
- 4) _____ Attach the slit motor cold strap to the slit motor.
- 5) _____ Seat the slit onto the main bench slit face until it is fully engaged and flush. Install all of the slit mounting bolts and torque.
- 6) _____ Insert the OIWFS field lens tube outer half into the inner half and torque bolts.
- 7) _____ Attach the OIWFS field lens tube clamp to the main bench and torque.
- 8) _____ Remove the field lens protective cover from the field lens tube.
- 9) _____ Seat the Offner onto the slit and into the OIWFS field lens tube, bolt and torque.
- 10) _____ Bolt the slit cold strap to the slit and torque. Be sure to install the appropriate belleville washers.
- 11) _____ Connect the slit wiring harness and temp sensor connectors to the connector plate on the slit.
- 12) _____ Connect the Offner and forward active shield temp sensor wiring harness to the temp sensor on the Offner.

F. ELECTRICAL CHECKOUT

- 1) _____ Using a meter verify that all science channel motor phases are present on the J760, J761, and J762 connectors; they should read around 2 - 3 ohms.
- 2) _____ Using a meter verify that all OIWFS motor phases are present on the J742 connector; they should read around 2 – 3 ohms.
- 3) _____ Using a meter verify all temperature sensors are present; they should have a junction voltage around .58V with the meter in diode check. Ensure that the polarity is correct.
*Note that the temp sensors for the forward active shield and the aft active shield will not be present yet because they have not been connected.
- 4) _____ Temporarily connect the components controller to J730, J731, J741, J742, J743, J744, J760, J761, and J762 with the appropriate instrument cables.
- 5) _____ Using the instrument software, ensure all temp sensors read proper temperature.
*Note that the temp sensors for the forward active shield and the aft active shield will not be present yet because they have not been connected.
- 6) _____ Using the instrument software, datum all science channel mechanisms with both primary and secondary home switches.
- 7) _____ Using the instrument software, verify all limit switches for the slit, decker, and acquisition mirror.
- 8) _____ Using the instrument software, datum all OIWFS mechanisms.
- 9) _____ disconnect the components controller from the instrument.

*NOTE: The electrical checkout for the science channel detector array is done when the detector array is installed and is part of a separate checklist.

G. FINAL DEWAR CLOSURE AND CHECKS

- 1) ___ Connect the collimator temp sensor harness to the temp sensor on the collimator.
- 2) ___ Transfer the OIFWS detector shorting plug from the OIWFS bench to the Bulkhead components controller connector panel.
- 3) ___ Suspend the aft main bulkhead assembly at a height adjacent to the forward main bulkhead assembly.
- 4) ___ Wipe the aft main bulkhead O-ring surface with a lint free wipe dampened with alcohol.
- 5) ___ Inspect the forward main bulkhead O-ring for damage and foreign debris.
- 6) ___ Install the four bulkhead guide pins into the forward main bulkhead at 90 degree intervals.
- 7) ___ Seat the aft main bulkhead onto the forward main bulkhead allowing the guide pins to locate it.
- 8) ___ Remove the four guide pins and install and torque all bulkhead bolts.
- 9) ___ Install the aft active shield.
- 10) ___ Connect the aft active shield wiring harness to the aft active shield temp sensor and install its cover.
- 11) ___ Suspend the aft dewar shell end cover at a height adjacent to the aft main bulkhead.
- 12) ___ Wipe the aft dewar shell end cover O-ring surface with a lint free wipe dampened with alcohol.
- 13) ___ Inspect the aft main bulkhead O-ring for damage and foreign debris.
- 14) ___ Install the four dewar shell end cover guide pins into the aft main bulkhead.
- 15) ___ Seat the aft dewar shell end cover onto the aft main bulkhead allowing the guide pins to locate it.
- 16) ___ Remove the four guide pins and install and torque all aft dewar shell end cover bolts.
- 17) ___ Install the forward active shield.
- 18) ___ Connect the forward active shield wiring harness to the forward active shield temp sensor and install its cover.
- 19) ___ Install the molecular sieve into the molecular sieve brackets on the main bench.
- 20) ___ Install and torque the molecular sieve cold strap to the molecular sieve. Be sure to install the appropriate belleville washers.
- 21) ___ Connect the molecular sieve temp sensor to the molecular sieve temp sensor wiring harness.
- 22) ___ Install the molecular sieve active shield cover onto the active shield.
- 23) ___ Suspend the forward dewar shell end cover at a height adjacent to the forward main bulkhead.
- 24) ___ Wipe the forward main bulkhead O-ring surface with a lint free wipe dampened with alcohol.
- 25) ___ Inspect the forward dewar shell end cover O-ring for damage and foreign debris.
- 26) ___ Install the four dewar shell end cover guide pins into the forward main bulkhead.
- 27) ___ Seat the forward dewar shell end cover onto the aft main bulkhead allowing the guide pins to locate it.
- 28) ___ Remove the four guide pins and install and torque all forward dewar shell end cover bolts.