8.0 Instrument Disassembly Procedures

8.1 General Considerations

8.1.1 Safety

There are many safety issues that must be addressed during disassembly of the instrument to avoid injury or damage to equipment, and it is imperative the safety procedures be followed during the disassembly process. Each procedure has a brief safety section associated with that section identifying the risks and hazards involved in that section that must be observed to insure personnel or hardware is not injured or damaged.

Before disassembling the instrument it is important that personnel involved are aware of the following conditions of the instrument that can cause injury or damage:

Heavy components: Total instrument weight is 2000Kg. Proper handling equipment must be used in the handling of the instrument. It is recommended that lifting cranes with a lift capacity of no less than 3 tons be used to lift the fully assembled instrument. Additionally, straps should be selected to support the loads with sufficient safety factors. When selecting straps one must consider load distributions as well as how straps are oriented to insure straps do not get over-loaded.

Dewar vacuum: The external dewar structure supports a vacuum load. Improper handling of the instrument could lead to structural damage of the dewar causing instrument failure. Attempting to remove covers, feedthroughs, etc., that provide vacuum seal while instrument is under vacuum could cause injury to personnel and/or damage to instrument.

Cryogenic temperatures: The internal structure of the instrument is maintained at cryogenic temperatures (~60K). Improper warm up procedures can cause condensation onto sensitive optics resulting in damage to optics.

High Voltages: The electronic systems that operate the instrument use high voltages. Shock hazards exist and personnel must be aware of these hazards.

Electrostatic sensitive devices: There are devices that are sensitive to electrostatic discharge and the appropriate precautions must be observed to protect these devices.

8.1.2 Sub-System Disassembly

The procedures outlined here are those required to disassemble GNIRS down to the level of individual sub-systems, including optics removal. However, it is important to recognize that access to some sub-systems *does not* require complete disassembly. Specifically:

- Certain sub-systems can be accessed without removing the cold structure (benches); these comprise filters (5.2.2), slit mask (5.2.3), IFU (similar to 5.2.3), and collimator (7.4). Detector removal and science focus stage removal (8.4.1) also do not involve major disassembly.

- Subsystems on the pre-slit bench, comprising the Offner, filter wheels, and slit and decker slide, can be removed without removing the main bench or thermal enclosures from the bulkhead. Since any work on these subsystems is likely to occupy more than a day or so, the detector and molecular sieve should still be removed. This means that one can skip portions of section 8.3 and all of 8.4 after the pre-slit bench removal.
- The OIWFS bench should be removed (8.5.1) only if it is necessary to access OIWFS mechanisms (8.6). Note that the OIWFS filter wheel and focus stage can be accessed without removing the OIWFS bench (see 8.6).
- In general, access to any subsystem within the cold structure does not require removal of other sub-systems. There are a few exceptions: the acquisition mirror must be removed (8.5.5) to access the prism turret (8.5.7) and camera turret (8.5.6), and the Foreoptics Module Assembly should be removed (8.4.5) for complete access to the slit and decker slides (but not for mask changes and other more routine activities).

You should therefore determine which sub-system (or sub-systems) need removal, and then plan out the sequence of operations with the aid of this manual. If you blindly follow all the listed steps up to the extraction of the relevant mechanism, you may find that you have done more work than you had to, and have created much more work during re-assembly.

Assembly procedures are for the most part simply the reverse sequence, although with additional checks, such as verifying connectors, setting bolt torques, and checking critical spacings. These additional steps are indicated in the appropriate sub-sections.

8.1.3 Assembly Overview Checklist

GNIRS ASSEMBLY CHECK LIST \ ORDERED 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)_____Verify proper positioning of prism and camera turret axels in the axel clamps.
4)_____Using a meter, verify proper actuation and adjustment of home switches for each turret.
5)____Torque bolts for light baffles inside main optical bench.
6)____Torque bolts for acquisition mirror stop plate inside main optical bench.
7)____Inspect interior of main optical bench for foreign debris i.e. dust and remove with a vacuum.
8)____Install access cover onto main optical bench and torque all access cover bolts.
9)____Using a meter, verify proper actuation and adjustment of acquisition mirror limit switches.
10)___Install acquisition mirror assembly into access cover on bench, torque acquisition mirror bolts.
11)___Connect acquisition mirror wiring to acquisition mirror motor and limit switch connectors.
12)___Install acquisition mirror wire harness retainers and torque retainer bolts.
13)___Use appropriate (40 mm) spacer fixture to ensure grating turret drive shaft position is correct.
14)___Install grating turret housing cover and torque housing cover bolts.
15)____Install grating turret motor drive assembly and torque motor drive bolts.
16)____Connect the grating turret wiring to grating turret motor and home switch connectors.
17)____ Flip bench over.

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 LN_2 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 89-NOAO-4200-0236 and 89-NOAO-4200-0235.
4)_____Connect inside shield electrical connectors for all connectors on the J730, J731, J760, J761, J762, J714, J715, J716, J718, and J719 cold stations.
5)_____Install active shield part # 89-NOAO-4200-0234.
6)_____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.
7)_____Connect inside shield electrical connectors for all connectors on the J740, J741, J742, J743, and J744 cold stations.
8)_____Install motor cold straps for the camera, prism, grating, slit, and acquisition mirror into the active shield.
9)_____Install active shield part # 89-NOAO-4200-1792.
10)____Connect inside shield electrical connectors for all connectors on the J717 cold station.
11)____Install active shield part #'s 89-NOAO-4200-0270 and 89-NOAO-4200-0271.
12)____Adjust the active shields to the predetermined positions and distances from the main bench.
13)____Torque the shield ball clamps.
14)____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.
15)____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.
16)____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.
17)____Lift the main bench off of the vertical stand fixture to a suitable height with which it clears the top of the main bulkhead assembly.
18)____Remove the vertical stand fixture out from underneath the main bench and place it inside of the main bulkhead.
19)____Install the detector access port active shield halves part #'s 89-NOAO-4200-0269 into the main bulkhead.
20)____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.
21)____Install and torque the tangent bar bolts into the bulkhead.
22)____Install and torque the "front" tangent bar to the tangent bar frame (bench side) and the bulkhead.
23)____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.
24)____Use a clean carpenters level and level the "top rim" of the bulkhead.
25)____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~ ¼" gap of thread showing at each end of the strut rods.
26)____Connect the LN_2 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 .

27)____Install 89-NOAO-4200-0305 LN_2 precool active shield feedthru around the LN2 precool lines.
28)____Connect the dewar shell temp sensor, passive shield temp sensor, and front tangent (three) temp sensors to the appropriate locations on the coldstations.
29)____Install 89-NOAO-4200-0235 active shield.
29)____Connect the two bulkhead wiring harness' coming from the components controller connector panel to the appropriate locations on the coldstations. Fasten the wiring harnesses into the retaining clamps on active shield # 89-NOAO-4200-0235 above the connector panel.
30)____Slide the detector access port active shield halves together to gain access to the detector wiring.
31)____Connect the two J717 ribbon cables to the appropriate locations on the J717 coldstation.
32)____Remove the O-ring saver plate from the J714, J715, and J716 connector opening in the main bulkhead.
33)____Wipe the J714, J715, and J716 connector port O-ring surface with a lint free wipe dampened with alcohol.
34)____Inspect the O-ring in the J714, J715, and J716 connector panel for damage and foreign debris.
35)____Connect the cable harness for the J714, J715, and J716 connector panel to the appropriate locations on the J714, J715, and J716 coldstations.
36)____Seat the J714, J715, and J716 connector panel on the O-ring surface and torque the panel bolts.
37)____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.
38)____Install the detector mount cold strap into the G10 standoff clamps in the detector access port active shield.
39)____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.
40)____Install the focus motor cold strap into the detector access port active shield.
41)____Connect the focus motor and home switch wiring harnesses to the appropriate connectors on the focus mechanism.
42)____Connect the detector mount wiring to the appropriate connectors on the detector mount.
43)____Install and torque the detector mount cold strap to the detector mount. Be sure to install the appropriate belleville washers.
44)____Use a meter to verify electrical isolation between the detector mount and the main bench, the detector coldstrap, and the dewar shell.
45)____Install the detector port active shield cover plate.
46)____Remove the detector access port O-ring saver from the detector access port.
47)____Wipe the detector access port O-ring surface with a lint free wipe dampened with alcohol.
48)____Inspect the detector access port cover O-ring for damage and foreign debris.
49)____Install the detector access port cover and torque all bolts
50)____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 that is 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 onto the dewar shell and torque the bolts.

E. SLIT AND OFFNER INSTALLATION / DEWAR SHELL UPRIGHT

1)_____Install active shield part #'s 89-NOAO-4200-0299.
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 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. ELECTICAL 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 shorting plug from the OIWFS bench to the Bulkhead components controller connector panel.
3)_____ Seat the aft main bulkhead onto the forward main bulkhead allowing the guide pins to locate it.
4)____ Remove the four guide pins and install and torque all bulkhead bolts.
5)_____ Install the aft active shield.
6)_____ Install the OIWFS connector access cover into the aft active shield.
7)_____ Suspend the aft main bulkhead assembly at a height adjacent to the forward main bulkhead assembly.
8)_____ Wipe the aft main bulkhead O-ring surface with a lint free wipe dampened with alcohol.
9)_____ Inspect the forward main bulkhead O-ring for damage and foreign debris.
10)_____ Install the four bulkhead guide pins into the forward main bulkhead at 90 degrees intervals.
11)____Install the four dewar shell end cover guide pins into the forward main bulkhead.
12)____Seat the forward dewar shell end cover onto the forward main bulkhead allowing the guide pins to locate it.
13)____Install the molecular sieve active shield cover onto the active shield.
14)____Suspend the aft dewar shell end cover at a height adjacent to the aft main bulkhead.
15)____Wipe the aft main bulkhead O-ring surface with a lint free wipe dampened with alcohol.
16)____Inspect the aft dewar shell end cover O-ring for damage and foreign debris.
17)____Install the four dewer shell end cover guide pins into the aft main bulkhead.
18)____Seat the aft dewar shell end cover onto the aft main bulkhead allowing the guide pins to locate it.
19)____Remove the four guide pins and install and torque all aft dewar shell end cover bolts.
20)____Remove the four guide pins and install and torque all forward dewar shell end cover bolts.
21)____Install the detector using the detector installation procedure.
22)____Wipe the detector access port O-ring surface with a lint free wipe dampened with alcohol.
23)____Seat the detector access port cover onto the main bulkhead.
24)____Install and torque the detector access port cover bolts.
25)____Install the molecular sieve into the molecular sieve brackets on the main bench.
26)____Install and torque the molecular sieve cold strap to the molecular sieve. Be sure to install the appropriate belleville washers.
27)____Connect the molecular sieve temp sensor to the molecular sieve temp sensor wiring harness.
28)____Connect the aft active shield wiring harness to the aft active shield temp sensor and install its cover.
29)____ Install the forward active shield.
30)____ Connect the forward active shield wiring harness to the forward active shield temp sensor and install its cover.
31)____ Suspend the forward dewar shell end cover at a height adjacent to the forward main bulkhead.
32)____Wipe the forward dewar shell end cover O-ring surface with a lint free wipe dampened with alcohol.
33)____Inspect the forward main bulkhead O-ring for damage and foreign debris.