

# APPENDIX A

Ballast Weight Station Table

LOCATION		Number of Ballast Weights	
Forward Truss	1		
	2		
	3		
	4		
Aft Dewar Shell	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8		
Aft Bulkhead	Port	1	
		2	
		3	
	Starboard	1	
		2	
		3	
	Bottom	1	
		2	
		3	
		4	
		5	
		6	
Port TEC Truss		1	
Starboard TEC Truss		1	

## 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 i.e. dust 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 with which it clears the top of the main bulkhead assembly.
  - 13) \_\_\_ Remove the vertical stand fixture out 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 harness' coming from the components controller connector panel to the appropriate locations on the coldstations. Fasten the wiring harness's 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 harness' 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 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 harness's to the appropriate cold stations.
- 7) \_\_\_ On the starboard side, locate the 2<sup>nd</sup> 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 2<sup>nd</sup> 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 2<sup>nd</sup> stage cold strap to the center 2<sup>nd</sup> 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 1<sup>st</sup> stage, common 2<sup>nd</sup> 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 1<sup>st</sup> 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 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 degrees to each other.
- 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 dewer 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.