

BSC7-ITMX REPLACEMENT – T030022-A-W

APPROVALS	DATE	REV	DCN NO.	BY	CHECK	DCC	DATE
AUTHOR: D.Cook	05/20/03						
CHECKED: B.Bland	05/22/03						
CHECKED: J Worden							
APPROVED: D.Coyne							
APPROVED: D.Sigg							
DCC RELEASE							

1 SCOPE

Task1: Vent BSC7 to replace the ITMx-2k Core Optic. We will use an auxillary PD mounted in front of the ITMx optical lever to give us an alignment set point after venting the volume. Adjust PAM screws to zero the controller biases (may require OSEM adjustments to maintain sensor voltages).

Task2: running parallel with task one, involves adjusting the ITMy PO mirror using values derived by steering FMy. The FMy was steered to produce the beam at the PO view port. The FMy optical lever laser beam was used to track the FMy angular change on an auxillary PD mounted on an X, Y translation stage. The calculated values will be used to dead reckon the PO mirror pitch and yaw changes. The PO adjustment utilizes four dial indicators, zeroed onto the PO mirror face. The PO mirror will be adjusted to the calculated value as read on the dial indicators. If after 8hr vent time, the POy re-alignment proves unsuccessful; we will place a beam dump into the front of the telescope to absorb the beam.

Task3: Additional view ports will be added to several chambers on this volume.

Task4: The 2K RM beam dump will be install in HAM8.

Task5: After the 2K-vertex volume is closed up the 4K vertex will be vented for the asymmetry adjustments on the ITMs. Translating the ITMs will utilize special fixturing and pointing will utilize auxillary PDs mounted on X, Y translation stages in front of the optical lever PDs.

Task6: The 4K RM beam dump will be install in HAM2.

Estimated Time Line and Task Leaders

Task 1-Doug, Task2-Betsy, and Task3-Kyle Parallel. Start and finish on 6/2 - Open and close BSC7.

Task 4 -Corey Start and finish 6/2 – Open and close HAM8 W.

Task - Doug5 Start and finish BSC3 6/3 – Open and close BSC3.

Start and finish BSC1 6/4 – Open and close BSC1.

**Potentially Task 5 can be completed in one day (6/4).

Task 6 – Corey Parallel to **Task 5**. Start and finish 6/4 or 6/5 – Open and close HAM2 W.

Vacuum Tasks – John.

Staging Ancillary Hardware - Ski

2 APPLICABLE DOCUMENTS

Listed below are the applicable documents and references for this procedure.

LIGO E000062	BSC Installation document
LIGO M990034	LHO Contamination Control Plan
LIGO M020131	LHO Laser Safety Plan
LIGO M020130	LHO 10 Watt Laser SOP
LIGO M980133	Vent Isolatable Volume
LIGO M980101	Procedure For Isolatable Volume Pump Down
LIGO M980136	HAM Chamber Access Door Removal
LIGO M980132	O-Ring Installation and Flange Assembly Procedure for HAM and BSC Doors
LIGO E000065	Chamber Entry and Exit Lists
LIGO M980086	Con-flat Flange Assembly Procedure
LIGO D970308	IFO Opto-mechanical layout for LHO
LIGO T030066	Schnupp Asymmetry of the 4k IFO
LIGO D000014/D000016	Laminated drawing for counterweight adjustments in BSC1 and BSC3
LIGO E010071	Large Optic Suspension Balancing



BSC7-ITMX REPLACEMENT – T030022-A-W

3 Pre-Requisites

Complete the following by 5/10:

- Receive spare ITM structure from LLO **Doug/Gary T.**
- Receive spare ITM from CIT. **Betsy/Helena**
- Design and machine auxiliary PD hardware for FMy Angle measurement. **Doug**
- Design/machine asymmetry ITM-4k translation fixturing **Doug**

Complete the following by 5/23:

- Receive final approval of this document and distribute.** **Doug**
- File work permits and get approval **Doug**
- Process optic per LIGO-E010071 and staged prior to venting **Doug, Betsy, Helena**
- Note: Review the balancing procedure to maximize balancing precision to minimize PAM adjustments.**
- Test new masks, body wicks, and thermal vests to be worn insitu. **Doug/Ski/Corey**
- Note: Corey worn Vest in HAMs 8 & 2 – chill packs lasted for two hrs**
- Note: Mask was deemed too cumbersome.**
- Establish team players and assign tasks **Doug**
- Figure out PO Mirror realignment procedure (theodolite or indicators?) **Daniel, Doug, Mike**
- Measure FMy angle for POy adjustment **Daniel, Doug,**
Cheryl.
- Note: Using the FM auxiliary PD: Pitch 1mm & YAW 2.6mm (see D Sigg Elog)**
- FMy steering calculations **Daniel, Doug,**
M.Smith, Hugh
- Note: POy PO mirror was rotated C’Clockwise .006 inch on the dial indicator about the center.**
- 1.5mRads.**
- Design/machine ITMx-2k, ITMx-4K, ITMy 4K Auxiliary PD hardware **Doug**
- Vacuum/air bake class ‘B’ fixture. **Bartie**
- PDs and hardware tested in place –4 units **Daniel, Doug, Rick**
- Outline for re-alignment of 2k ITMx **Doug**
- Note: Update E000062 to include OSEM/PAM iterations and better contamination controls. Doug**

4 PREPARATIONS

Complete the following LVEA Staging by 5/28:

- 5/28-Review this document to be sure everyone involved understands the game plan.**
- BSC7 Big/Pink clean room in place and running **John/Ski/Gerardo/?**
- BSC1 & BSC3 Mini White clean rooms on “horses” staged **John/Ski/Gerardo/?**
- Particle counter under clean room and monitoring on **Gerardo**
- Break all but 4 bolts. **John, Kyle, TBD**
- Note: Contamination procedures- frock, shoe covers, and caps minimum.**
- Note: Seal soft wall enclosures to floor and chambers.**
- Vacuum and damp mop BSC1, BSC3, BSC7, HAM2, & HAM8 areas **Terry and CO.**
- 6 x 12 clean room work area to BSC7 **Ski & Co.**
- Change room and garb setup at BSC7, HAM2, HAM8, BSC1 **Ski & Co.**
- Vacuum purge air supply operable **John**
- Optical flat, Tripod and related equipment staged **Doug**
- Note: Note used.**
- Forklift and attachments and/or engine hoist for door removal, staged **John, Kyle**
 - o Forklift at HAM8 (will then be moved to HAM2)
 - o Hoist at BSC7 (will then move to BSC3, then BSC1)
- View ports and hardware ready for installation at ports: **Kyle and Co.**

HAM1	F1 W	Faraday Isolator
HAM2	F2 W	MMT2
HAM7	F2 W	MC1 and MC3 fronts
HAM4	Top Most E	Looking down on rear of telescopes



BSC7-ITMX REPLACEMENT – T030022-A-W

HAM4	F1 N	Rear telescope optical trains
HAM10	Top Most W	Looking down on rear of telescopes
HAM10	F1 S	Rear telescope optical trains
BSC3	NE corner of chamber	Camera for ITM face view
BSC7	G4	View from ITMx to BS to Telescopes

Things to be staged at BSC7 by 5/28:

- | | |
|--|------------------------------|
| <input type="checkbox"/> Place clean room over BSC7. | John and Co. |
| <input type="checkbox"/> Class 'B' hardware and tools clean bubble level for insitu. | Betsy |
| <input type="checkbox"/> Solvents and wipes and foil staged. | Ski |
| <input type="checkbox"/> Flashlights and batteries, staged. | Ski |
| <input type="checkbox"/> Digital camera, staged | Ski |
| <input type="checkbox"/> N2 Ionization gun, staged. | Ski/Gerardo |
| <input type="checkbox"/> CO2 snow gun, staged. | Doug, Ski |
| <input type="checkbox"/> O-scope and BNC cables for PD read back at BSC 7 | Ski |
| <input type="checkbox"/> Belly Bars at HAM 2 and HAM 8 | Ski/Gerardo & Co. |
| <input type="checkbox"/> Forklift Plank by HAM 8 | Ski/Gerardo & Co. |
| <input type="checkbox"/> 2 sets BSC door soft covers | Ski/Gerardo & Co. |
| <input type="checkbox"/> O-ring protectors | Ski/Gerardo & Co. |
| <input type="checkbox"/> Straddle lift | Ski/Gerardo & Co. |
| <input type="checkbox"/> Lazy Susan | Ski/Gerardo & Co. |
| <input type="checkbox"/> Lift table | Ski/Gerardo & Co. |
| <input type="checkbox"/> Roller table for lazy Susan | Ski/Gerardo & Co. |
| <input type="checkbox"/> Roller transfer platform for straddle | Ski/Gerardo & Co. |
| <input type="checkbox"/> Transport cart and cover, staged in optics lab. | Doug, Betsy |
| <input type="checkbox"/> TFE highway | Betsy |
| <input type="checkbox"/> Class 'B' dog clamps to place dead stops around ITMx structure before removing structure. | Betsy |
| <input type="checkbox"/> Flourel tips for bottom quake stops | Betsy |
| <input type="checkbox"/> TFE pads | Betsy |
| <input type="checkbox"/> The two orange BSC/HAM installation boxes complete w/tools | Betsy |
| <input type="checkbox"/> Backup 2k POy Class A Beam Dump | Betsy |
| <input type="checkbox"/> PO Mirror Adjustment tools | Betsy |
| <input type="checkbox"/> Laser pointer & belly bar mount for SOS stop set technique | Betsy |
| <input type="checkbox"/> HAM2 camera assy. and mount/housing | Betsy/Gerardo |
| <input type="checkbox"/> HAM2 Class A Camera mirror | Betsy |
| <input type="checkbox"/> COS "thumb screw" pusher assy. | Betsy |
| <input type="checkbox"/> Gage Indicator Assy. | Betsy/Doug |
| <input type="checkbox"/> Elliptical Baffle Counterweight | Betsy |
| <input type="checkbox"/> Reducers (2) – 13.25-10" for HAM10, HAM4 top view ports | John |
| <input type="checkbox"/> Theodolite equipment as a backup? | Hugh |
| <input type="checkbox"/> ½ Round Baffles (2) | M. Smith |
| <input type="checkbox"/> POy Beam Dump | M. Smith |
| <input type="checkbox"/> MMT2 Beam Dumps/Shields (2) | M. Smith |
| <input type="checkbox"/> MC2 Beam Blocks/Shields (2) | M. Smith |

5 TASK STEPS (Task 1,2,3&4-in parallel)

Complete the following by 10:00AM 6/2:

- | | |
|--|-----------------------------|
| <input type="checkbox"/> <i>Switch to "Laser Safe Condition" in the LVEA Lasers Off (Card Access System will be still active).</i> | Doug/John/Rick |
| <input type="checkbox"/> <i>Align ITMx to best alignment and re-zero optical lever <u>Before Venting.</u></i> | Control Room, Nathan |
| <input type="checkbox"/> <i>Record ITMx Sensor Monitor Values. <u>Before Venting</u></i> | Control Room, Nathan |
| <input type="checkbox"/> <i>Align both IFO's and re-zero all optical levers <u>Before Venting</u></i> | Control Room, Nathan |



BSC7-ITMX REPLACEMENT – T030022-A-W

- Mark MC fiducials on the walls.* *Control Room, Betsy*
- Put a freeze on any 2K IFO work effecting this operation Before Venting* *Control Room, Nathan*
- Follow along with this checklist and communicate with task leaders via radio* *Control Room, Nathan*
- Install auxiliary PD on 4K-ITMy, 4K-IYmX, 2K ITMx* *Doug, Daniel*
- Note: Set up and make measurements on Sun 6-1-03*
- Note:*
- Check with Control Room before proceeding* *Doug*
- (Operator to be in attendance at all times during vent)*
- Lock & Tag 2K PSL Laser Shutter CLOSE* *Doug/Rick*
- Close gate valves WGV2, 3, and Lock & Tag* *John, Doug*
- Slow vent (~1 hr to minimize static build up on SOS optics) per M980133.*
- Remember to turn off RGA and all 2K LOS and SOS SUS controller high voltages.* *John,*
- Control Room*
- Install auxiliary QPD on ITMx-2K optical lever pier and zero using the X, Y translation stages. Connect an O-Scope to the QPD and place O-scope for access near BSC7.* *Doug, TBD.*
- Energize ITMx Controller HV*
- Pull BSC7 Door per M980136 (Install O-Ring protectors and soft covers). *John, Kyle and Co.*

Task1: 2K ITMx replacement.

- Team Enters. **Doug, Rick**
- Confirm optical lever pointing to PD. **Doug, TBD.**
- Note: This step was over looked. One of the most important steps. Using pre-vent pointing and a resistor change in the controller, we recovered without having to vent a second time around.**
- Place FMx and ITMx optics on earthquake stops (TFE caps on 4 bottom stops) **Doug, Rick.**
- Note: Missing stops, so we remove the OSEMs to protect the magnets and clamp the optic using Florel tips.**
- Remove ITM Elliptical Baffle **Doug**
- Install lazy Susan and transfer table. **Doug, Ski, Vagesh, Rick**
- Install lift table **Doug, Ski, Rick**
- Place 3 dog clamps against ITMx structure base before removing. **Doug, Ski, Rick**
- Check table level (with elliptical baffle installed) **Doug, Ski, Rick**
- Note: East West level to <one tick – North to South, North high 2 ticks.**
- Check pointing on PD. **Rick, Doug**
- Use adaptor plate under structure. **Doug, Ski, Rick**
- Pull ITMx with structure and transport to optics lab -maintaining contamination controls. **Doug, Ski, Rick**
- Swap Height adaptor to replacement structure **Doug, Ski, Rick**
- Transport replacement optic to BSC7 ----- maintaining contamination controls. **Doug, Ski, Rick**
- Install ITMx per LIGO E000062 **Doug, Ski, Rick (Use**
- as a guideline with modifications pertaining for this special installation)
- Note: LIGO E000062 needs to be updated**
- Adjust PAMs and maintain 50% open light voltages **Doug, Ski, Rick (Use**
- Note: Requires several iterations to minimize the final PAM adjustments when the elliptical baffle gets installed.**
- Add this process to E000062.**
- Reinstall Elliptical Baffle on new ITM.
- Check level **Doug**
- Note: East West level to <one tick – North to South, North high 2 ticks.**
- Back off the bottom earthquake stops and replace the TFE tips with Florel tips **Doug**
- Remove the earthquake stops on all optics. **Doug**
- Re-align ITMx with Controller biases nulled **Doug**
- (Maintain sensor voltages by adjusting OSEM positions/PAMs)
- Perform the BSC7 chamber exit checklist. **Doug**



LIGO INSTALLATION SPECIFICATION

BSC7-ITMX REPLACEMENT – T030022-A-W

- Pull BSC3 Door per M980136 Co. John, Kyle, Hugh &
- Install O-Ring protectors and soft covers. Co. John, Kyle, Hugh &
- Clean room and stage a garb room, worktable, and hardware. Ski, Gerardo & Co.
- Team Enters. Doug, TBD
- Place ITMx optics on earthquake stops. Doug, TBD
- Check table level.
- Note: South high 1.5 ticks, east – west level.**
- Install ITM translation fixture and zero the indicators** Doug
 - Use cleaned and baked SST shims to compensate for height adaptor top plate thickness.
 - Remove dog clamps from the long sides of the LOS structure first.
 - Slide the fixture through the height adaptor (two persons)
 - Locate squaring tabs against LOS structure on the pusher end.
 - Use LOS dog clamps to secure translation fixture.
 - Remove the end LOS dog clamps.
 - Install the two side guide rails against the LOS structure.
 - Block fixture components on all sides to prevent any movement. Do not rely on the dog clamps to have adequate holding power.
 - Zero indicators against LOS 2x2 posts allowing adequate indicator travel to complete move (2" max on indicators ~1.5" on fixture).
 - Drive the LOS using the screw and watch indicators for rotation and distance. Maintain rotation to <.001".
 - Translate ITMx 2.8cm AWAY FROM BS
 - Remove the side guides and dog the LOS structure to table.
 - Remove the translation fixture
 - Re-dog the LOS structure.
- Move the counterweights per laminated layout to compensate for ITM shift (180in/lbs in the opposite direction, without rotating c'weights). Doug, TBD
- Check table level. Doug, TBD
- Release the EQ stops. Doug, TBD
- Check sensor voltages. Control Room, Nathan
- Place ITMx optics on earthquake stops.
- Check table level. Doug, TBD
- Reset EQ stops Doug, TBD
- Perform the BSC3 exit chamber checklist.
- Remove O-ring protectors. John, Kyle, Hugh & Co.
- Replace the door on BSC3. John, Kyle, Hugh & Co.

- Move equipment and stage for BSC1
- Pull BSC1 Door per M980136 (Install O-Ring protectors and soft covers). John, Kyle and Co.
- Place 6 X 12 clean room against BSC1 Ski, Gerardo & Co.
- Clean room and stage a garb room, worktable, and hardware. Ski, Gerardo & Co.
- Team Enters BSC1 Doug, Cheryl
- Place ITMy optic on earthquake stops. Doug, Cheryl
- Install ITM translation fixture and zero indicators (as above). Doug, Cheryl
- Loosen LOS dog clamps. Doug, Cheryl
- Translate ITMy 2.8cm TOWARDS BS Doug, Cheryl
- Note: BS PO mirrors are a tight fit but shouldn't need to be moved! (could cause a major beam mis-pointing at the viewport).**
- Note: It may be useful to use an optical lever to help maintain the alignment through the BS PO mirrors and out of the viewport and onto a target.**



LIGO INSTALLATION SPECIFICATION

BSC7-ITMX REPLACEMENT – T030022-A-W

- | | |
|--|-------------------------------|
| <input type="checkbox"/> Re-dog the LOS structure and remove the translation fixture. | Doug, Cheryl |
| <input type="checkbox"/> Check table level. | Doug, TBD |
| <input type="checkbox"/> Reset EQ stops | Doug, TBD |
| <input type="checkbox"/> Check sensor voltages. | Doug, TBD |
| <input type="checkbox"/> Move the counterweights per laminated layout to compensate for ITM shift (180in/lbs in the opposite direction, without rotating c'weights). | Doug, TBD |
| <input type="checkbox"/> Check table level. | Doug, TBD |
| <input type="checkbox"/> Clean optic with Co2 and N2. | |
| <input type="checkbox"/> Reset EQ stops .5mm gap. | Doug, TBD |
| <input type="checkbox"/> Perform the BSC1 exit chamber checklist | Doug, TBD |
| <input type="checkbox"/> Remove O-ring protectors, belly bar. | Doug, TBD |
| <input type="checkbox"/> Replace the door on BSC1. | Doug, TBD |
|
 | |
| <input type="checkbox"/> Task6: 4K RM beam dump/baffle. | |
| <input type="checkbox"/> Stage equipment at HAM2 west door.
(Some Task6 items can be completed parallel to Tasks 5) | Ski, Gerardo & Co. |
| <input type="checkbox"/> Mark orientation and remove RM optical lever receiver pier
(Only if clearance for door removal is required). | Ski, Gerardo & Co. |
| <input type="checkbox"/> Pull HAM2 west Door per M980136
(Install O-Ring protectors, stairs, belly bar and soft covers). | |
| <input type="checkbox"/> Place a change room. | John, Kyle and Co. |
| <input type="checkbox"/> Position worktables and hardware. | Ski, Gerardo & Co. |
| <input type="checkbox"/> Check table level. | Ski, Gerardo & Co. |
| <input type="checkbox"/> Place optics on EQ stops on all suspended optics. | Corey, Betsy |
| <input type="checkbox"/> "Ride the plank"(forklift). | Corey, Betsy, Justin |
| <input type="checkbox"/> Remove old beam dump and baffle in front of MMT2. | Corey, Betsy, Justin |
| <input type="checkbox"/> Install RM beam dump baffle/wire protector on table per M.Smith. | Corey, Betsy, Justin |
| <input type="checkbox"/> Install ½ round baffle into beam tube in front of HAM2 facing toward HAM1 | Corey, Betsy, Justin |
| <input type="checkbox"/> Install 2" silver camera mirrors. | |
| <input type="checkbox"/> Install wire protection shield on MC. | Corey, Betsy, Justin |
| <input type="checkbox"/> Reset EQ stops | Corey, Betsy, Justin |
| <input type="checkbox"/> Perform the HAM2 exit chamber checklist. | Corey, Betsy, Justin |
| <input type="checkbox"/> Remove O-ring protectors, belly bar. | John, Kyle and Co. |
| <input type="checkbox"/> Replace the door on HAM2. | John, Kyle and Co. |
| <input type="checkbox"/> Turn off RGA and all SUS controller high voltages. | John |
| <input type="checkbox"/> Begin pump down per E000118. | John |
| <input type="checkbox"/> Remove Locks and Tags from 4k PSL shutter and gate valves. -Doug, John | |
| <input type="checkbox"/> Clean up and re-configure LVEA. | All Hands |