

MAGNET SWAP ETMS – VENT PLAN

APPROVALS	DATE	REV	DCN NO.	BY	CHECK	DCC	DATE
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APPROVED:							
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DCC RELEASE							

1 SCOPE

This is the **AS_BUILT** procedure for replacement of NdFeB face magnets on H1 ETMy with physically compatible SmCo magnets as part of the ELI upgrade. Our objective is to mitigate upconversion noise due to excessive Barkhausen effect associated with the NdFeB magnet formulation. Replacement of Flourel-tipped earthquake stops with silica tipped kinematic replacements (procedure T070257) is incorporated as the final stage to take advantage of the vent opportunity. The earthquake stops were swapped in the lab while the optic is removed from the LOS. Only face magnets on ETMy were replaced for each 4km interferometer. Side magnets, wire standoffs etc., were not disturbed. The existing side magnet was used as a geometric reference to insure new face magnets are installed in the correct relative positions.

BSC10 remained vented for the duration of the ETM work. The door was hung loosely such that purge flow was efficient and the chamber remained dry for the many days it was up to atmosphere. The ETMy was reinstalled using the optical lever system. As well, an autocollimator was setup inside of the chamber in order to snap shot the ETMy alignment, as a backup.

Task 1 – Optic Surface Inspection

Task 2 – Photon Calibration Measurements

Task 3 – LOS removal - restrain the optic in its LOS cage, and remove the assembly to the site optics lab.

Task 4 - Scatter light inspection.

Task 5 - Removal of Arm Cavity Baffles from the spool volume.

Task 6 – De-installed the optic from the suspension. Remove existing NdFeB face magnets and standoffs using a solvent that attacks cured epoxy resin. Replacement SmCo magnets are pre-bonded to new standoffs and will be attached using a subset of the COC/LOS initial build procedure. The mirror is then re-suspended in its LOS.

Task 7 – Vacuum chamber surfaces with new Class B vacuum equipment – particulate control.

Task 8 - Reinstall and align the ETM LOS according to the original interferometer build procedure.

Estimated Time Line and Task Leaders

Task 1 - Cheryl

Task 2 - Rick/Evan

Task 3 - Doug

Task 4 - Robert

Task 5 – Robert

Task 6 - Betsy/Doug

Task 7 – Cheryl

Task 8 – Doug

Vacuum related Tasks – Kyle/John

Time estimate: 2 weeks

2 APPLICABLE DOCUMENTS

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

LIGO E000062	BSC Installation document Note: Update E000062 to include OSEM/PAM iterations and better contamination controls.
LIGO M990034	LHO Contamination Control Plan

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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 E970154	Large Optic Suspension Balancing

3 Pre-Requisites

- File work permits
- Clean and airbake tools/Class B hardware. Betsy
- Assemble SmCo magnet/standoff sets. Betsy
- Stage installation EQ at end stations. Ski
- Clean end stations (damp mop, wipe down chambers) Terry
- Prep Optics Lab balancing bench (ensure level) Betsy
- Set up autocollimator assy on bench in optics lab
- Zero ETMy optical levers
- Test purge air compressor and roughing pumps Kyle
- Ensure cranes are parked nominally
- Ensure clean rooms are over BSC10 and are in working order Ski
- Setup mobile dust monitors at end stations, just below door flanges Ski
- Ensure CDS computer is working at end stations
- Get SUS damping controls working in optics lab
- Transition to Laser Safe
- Ensure proper beam dumping of the Photon Cal. beam

- Install and zero ETMy Auxiliary Optical Lever – Record position

Pitch 19.19mm, Yaw 6.4mm

See trends and elogs.

4 PREPARATIONS

Staging

Orange LOS Installation Case II	Stage at End Stations
CLASS B tools	Garb room
In-chamber bubble level	Staging cleanroom
TFE Highways	Engine Hoist
TFE pads	Lazy Susan
CLASS B C-Clamps	Lift Table
CLASS B Dog Clamps to mark existing ITM tower	Straddle
LOS Table clamps	Roller Table
CLASS A tie back wire	Orange LOS case
CLASS B TFE EQ stop caps	Pallets
Installation adapter plate	BSC Door Covers
CLASS A ¼-20 stock	BSC O-ring Protectors

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Flashlights/Batteries	Garb
Digital cameras	Mobile Dust Monitor
3 Oscilloscopes and BNC cable sets	Foil/ Wipes/ Alcohols
Octopus box and BNC cables	200 lbs of counterweights and assoc. screws
Auxiliary Optical Lever Setups	Backup Autocollimator Assy w/scope
	BSC mounting brackets for AC assy.

5 TASK STEPS

Complete the following between 7:00AM and 10:00AM 03/24/08:

1. Put a freeze on any 4K IFO work effecting this operation Control Room
2. Close gate valves
3. Slow vent (~1 hr to minimize static build up on optics) per M980133.
 - a. Turn off RGA and 4K ETMy SUS controller high voltages. Kyle
4. Break bolts on BSC10 E door – leave all but 4
5. Pull BSC10 E door (Install O-Ring protectors and soft covers).
6. Turn on SUS controllers
7. Setup oscilloscope equipment to monitor aux. optical lever readout
8. Record ETMy Sensors and SUSPIT/YAW values (or attach snapshot) – COMPARE WITH RECORDS ABOVE. LOOK FOR DISCREPANCIES WHICH MAY INDICATE CHARGE.

Checked – looks ok.

9. Zero and record ETMy Auxiliary Optical Lever Position

Pitch 19.35mm, Yaw 6.35mm

Task1 - Optic Surface Inspection

10. Entrance chamber checks (pictures, contamination control)
11. Place ETMy optic on earthquake stops (TFE caps on 4 bottom stops)
12. Optic Surface Inspection

Task2 - Photon Calibration Measurements

13. See T080005

Task3 - ETMy LOS removal from chamber

14. Install lazy Susan and transfer table.
15. Install lift table.
16. Verify the table level using a bubble level and record the values.
 - i. North/South centered ; East/West 2 ticks H1 to the West
17. Record PAM gaps. – See elog.

18. Install Autocollimator setup in front of ETMy, mounting to BSC wall gussets
19. Retroreflect off of ETMy HR, then zero autocollimator and scope – DO NOT TOUCH SETUP...

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20. Place 3 each class 3 dog clamps against ETMy structure height adaptor for dead stops.
21. Remove the OSEMs and mark the wire connector locations and directions. 9:55am 4/11/08

Side OSEM on North side of LOS. Plug in to J connectors in standard configuration.
Pigtails oriented away from center of optic.

NOTE – Found LR Coil unplugged since 1/4/08. Plugged back in ~9am 4/11/08

22. Place TFE highway and adaptor plate under structure.
23. Raise Lift Table and match the tapered pins into the SUS tower holes.
24. Remove the Tower dog clamps and leave them inside.
25. Pull ETMy with structure.
 - a. DO NOT REMOVE HEIGHT ADAPTOR
- ~~26. Remove the installation adaptor plate.~~
27. Install 200 lbs of counterweights at LOS table location.
28. Wrap tower and transport to optics lab maintaining contamination controls.

Task 4 - Scatter Light Inspection

29. Robert has a look around inside BSC 10

Task 5 – Arm Cavity baffle Removal

30. Disassemble the Arm Cavity Baffle which is located in the beam tube manifold on the vertex side of BSC 9.
31. Carry all pieces and tools out through BSC 10 – BE VERY CAREFUL NOT TO DISTURB AUTOCOLLIMATOR ASSY
32. Wrap parts
33. Rehang BSC10 door loosely so that the purge can keep the chamber as dry as possible.

Task 6 - ETM magnet swap

34. Record all processes below in optics traveler and file with DCC when completed.
35. Place ETMy LOS on level optics bench such that top surface of LOS is level. – Lifted off adaptor plate at this point.
36. Unclamp optic and record balance angle with autocollimator. ~1 min DOWN
37. Clamp optic.
38. Remove optic from LOS, leaving wire in place. Utilize the optic carrier fixture.
39. Transfer optic to cleaning area.
40. Weigh optic. 10,380g
41. Place optic in tripod base plate fixture. Stand silver BNC enclosure caps around magnet to act as an enclosure to hold Dynasolv 165. Apply a few drops of Dynasolv into magnet enclosure. After a few minutes, remove the enclosure cap and check magnet bond integrity via wiggling with your finger and/or pressing with a razor blade. Remove excess glue which is dissolving away with methanol. Keep area clean with methanol. Work all 4 face magnets simultaneously with more enclosure caps. Remove these magnet sets via the continual wetting process with Dynasolv 165.
42. Replace each of the 8 Barrel EQ Stops with the new silica tipped version, one at a time maintaining clamping of optic.
43. Replace each of the 8 Chamfer EQ Stops with the new silica tipped version, one at a time maintaining clamping of optic.
44. Clean areas where magnets were removed with methanol.
45. Clean full surface of mirror via drag wiping technique.

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46. Transfer optic to magnet gluing ring fixture and base plate and glue new SmCo magnet sets to face of optic via E970154 LOS Balancing Specification. Use existing side magnets to help register fixture in place.
47. Weigh optic. **10,379g - This time, weighed with fixture, then subtracted fixture weight.**
48. Vacuum Bake ETMy.
49. Re-suspend ETMy and verify balance angle with autocollimator.
50. TAKE CARE TO NOT DAMAGE EXISTING WIRE

51. If balance is found to be off, remove side guide rod and work through E970154 to rebalance the optic. This will require an additional vacuum bake of the optic since more vacseal will be applied.

52. Clamp Optic, preserving balance pointing to autocollimator.
53. Wrap LOS and transport to Y-End for installation
54. Reset PAMs in OSEMs to nominal 5/8" setting (from under PAM screw head to top TFE surface of OSEM)
55. Plugin and test voltages in lab
56. Wrap and transport to end station

~~Task 7 – Vacuum chamber – particulate contam. Control~~

57. ~~Vacuum Chamber – BE VERY CAREFUL NOT TO DISTURB AUTOCOLLIMATOR ASSY~~

Task 8 – Reinstallation of ETMy at end stations (starting with ETMy)

58. Ensure that ETMy SUS and IFO alignment biases are ZERO.
59. Place the ETMy onto the adaptor plate and dog it down.
60. Transfer ETMy onto the Straddle lift TFE highway.
61. Remove 200 lbs of temporary counterweights.
62. Install ETMy per LIGO E000062
 - a. (Use as a guideline with modifications pertaining for this special installation)
63. Dog the tower to the table against the dead stops.
64. Replace the bottom earthquake stops with Flourel tips.
65. Install elliptical baffle counter weight.
66. CHECK TABLE LEVEL
67. Plug in OSEMS
68. Reinstall OSEMs to 50% OLV in ETMy LOS.
69. Release all earthquake stops.
70. Adjust PAMs and OSEMs to maintain 50% open light voltages and to align to Auxiliary Optical Lever/AC.
 - i. MANUALLY YAW the tower as necessary (and very likely at this point). **3:40pm 4/24/08**
71. Place optic onto earthquake stops.
72. Remove the elliptical baffle counter weight and install the elliptical baffle.
73. Verify the table level using a bubble level and record the values.
74. North/South **centered**; East/West **2 ticks Hi to the West**
75. Release all earthquake stops.
76. Adjust PAMs and OSEMs to maintain 50% open light voltages and to align to Auxiliary Optical Lever/AC.
 - a. **Note: Requires several iterations to minimize the final PAM adjustments when the elliptical baffle gets installed. (Add this process to E000062).**

77. Place optic onto earthquake stops.
78. Remove Lift Table and Lazy Susan
79. Remove monitoring hardware/AC assy. from in situ.
80. Measure PAMs - **Only measured the PAM head to body, not the body to the optic face.**

Task2 - Photon Calibration Measurements (AGAIN)

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81. See T080005 – Made measurements with ETMy off it's EQ stops (hanging freely)

Watched drift for a day, made a second PAM adjustment after major alignment drift had slowed to negligible. See elogs ~4/24/08-4/30/08. Possible table hysteresis from installation activity – major drift seen in ETMy in first 8 hours after reinstallation. After re=PAMing, trends showed that the drifting was settling out.

- 82. Perform the BSC10 chamber exit checklist.
- 83. Replace the door on BSC10
- 84. **Turn off SUS controller high voltage**
- 85. Begin pump down per E000118.