



CALIFORNIA INSTITUTE OF TECHNOLOGY
 MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DCN No. E010129-00-W

SHEET 1 OF 1

7/11/01

DOCUMENT CHANGE NOTICE (DCN)

DOCUMENT No. (DOC-REV-GR. ID)	TITLE	NEW REV.
LIGO-E010001-B-W	LHO Detector, Y-End Station, In-Chamber Installation	C

CHANGE DESCRIPTION (FROM/TO):

Rev. B is a procedure written prior to starting the tasks inside WBSC 10.
 Rev. C is a revision to the procedure based on what was actually done inside WBSC 10, including any deviations from the tasks outlined. All revisions are noted in red italics.

REASON FOR CHANGE: Updated for 4k Detector Installation

ACTION: Incorporate change Attach DCN to drawing(s) Other action (specify):

DISPOSITION OF HARDWARE (IDENTIFY SERIAL NUMBERS)	DCN DISTRIBUTION (X=incl. docs)
<input checked="" type="checkbox"/> No hardware affected (record change only)	X Coyne Barish Coles
<input type="checkbox"/> List S/Ns which comply already:	X Raab Lazzarini Lindquist
<input type="checkbox"/> List S/Ns to be reworked or scrapped:	X Stapfer Sanders Shoemaker
<input type="checkbox"/> List S/Ns to be built with this change:	X Whitcomb Tyler Weiss
<input type="checkbox"/> List S/Ns to be retested per this change:	X Cook
<input type="checkbox"/>	X Radkins
<input type="checkbox"/>	X Mike Smith
<input type="checkbox"/>	
<input type="checkbox"/>	
<input type="checkbox"/>	

SAFETY, COST, SCHEDULE, REQUIREMENTS IMPACT? No Yes (if yes, enter Change Request number)

APPROVALS:	DATE	OTHER APPROVALS (specify)	DATE
ORIGINATOR: L. Jones/B. Weaver	7/11/01		
TASK LEADER: D. Coyne	7/11/01		
GROUP LEADER: s. Whitcomb	7/11/01		
DCC RELEASE:	7/24/01		



INSTALLATION SPECIFICATION

TITLE

**LHO DETECTOR, Y-END STATION, IN-CHAMBER <
> INSTALLATION**

APPROVALS:	DATE	APPROVALS:	DATE
DRAWN: L. Jones, B. Weaver, D. Coyne	6/22/01	CHECKED:	
CHECKED: Hugh Radkins	7/11/01	CHECKED:	
CHECKED:		DCN NO	APPROVED
CHECKED:		E010122-00-W	Dennis Coyne
		E010129-00-W	6/24/01

1 SCOPE

This installation procedure covers the installation, alignment and initial check-out of Detector equipment in the Y End Station, vacuum chambers. The primary tasks are the End Test Mass, y-arm, (ETMy) optic installation, the ETMy telescope and beam dump installation, the arm cavity baffle installation (and moving the baffle out of the way for initial beam alignment checks), optics table access cable installation, alignment of the ETM transmission monitor and viewport installations for photon calibration and a temporary camera (to be removed when the arm cavity baffle is later erected back into position).

2 APPLICABLE DOCUMENTS

Listed below are all of the applicable and referenced documents for this task procedure. This list gives the latest revisions of the documents; within the installation steps, only the document number (and not the revision) is quoted.

D000068-A	Access Cable
M990034-B	Contamination Control Plan
E000062-C	LOS Installation Procedures
T970151-C	ASC Initial Alignment Procedures
E000119-A	Hanford Checklist - Vent Isolatable Volumes
M980133-B	Vent Isolatable Volumes
E000121-A	Hanford Checklist - Spool Removal
E000120-A	Hanford Checklist - BSC Door Removal
M980132-B	O-Ring Installation and Flange Assembly Procedure for HAM and BSC Doors
M980101-B	Procedure for Isolatable Volume Pump Down
D970210-B	ASC Monument Locations, Washington Site, End Station, Y-Arm (sheet 5)
E000065-04	Chamber Entry/Exit Checklist
D000462-A	ETMy, ETM Telescope Location, LHO, BSC10



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D990340-A	Arm Cavity Baffle, ETM Assembly Drawing
D990350-A	Arm Cavity Baffle, ITMy/ETM, Glass Support Assembly Drawing
D990491-A	Arm Cavity Baffle, ETM, Outer Support Assembly Drawing
M990316-00	Standard Operating Procedure: COS Infrared Alignment Laser Operation in the Midstation and Endstation
M980047-E-W	Transition to Laser Hazard
M980048-E-W	Transition to Laser Safe
T000065-05	COS 4k IFO Alignment Procedure Except: Adapt for alignment with the PLX as described herein.
T010071-00	Recording Form for Sensor/Actuator Measurements Taken at the Vacuum Feed Throughs using the MIT Breakout Box
D970220-C	ISC Equipment Layout, End Station, Y-Arm, Washington Site (sheet 8)
D980228-00	Naming Convention for Ports on Adapter
D980227-00	Naming Convention, BSC Ports
D980229-00	Naming Convention, BSC Door Ports
D010115-A	Arm Cavity Baffle, 4k ETMy Installation

3 PRE-REQUISITES

- 1. Revised satellite boxes: New or modified to handle the higher current requirements of the modified Sensor/Actuator Heads (alias OSEM), D000069-A.
- 2. A BSC cleanroom must be in place over WBSC 10 and operable.
- 3. The vacuum equipment purge air system must be operable before starting the task.
- 4. Perform laser safety walkthroughs per M990316 for unescorted workers in the VEA, as required.
- 5. Quad photo diode and optics for the transmission monitor should be assembled and installed on the ETM transmission tower.
- 6. The optical lever transmitter and receiver should be assembled and installed on the optical lever bench.
- 7. The ETM Large Optic Suspension (LOS) must have the modified chamfer stop tips installed.



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4 PREPARATION

All preparation must be in accordance with the Contamination Control Plan (M990034).

- 8. Clean the Y End Station VEA, particularly the floor; Particulates and dust should be removed by mopping with clean water. Clean the BSC chamber (wipe or mop with clean water) from the stiffening ring above the door down, as well as the floor in the vicinity of the chamber well in advance of the opening of the vacuum system.
Check the clean room HEPA filters; replace is necessary.
Examine and if necessary clean the top of the BSC chamber and the top of the BSC clean room.
Allow the dust settle for approximately 1 day prior to performing any clean room activities in an area which has been cleaned.
- 9. Insure that there are no large openings to the exterior or the beam tube enclosure where insects or dust can get into the VEA.



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- 10. Transport the following items to the Y End Station VEA:
 - Appropriate cleanroom garb, including gloves, in-chamber booties
 - Flashlights, radios, batteries
 - Arm Cavity Baffle Installation Tools
 - Arm Cavity Baffle
 - Arm Cavity Baffle hardware
 - Arm Cavity Baffle Target
 - CLASS A Ground Strip (D000068)
 - CLASS A 1/4-20x1/2" SHCS
 - Cloth Door Covers
 - COS Table Clamps
 - COS Tool pan (wrenches and allen keys)
 - Camera and lens
 - CO2 gun and portable bottle and portable N2 gun with ionizer.
 - Precision Bubble level
 - ETMy Height Adaptor
 - ETMy Suspended Optic
 - ETMy Telescope and Beam Dump
 - ETM Telescope Targets
 - BSC work stool
 - LOS Table Clamps and Fasteners
 - LOS Installation Fixtures (Lazy Susan, Lift Truck, Straddle, etc.)
 - Oscilloscope and BNC Cables
 - Sony Nightshot Videocam
 - Foil, Ameristat, and Tape
 - 2 Viewports - VP800 AR 1064 *LHO only had 1 AR coated viewport at the time.*
 - ETM Telescope Steering Mirror and Mount
 - Surveying equipment & laser/autocollimator equipment with LLO laser autocollimator.
 - In-chamber vacuuming system *Didn't have at LHO at the time of this installation.*
 - Viewport copper gaskets, flange bolts and nutplates
 - Flange toolkit
 - Viewport covers
 - PLX Assembly/Stand

5 TASK STEPS

All tasks must be in accordance with the Contamination Control Plan (M990034).

- 11. **Assemble the Arm Cavity Baffle** (as much as possible) in the cleanroom outside of the chamber.
- 12. **Vent** the BSC 10 section volume per procedure M980133.

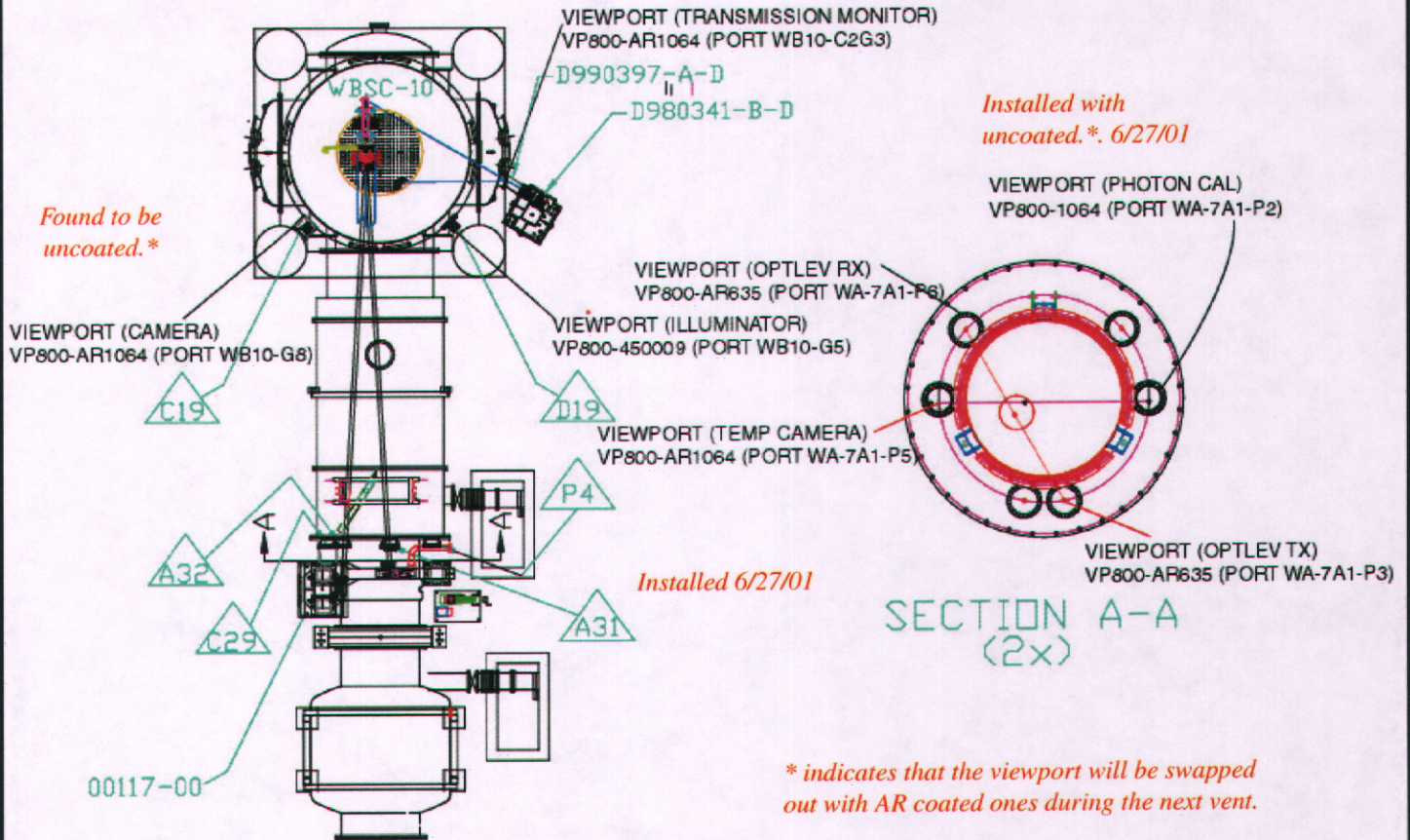


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- 13. **Install viewports** as necessary in accordance with D970220-C (where the port naming convention is per D980228-00 for adapters and D980227-00, D980229-00 for BSC chamber and doors). For convenience the viewport location information is included below.





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- 14. **Remove BSC West and South doors** and turn up purge air to maximum flow. **NOTE!** It is very important that we limit exposure of the vacuum surfaces to atmospheric moisture, to minimize pumping time required before gate valves can again be opened. This is largely a function of purge air flow volume and the duration of chamber open times. This procedure is written to minimize the durations of removal. **Fabric door covers afford a surprising amount of shielding (with purge), so they should be installed whenever access through the door opening is not required within a short time period. This includes the practice of installing a cover when workers are inside a chamber.**
- 15. **Perform alignment check** of the Brunson 75H optical square per Appendix 3 of T970151. Position Brunson optical square on 10' offset beamline at IAM 23. Set height ~96.5mm below WBSC10 60" flange centerline. Align Brunson to offset Beamline.
- 16. Enter the BSC and perform applicable **chamber entry tasks** per E000065-04.
- 17. **Install arm cavity baffle** in beam manifold section. (Best if done prior to installation of any equipment onto the optics table.) Position the arm cavity baffle in accordance with the layout drawing.
- 18. **Install the LOS tooling**, support beam and lift table.
- 19. **Position the Sokkia total station** (with the LDS-1000 laser autocollimator mounted on top) over IAS monument IAM 24. The global coordinates of IAM24 are {+0.200x, 4002.372y} m (as indicated in D970210).

Set the height so that the center of the LDS-1000 aperture is at -96.5 mm in local coordinates. Site Brunson mirror (normal to offset beamline) with LDS-1000 and zero the LDS readout. Set the Sokkia Horizontal angle to zero and note the vertical (zenith) angle.

Adjust the Sokkia so that it is pointing as follows:
 Yaw = - Y direction, 90 deg. 00' 00"
 Pitch =90 deg 02' 12" (2' 12" below Horizontal, toward vertex), relative to the vertical (zenith) angle of the Brunson mirror.
- 20. **Install ETMy telescope** and beam dump, and coarsely align both. Re-level the table using the precision bubble level.



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- 21. **Install the ETMy optic** per E000062-C. Be certain that the optics table is level before releasing the stops on the ETM optic.
*We positioned the LOS with the Sokkia to the following coordinates:
-199.4, 3999870 (x,y)
*This is 10mm in the +y direction to compensate for the +10mm positioning of the 4k ETMx in the +x direction. This was accomplished by adjusting the theodolite to an angle of 10 deg. 00' 46" relative to the -y axis and measuring a distance of 2298mm from the theodolite to the LOS retroreflecting prism. Rotation (yaw) of the LOS was achieved by retroreflecting off of the ETMy optic through the PLX using the numbers indicated in Step 19 above.
Note: this optic setup includes the new design OSEM heads, which will be tested later.
Reminder: cover door opening when access is not being required.*
- 22. **Install the access cable** (D000068) from the kapton cable connector to the optics table. This cable is inserted into the J2 connector in the position adjacent to the Side (S) OSEM connector (see the sketch on page 9 of E000062). Record the position of the table connection of this cable as an "as-built" mark-up for drawing revision.
- 23. **Position the PLX** (Lateral Transfer Hollow Retroreflector) on a clean, stable mount in the manifold tube in front of ETMy-4k oriented horizontally, with its aperture approximately centered laterally and vertically with respect to the EMTx-4k optic. *This was done with the assistance of a "height centering target" placed in front of the LOS structure. Originally, the PLX was placed such that retroreflection was the only parameter adjusted for. The position of the PLX projected beam needs to be correct however, in order to perform Step 31 below. Pre-setting the height of the ETM Telescope on the bench before installing it would serve as the centering target for the PLX beam. We had the telescope at the wrong height initially, however.*
- 24. **Adjust the PLX** if/as required so that the LDS-1000 beam is centered in both apertures.
- 25. Put SEI on PZTs while monitoring the ETMy optic.



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- 26. **Align ETMy optic.**
Block reflections from the ETM telescope by putting a piece of UHV foil in front of the telescope primary mirror.
Switch off the optical lever (which can interfere with the LDS-1000 autocollimator).
Adjust the PAM magnets of the ETMy4k suspension assembly until the LDS-1000 beam is auto-collimated to within 10 microradians.
Maintain the proper 50% open light voltages throughout alignment when adjusting PAM screws.
If a large yaw adjustment is required (greater than ~1 mrad), then first perform a coarse yaw alignment by shifting the suspension structure on the optics table as follows:
 - a) clamp the suspended optics on the table
 - b) position stops on two sides of the structure as a reference to the position, preferably with pusher screws to help rotate the structure
 - c) loosen the dog clamps which secure the structure to the table
 - d) rotate the suspension structure slightly, steering with a target having a small aperture and retighten the dog clamps
 - e) unclamp the optic and recheck the yaw error with the LDS-1000 autocollimator
- 27. **Measure OSEM values** using MIT breakout box at feedthrough port; see section 6.3 "OSEM Test Box" of E000388 for instructions.
Complete the table in T010071 and file in the elog.
- 28. **Transition to Laser Hazard.**
- 29. **Put the COS alignment laser standard operating procedure** (M990316-00) in place.
- 30. **Setup COS laser autocollimator** in theodolite fixture on optical beam center line. Align the COS LAC by retroreflection off of the ETMy high reflectance (HR) surface, through the PLX. Ensure that the ETMy is freely suspended during this step.
- 31. **Align ETMy telescope, beam dump and transmission monitor** using the COS laser autocollimator per procedure T000065 (except adapted for use with the PLX).
Caution: Ensure that the ETM optic is securely on its stops during any operations involving adjustment of the telescope or the beam dump.

*The steering mirror used at the back of the telescope is an S-polarized mirror.
The transmission monitor pier was moved beyond it's originally designed base plate mounting position (similar to the as-built transmission pier for the 4k ETMx). The base plate needs to be moved to where the pier is now located and re-anchored to the floor.*
- 32. *Remove the PLX.*
- 33. **Align arm cavity baffle**, using the COS laser autocollimator and target in the Arm Cavity Baffle 2k hole. We leveled the baffle so that we could assume that aligning to the 2k hole meant that the 4k hole was also aligned.



INSTALLATION SPECIFICATION

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- 34. **Transition to Laser Safe.**
- 35. **Setup optical lever and align;** confirm arm cavity baffle does not clip beam.
- 36. **Check Photon Calibrator Path:** Use a HeNe alignment laser to confirm that the photon calibrator path from the designated viewport to the ETM optic is not clipped or blocked by the arm cavity baffle.
- 37. **Set Arm Cavity Baffle on bottom of manifold tube:** Scribe arm cavity baffle parts for precision replacement (+/- 1 mm); remove baffle from frame and lay in beam manifold for later replacement. **Reminder: cover door opening when access is not being required.**
- 38. Perform applicable **chamber exit tasks** per E000065-04.
- 39. **Set safety stops** $\leq 0.5\text{mm}$.
Check optical lever screen and bias pitch and yaw for full travel at max gain settings.
Reduce gains to 10%, invert signal temporarily and observe ringdown for possible railing of the optic against safety stops.
- 40. **Re-install the chamber doors** per M980132.
- 41. **Pump down** the BSC chamber volume per M980101.
- 42. **Make an Elog entry** pertaining to the task completed, including any deviations, recorded values, and notes. Be sure to include the data from T010071 recorded above.