This document covers the technical content for acceptance review of a subset of the Advanced LIGO (aLIGO) installation. See document [M1300468](https://dcc.ligo.org/LIGO-M1300468) for an overview of the aLIGO acceptance process. Acceptance by Systems Engineering is to be indicated in the metadata for this document in the LIGO Document Control Center (DCC).

# Installation Instance/Subset Definition

*Insert a brief description of the subset of the aLIGO equipment which is covered under this installation acceptance document. Complete the entries in the following table. If elements of the table are not applicable, enter “not applicable”.*

This installation covers the HAM chamber LHAM2 and all of the equipment within and attached plus associated electronics racks.

|  |  |
| --- | --- |
| **Interferometer** [*L1 or H1*]: | **L1** |
| **Building**(s)/**Room**(s): [*e.g. corner/LVEA*] | **LVEA** |
| **Vacuum Chamber**(s): | **LHAM2**  Top Level Chamber Assembly drawing [D0900365](https://dcc.ligo.org/LIGO-D0900365) includes the following major assemblies:   * HEPI * HAM ISI * One HLTS: PR3 * Three HSTS: MC1, MC3, PRM * Four HAUX: SM1, SM2, PMMT1, PMMT2 * Faraday Isolator Assy * Three IO Periscope Assy (2 types) * PSL Photodiode Assy * Plus fixed mirror assemblies, baffles and balance masses. |
| **Electronics Rack Designation**(s): | [D1100909](https://dcc.ligo.org/LIGO-D1100909), Input Optics Electronics Layout  [D1100170](https://dcc.ligo.org/LIGO-D1100170), Vertex ISC Electronics Layout  L1-ISC-R1 (LVEA)  L1-SUS-R1 (LVEA)  L1-ISC-C1 (CER)  L1-SEI-C2 (CER)  L1-SUS-C3 (CER)  L1-SUS-C4 (CER)  Note that the Capacitive Position Sensor readout boxes which sit on the cable trays do not have an official designation |
| **Optics Table(s)/Enclosure(s) Designation**(s), and **other equipment/assemblies related to this installation**: | Two IO Tables: IOT2L and IOT2R  Ground Seismometer SEI-GND-STS-A  Mode Cleaner Tube Baffle Assys for the IMC  Optical Levers for PR3 & HAM2 table |

# Procedures

If there are any caveats or explanatory notes regarding the procedure documentation cited in the table below, then add these notes to the table entries.

|  |  |
| --- | --- |
| **Baseline or initial Installation Procedure**(s):  *[enter linked DCC document #(s); found under* [*E1200023*](https://dcc.ligo.org/LIGO-E1200023)*]* | [E1200565](https://dcc.ligo.org/LIGO-E1200565)-v1 was the initial procedure for the LHAM2 chamber. This procedure lists the major sub-assemblies.  [E1100718](https://dcc.ligo.org/LIGO-E1100718) was the procedure used to install the MC Tube Baffles  [E1200063](https://dcc.ligo.org/LIGO-E1200063), was the procedure used to install the Optical Levers |
| **As-Built/Installed Procedure**(s), either:   1. Enter hyperlinked DCC number for revised or red-lined baseline install procedure, and/or 2. Enter hyperlinked DCC number for separate document with installation notes on deviations, changes in procedure, changes in tooling, etc., and/or 3. Enter a list of hyperlinked electronic log entries detailing the experience in applying the baseline installation procedure | No as-built notes were recorded in any of the installation documents, including E1200565.  The LHAM2 ISI was removed from the transport container and placed on test stand on 14-Feb-2012 in elog [#2489](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=2489).  The LHAM2 ISI installation was reported as completed on 28-Feb-2012 in elog [#2586](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=2586).  elog #[2604](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=2604): MCA1 Baffle installation  elog #[2683](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=2683): LHAM2 ISI  elog #[2686](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=2686): MCA2 Baffle installation  elog #[3522](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=3522): PR3 suspension installation  elog #[3611](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=3611): MC1 suspension installation  elog #[3693](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=3693): MC3 suspension installation  elog #[3976](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=3976): optics table balanced  elog #[4083](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=4083): viewports installed  elog #[6149](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=6149): HEPI controller working  elog #[6556](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=6556): IO baffles installed  elog #[1298](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=1298): closeout LHAM2  elog #[7344](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=7344): PDL outer loop PD Array installed  elog #[10811](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=10811): PR3 and LHAM2 OptLevs are installed and working |
| **Baseline or initial Alignment Procedure**(s): *[enter linked DCC document #(s); found under* [*E1100734*](https://dcc.ligo.org/LIGO-E1100734)*]* | [E1200640-v5](https://dcc.ligo.org/LIGO-E1200640-v5) was the principal initial alignment procedure (for chambers, optics tables and core optics)  [E1200037](https://dcc.ligo.org/LIGO-E1200037) is the alignment procedure for optical levers |
| **As-Built/Aligned Procedure**(s), either:   1. Enter hyperlinked DCC number for revised or red-lined baseline alignment procedure, and/or 2. Enter hyperlinked DCC number for separate document with alignment notes on deviations, changes in procedure, changes in tooling, etc., and/or 3. Enter a list of hyperlinked electronic log entries detailing the experience in applying the baseline alignment procedure | [E1200640-v6](https://dcc.ligo.org/LIGO-E1200640-v6) is the as-built alignment procedure, with embedded notes.  elog #[7383](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=7383): DRMI alignment checked out as well within IAS tolerances |

# Drawings

*Enter hyperlinked DCC document number(s) for each drawing in the table below. If elements of the table are not applicable, enter “not applicable”. All chamber-level, assembly drawings can be found listed at* [*E1200562*](https://dcc.ligo.org/LIGO-E1200562) *and found linked under* [*D0901491*](https://dcc.ligo.org/LIGO-D0901491)*.*

|  |  |
| --- | --- |
| Applicable Building/Room Top-Level Drawing(s): | [D0901466](https://dcc.ligo.org/LIGO-D0901466), aLIGO Systems Layout LLO Corner Station |
| Top-Level Chamber Assembly Drawing(s): | [D0900365](https://dcc.ligo.org/LIGO-D0900365), aLIGO Systems, LHAM2-L1 Top Level Chamber Assembly |
| Electronics Rack Drawing(s): | All drawings for the racks can be found by navigating through [G1001032](https://dcc.ligo.org/LIGO-G1001032). |
| Optics Table/Enclosure Drawing(s): | [D1300356](https://dcc.ligo.org/D1300356), As Built Layouts for ALIGO L1 IOT2L and IOT2R |
| Optical Lever Drawing(s): | [G1000700](https://dcc.ligo.org/LIGO-G1000700) Floor Occupancy, Optical Levers, LLO Corner Station  [D1001334](https://dcc.ligo.org/LIGO-D1001334), PR3 OptLev Transmitter (Tx) Assy  [D1001166](https://dcc.ligo.org/LIGO-D1001166), PR3 OptLev Receiver (Rx) Assy  [D1001851](https://dcc.ligo.org/LIGO-D1001851), HAM2 OptLev (Tx/Rx) Assy |
| Mode Cleaner Tube Baffle Dwg(s): | [D1000774](https://dcc.ligo.org/LIGO-D1000774), Mode Cleaner Tube Baffle Assy (specifically MCA1 and MCA2) |

# Serial Number Records

*Serial numbers are used to track a subset of the parts, particularly active elements (see* [*M1000051*](https://dcc.ligo.org/LIGO-M1000051)*) and electronics (with S-numbered documents; see* [*T0900520*](https://dcc.ligo.org/T0900520)*). Enter the hyperlinked DCC document number(s), and name(s) for the highest level assembly(ies) covered by this installation acceptance document in the table below. Also enter the hyperlink to the ICS entry for the instance of this assembly in the Inventory Control System (ICS). If elements of the table are not applicable, enter “not applicable”. If elements of the table are not available/missing, then enter “not available”.*

|  |  |  |
| --- | --- | --- |
| Assembly DCC D-Number | Assembly Name | ICS entry |
| [D0900365](https://dcc.ligo.org/LIGO-D0900365) | aLIGO Systems, LHAM2-L1 Top Level Chamber Assembly | https://ics-redux.ligo-la.caltech.edu/JIRA/browse/ASSY-D0900365-NA |
| [D1000514](https://dcc.ligo.org/LIGO-D1000514) | HEPI | N/A (assembly and install done in 2004, before ICS) |
| [S1201192](https://dcc.ligo.org/LIGO-S1201192) | L1-ISC-R1 (LVEA) | NA |
| [S1200749](https://dcc.ligo.org/LIGO-S1200749) | L1-SUS-R1 (LVEA) | NA |
| [S1201186](https://dcc.ligo.org/LIGO-S1201186) | L1-ISC-C1 (CER) | NA |
| [S1200744](https://dcc.ligo.org/LIGO-S1200744) | L1-SEI-C2 (CER) | NA |
| [S1104357](https://dcc.ligo.org/LIGO-S1104357) | L1-SUS-C3 (CER) | NA |
| [S1104358](https://dcc.ligo.org/LIGO-S1104358) | L1-SUS-C4 (CER) | NA |

# Testing

*All post-installation, stand-alone, in situ, checkout/testing (phases 2 and 3 per* [*M1000211*](https://dcc.ligo.org/LIGO-M1000211)*) must be completed, be successful and be documented:*

* *phase 2: pre-installed, post-storage, test results for the assembly (testable item)*
* *phase 3: stand-alone, in situ test results for the assembly (testable item)*

*Note that integrated testing (phase 4 testing per* [*M1000211*](https://dcc.ligo.org/LIGO-M1000211)*) is covered under the system acceptance review, not this installation acceptance review. In the table below, enter hyperlinked DCC document number(s) for all of the relevant testing for the major subassemblies/subsystems covered within this installation instance/subset. If elements of the table are not applicable, enter “not applicable”. If elements of the table are not available/missing, then enter “not available”.*

|  |  |  |  |
| --- | --- | --- | --- |
| Subsystem | Testable Item | DCC document numbers | |
| Phase 2 | Phase 3 |
| SEI | HAM-ISI | [E1200105](https://dcc.ligo.org/LIGO-E1200105) | |
| SEI | HEPI | N/A | [E1300923](https://dcc.ligo.org/LIGO-E1300923) |
| SUS (under *Test Results*) | PR3 Suspension | [E1300836](https://dcc.ligo.org/LIGO-E1300836) | |
| PRM Suspension | [E1400114](https://dcc.ligo.org/LIGO-E1400114) | |
| MC1 Suspension | [E1400118](https://dcc.ligo.org/LIGO-E1400118) | |
| MC3 Suspension | [E1400120](https://dcc.ligo.org/LIGO-E1400120) | |
| IO | HAM AUXiliary Suspensions (4 reports linked to DCC entry) | [T1300396](https://dcc.ligo.org/LIGO-T1300396) | |
| AOS/SLC/Viewports | Leak and pressure testing. | E1200445. Leak & pressure testing completed. All viewports tagged at time of inspection and testing. | Visual inspection in-situ not completed, refer to bug list. |
| AOS/OptLev | PR3 OptLev | [E1200992](https://dcc.ligo.org/LIGO-E1200992): Completed test reports for OptLev QPD Amplifiers  [E1200214](https://dcc.ligo.org/LIGO-E1200214): In-situ optical-lever testing and acceptance procedure (no completed reports filed) | |
| IO | Faraday Isolator | [E1300484](https://dcc.ligo.org/LIGO-E1300484) | |
| PSL | ISS outer loop PD Array | [T1300594](https://dcc.ligo.org/LIGO-T1300594) | |

# Installation Completeness

*If/as applicable, provide a hyperlink reference to a list of remaining tasks to be completed before the installation is finished (i.e. a ‘punch’ list).*

|  |  |
| --- | --- |
| Installation tasks remaining to be completed: | **All items are installed.** |

# Installation/Integration Issues and ECRs

*If/as applicable, provide a hyperlinked list of integration issues and Engineering Change Requests (ECRs) encountered during installation and which are relevant to the installation subset/instance covered by this acceptance document. See* [*M1300323*](https://dcc.ligo.org/LIGO-M1300323) *for a description of the Integration Issue and ECR Tracker. The format of the url for the issue tracker is as follows.*

*https://services.ligo-wa.caltech.edu/integrationissues/show\_bug.cgi?id=\**

|  |  |  |  |
| --- | --- | --- | --- |
| \*id | status | resolution | Title/description |
| 3 | Closed | Won’t fix | Unintentional ground connection at GS-13 pods |
| 9 | Accepted | Pending | SUS Coil Driver Noise Monitor Circuits Untrustworthy |
| 19 | Closed | fixed | Increasing "Control" HSTS M2 (Middle) Stage Coil Drivers |
| 24 | Closed | Fixed | Increase series resistors on HAM-A and TT coil drivers |
| 45 | Closed | Fixed | propose new location for the corner station STS-2 ground seismometers |
| 53 | Closed | Fixed | HSTS lower blade stop replacement |
| 71 | Closed | Fixed | ISS PD array issues |
| 78 | Closed | Fixed | SUS Electronics Missing/Incomplete/Out-of-date Drawings |
| 91 | Closed | Fixed | ECR - Adding Coil Driver Monitor Signals to Frames |
| 108 | Closed | Won’t fix | Light transmitted through the HAM OptLev mirrors may scatter into OSEMs, PDs |
| 118 | Closed | Fixed | ECR: HEPI medm screen update |
| 140 | Closed | Fixed | ECR HAM-ISI model and MEDM screen update |
| 186 | Closed | Fixed | ECR: Topology Changes to SUS models as a result of ISC Informed Interaction |
| 205 | Closed | Fixed | ECR: Add Cartesian bias monitoring and offsets to the ISI models |
| 207 | Closed | Fixed | ECR: Model and screens update to allow sensor correction to the ISI using Ground seismometers (STS-2) |
| 257 | Closed | Won’t fix | Include new 'command' screen using Python/ guardian tools |
| 283 | Accepted | Pending | CPS Circuit Modification to eliminate a high frequency oscillation |
| 355 | Closed | Fixed | ECR: Modify HAM-ISI and BSC-ISI simulink control filters to monitor gain for ODC |
| 360 | Closed | Fixed | Ground loop fix in interface to all GS-13 |
| 375 | Closed | Fixed | ECR: Migrate the ISI Checker Script functions to the frontend code |
| 385 | Closed | Fixed | ECR: create science frame channels for the SEI models |
| 445 | Closed | Fixed | Update the SAFE level for the BSC and HEPI model watchdog |
| 460 | Closed | Fixed | Update watchdog trip plotting software |
| 461 | Closed | Works | Move HAM-ISI Optical Levers to HSTSs |
| 464 | Closed | Fixed | Baffle on PR3 SUS to prevent pitch alignment drift |
| 482 | Accepted | Pending | ECR: ODC changes in SUS, SEI, HPI and PSL |
| 487 | Closed | Fixed | ECR: Remove ISI IPC links which come from SUS offload |
| 500 | Closed | Fixed | ECR: HEPI MEDM Update |
| 530 | Closed | Fixed | ECR: update to the HEPI master model and related MEDM screens |
| 534 | Closed | Won’t fix | Dual 5 way coax feedthrus installed on HAM 1 and 2 are not of the latest version |
| 551 | Closed | Fixed | ECR: HEPI script update |
| 571 | Accepted | Pending | LHAM2 Issue Tracker: a place to collect any pending issues specific to LHAM2 |
| 629 | Accepted | Pending  L1 Fixed | CPS Racks Grounding Schemes |
| 630 | Accepted | Pending | CPS cross talk |
| 644 | Accepted | Pending | checking electronics modules without visible over-current protection |
| 650 | Accepted | Pending | ECR: ISI model update - Jan 2014 |
| 659 | Accepted | Pending | options to ameliorate spot size issues with ISS PD arrays in HAM2 chambers |
| 668 | Accepted | Pending | DC Switch Breaker Box Install in Pier Pod and TCS ISS Power cords. |
| 721 | Assigned |  | ECR: Replace the custom cartesian-bias-ramping code with cdsFiltCtrl2 parts |
| 722 | Accepted | Pending | ECR: Adding Independent ASC IPC Paths for Dither Alignment to Most SUS |
| 741 | Accepted | Pending | ISC/IO tables: Lights and fan status readback |
| 746 | Accepted | Pending | ECR: store suspension mis/alignment values separately in EPICS database |
| 759 | Closed | Fixed | Add BLRMS for OpLevs on suspensions |
| 761 | Accepted | Pending | In Situ, Visual Inspections of All Viewport Windows |
| 779 | Assigned |  | HAM 2&3 and ITMX, BS & ITMY (ISI and HEPI) local models slightly differ from documentation (ADC/DAC numbering) |
| 788 | Assigned |  | mechanical problems with the Optical Levers (OptLev) at both sites |
| 803 | Accepted | Pending | IM3 (HAUX) excess noise on UL channel |
| 804 | Accepted | Pending | IM1 (HAUX) excess noise on LR channel |
| 805 | Accepted | Pending | IM3 (HAUX) first structural mode resonance non-compliance |
| 836 | Accepted | Pending | Glitches in ISI drives from the Blend switching algorithm |
| 837 | Accepted | Pending | HEPI L4C watchdog trips |
| 842 | Accepted | Pending | ECR: Adding optical lever damping infrastructure to QUAD, BSFM, and HLTS |
| 848 | Accepted | Pending | ISS Picomotor Nonfunctional |