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 LHAM5 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): | **LHAM6** |
| **Electronics Rack Designation**(s): | L1-ISC-C1, L1-ISC-C2, L1-ISC-C3, L1-ISC-C4, L1-ISC-R3. L1-ISC-R5. L1-SUS-C7. L1-SUS-C8. L1-SEI-C1.  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: | L1-ISCHT6R drawing at [D1201210](https://dcc.ligo.org/LIGO-D1201210) |

# 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)*]* | [E080012](https://dcc.ligo.org/LIGO-E080012) was the initial procedure to install the ISI.  [E070341](https://dcc.ligo.org/LIGO-E070341) was the hazard analysis for the ISI Install. |
| **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 document.  The installation of The HAM-ISI was recorded in aLOG [#3784](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=3784) .  The OMC Installation in aLOG [#7486](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=7486), cabling in aLOG [#7494](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=7494).  Installation of tip-tilts is in aLOG [#7505](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=7505) |
| **Baseline or initial Alignment Procedure**(s): *[enter linked DCC document #(s); found under* [*E1100734*](https://dcc.ligo.org/LIGO-E1100734)*]* | [#E1101072](https://dcc.ligo.org/LIGO-E1101072) was the initial procedure. This is just an empty file card since there are no suspensions on this table to align. Tip-tilt mirrors and the OMC are aligned using interferometer beams. |
| **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 | Optics on the table were aligned using interferometer beams. |

# 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): | [D0901811](https://dcc.ligo.org/LIGO-D0901811) aLIGO Systems, LHAM6-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): | L1-ISCHT6R drawing at [D1201210](https://dcc.ligo.org/LIGO-D1201210) |

# 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. |
| D0900421 | aLIGO Systems, LHAM6-L1 Top Level Chamber Assembly | ICS entry click here [D1000342](https://ics-redux.ligo-la.caltech.edu/JIRA/browse/ASSY-D1000342-L1). Note that this ICS entry seems to have no entries for ISC. The ISI table was constructed to eLIGO and predates ICS. |
| D1000513 | HEPI | The aLIGO HEPI assembly is at [D1000514](https://dcc.ligo.org/LIGO-D1000514) . Note that in contrast to most other LLO chambers HAM6 (which used to be HAM5) did not previously have HEPI installed. |

# 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 | [E1200107](https://dcc.ligo.org/LIGO-E1200107) | |
| SEI | HEPI | N/A | [E1300927](https://dcc.ligo.org/LIGO-E1300927)  **Note: LHAM6 HEPI has yet to be commissioned so this record is empty.** |
| SUS | OMC Suspension  Tip-Tilt Mirrors | [#E1400034](https://dcc.ligo.org/LIGO-E1400034) (under Test Results)  [E1300878](https://dcc.ligo.org/LIGO-E1300878) (under *Other Files*) | |
| AOS/SLC/Viewports | Leak and pressure testing. | [E1200445](https://dcc.ligo.org/LIGO-E1200445). Leak and pressure testing was completed, refer to above link. All viewports were tagged at time of inspection and testing. | Visual inspection in-situ not completed, refer to bug list. |

# 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.** |
| ICS Assembly Record needs to be updated | **The ICS records for HAM6 appear to be incomplete; There is no top level assembly record, the ISC information is sorely lacking, the ISI table precedes aLIGO and has no ICS entry.** |

# 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 bug tracker is as follows e.g.*

***\****[***https://services.ligo-wa.caltech.edu/integrationissues/show\_bug.cgi?id=****826*](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=826)

|  |  |
| --- | --- |
| Tracker # *[hyperlinked]* | Title/description |
|  |  |
| [#3](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=3) closed | Unintentional ground connection at GS-13 pods |
| [#24](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=24) closed | Increase series resistors on HAM-A and TT coil drivers |
| [#73](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=73) closed | The RF photodetectors self destruct on loss of a single DC power rail |
| [#78](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=78) closed | SUS Electronics Missing/Incomplete/Out-of-date Drawings |
| [#118](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=118) closed | ECR: HEPI medm screen update |
| [#140](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=140) closed | ECR HAM-ISI model and MEDM screen update |
| [#182](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=182) closed | ECR: BSC-ISI and HEPI MEDM (Duplicate of #500) |
| [#183](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=183) closed | Change the CPS biases from the local basis to the calibrated cartesian basis (Duplicate of #205) |
| [#186](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=186) closed | ECR: Topology Changes to SUS models as a result of ISC Informed Interaction |
| [#205](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=205) closed | ECR: Add Cartesian bias monitoring and offsets to the ISI models |
| #[207](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=207) closed | ECR: Model and screens update to allow sensor correction to the ISI using Ground seismometers (STS-2) |
| [#214](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=214) | beam hit OM1 ~2" to the right (east) of the center of the optic |
| [#216](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=216) closed | QPD OMC\_A/B electronics chain missing |
| [#283](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=283) | CPS Circuit Modification to eliminate a high frequency oscillation |
| [#332](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=332) | RF phase shifts when cables moved |
| [#355](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=355) closed | ECR: Modify HAM-ISI and BSC-ISI simulink control filters to monitor gain for ODC |
| [#360](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=360) closed | Ground loop fix in interface to all GS-13 |
| [#375](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=375) closed | ECR: Migrate the ISI Checker Script functions to the frontend code |
| [#385](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=385) closed | ECR: create science frame channels for the SEI models |
| [#441](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=441) closed | Cable plan for 5-way coax cables |
| [#443](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=443) closed | RF splitter for BBPDs need to be documented (Duplicate of #465) |
| [#445](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=445) closed | ECR: Update the SAFE level for the BSC and HEPI model watchdog |
| [#459](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=459) closed | Add XTerm window pop-up for BSC-ISI and HAM-ISI transition command buttons (Duplicate of #650) |
| [#465](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=465) closed | Need for additional amplification on the 135MHz signal chain |
| [#469](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=469) | ECR: New naming scheme for OMC channels |
| [#482](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=482) | ECR: ODC changes in SUS, SEI, HPI and PSL |
| [#487](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=487) closed | ECR: Remove ISI IPC links which come from SUS offload |
| [#500](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=500) closed | ECR: HEPI MEDM Update |
| [#502](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=502) | ECR to reposition the Fast Shutter and Beam Dump in HAM6 |
| [#530](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=530) closed | update to the HEPI master model and related MEDM screens |
| [#551](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=551) closed | HEPI script update |
| [#561](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=561) closed | Update ISI command scripts to match HEPI |
| [#577](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=577) | LHAM6 table weights are missing viton damping pads |
| [#593](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=593) closed | LHAM6 flange layout discrepancy |
| [#629](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=629) | CPS Racks Grounding Schemes |
| [#650](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=650) | ISI model update - Jan 2014 |
| [#668](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=668) | DC Switch Breaker Box Install in Pier Pod and TCS ISS Power cords. |
| [#741](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=741) | ISC tables: Lights and fan status readback |
| [#742](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=742) | L1 SUS OM3 LL OSEM Coil Non-functional |
| [#761](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=761) | In Situ, Visual Inspections of All Viewport Windows |
| [#827](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=827) | LHAM6 Issue Tracker |
| [#836](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=836) | Glitches in ISI drives from the Blend switching algorithm |
| [#837](https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=837) | HEPI L4C watchdog trips |