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 H1 PSL and all of the equipment within and attached plus associated electronics racks.

|  |  |
| --- | --- |
| **Interferometer** [*L1 or H1*]: | **H1** |
| **Building**(s)/**Room**(s): [*e.g. corner/LVEA*] | **LVEA, H1 PSL Laser Area Enclosure (LAE)**  **Corner Station, Laser Diode Room (LDR)** |
| **Vacuum Chamber**(s): | **NA** |
| **Electronics Rack Designation**(s): | [H1-PSL-C1](https://dcc.ligo.org/LIGO-S1301858)  [H1-PSL-R1](https://dcc.ligo.org/LIGO-S1301880)  [H1-PSL-R2](https://dcc.ligo.org/LIGO-S1301881) |
| **Optics Table(s)/Enclosure(s) Designation**(s), and **other equipment/assemblies related to this installation**: | PSL Enclosure  IO Components on the PSL Optics 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)*]* | [T0900568](https://dcc.ligo.org/LIGO-T0900568), aLIGO PSL Installation Plan  [E1000679](https://dcc.ligo.org/LIGO-E1000679), aLIGO PSL Table Legs Installation Procedure  Section “Installation of PSL table components” in [T1000097](https://dcc.ligo.org/LIGO-T1000097), Input Optics Installation Plan |
| **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 procedures.  elog #[1983](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=1983): PSL floor installation completed  elog #[2006](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=2006) : PSL optical table legs installation completed  elog #[2040](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=2040): PSL optics table installation completed  elog #[2086](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=2086): PSL Laser Area Enclosure (LAE) construction starts  elog #[2655](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=2655): PSL enclosure QA inspection  DCC #[L1200277](https://dcc.ligo.org/LIGO-L1200277): PSL LAE completed & ready, certification report from Gerbig  elog #[2379](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=2379): 35W laser under test  elog #[2378](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=2378): 200W laser under test  elog #[2796](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=2796): PSL achieved 204W, starting characterizing measurements  elog #[3060](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=3060): punchlist of items after completion of PSL installation  elog #[1457](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=1457): PSL dust monitor plots signifying that a dust monitor has been installed  elog #[3294](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=3294): started IO installation on the PSL/IO optics table  elog #[8606](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=8606): power control stage installed  elog #[8731](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=8731): power control stage tested  elog #[4673](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=4673)& #[4688](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=4688) :(essentially) completed IO installation onto the PSL/IO optics table  elog #[7169](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=7169): PEM sensors installed in PSL room  elog #[9306](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=8731) : PSL rotation stage installed |
| **Baseline or initial Alignment Procedure**(s): *[enter linked DCC document #(s); found under* [*E1100734*](https://dcc.ligo.org/LIGO-E1100734)*]* | There is no separate, stand-alone alignment procedure for the PSL, or the IO components on the PSL/IO optics table. However alignment is covered in the following documents:  [T0900646](https://dcc.ligo.org/LIGO-T0900646), LIGO 35W MOPA laser - user guide  [T0900641](https://dcc.ligo.org/LIGO-T0900641), User Manual 200W laser  [T0900133](https://dcc.ligo.org/LIGO-T0900133), aLIGO PSL Diagnostic Breadboard Instruction Manual |
| **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 | NA |

# 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)*.*

N.B.: All documentation regarding the H1 PSL installation can be found referenced or linked to [E1200039](https://dcc.ligo.org/LIGO-E1200039), aLIGO PSL #1 Acceptance

|  |  |
| --- | --- |
| Applicable Building/Room Top-Level Drawing(s): | [D1002633](https://dcc.ligo.org/LIGO-D1002633), Ante-room Plan, H1 Laser Area Enclosure  [D1002634](https://dcc.ligo.org/LIGO-D1002634), Ante-room Elevations, H1 Laser Area Enclosure  [T1000028](https://dcc.ligo.org/LIGO-T1000028), aLIGO Laser Area Enclosure Concept  [T070195](https://dcc.ligo.org/LIGO-T070195), aLIGO PSL Laser Diode Room |
| Top-Level Chamber Assembly Drawing(s): | NA |
| Electronics Rack Drawing(s): | [S1301858](https://dcc.ligo.org/LIGO-S1301858) , H1-PSL-C1 [S1301880](https://dcc.ligo.org/LIGO-S1301880), H1-PSL-R1 [S1301881](https://dcc.ligo.org/LIGO-S1301881), H1-PSL-R2  [D1101778](https://dcc.ligo.org/LIGO-D1101778), aLIGO PSL Laser Diode Rack |
| Optics Table Drawing(s): | [D1300348](https://dcc.ligo.org/LIGO-D1300348), As Built PSL Table Layout for Advanced LIGO H1  [D1003076](https://dcc.ligo.org/LIGO-D1003076), L1 and H1 PSL/IO optical table and Laser Area Enclosure layout drawing |

# 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”.*

N.B.: There are no PSL assemblies entered into the ICS system. Most of the PSL parts entered into the ICS are for the ISS outer loop photodiode array assembly. The PSL optics table parts were all entered as D1300462, PSL-T-Misc Parts instead of individually by part number.

|  |  |  |
| --- | --- | --- |
| Assembly DCC D-Number | Assembly Name | ICS entry |
| [S1301858](https://dcc.ligo.org/LIGO-S1301858) | H1-PSL-C1 | NA |
| [S1301880](https://dcc.ligo.org/LIGO-S1301880) | H1-PSL-R1 | NA |
| [S1301881](https://dcc.ligo.org/LIGO-S1301881) | H1-PSL-R2 | 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 |
| PSL | PSL | After shipment only visual inspections were done before installation | [E1300129](https://dcc.ligo.org/LIGO-E1300129) |
| Front-End Laser Diodes | NA | [E1100540](https://dcc.ligo.org/LIGO-E1100540) |
| LAE | NA | [T1200171](https://dcc.ligo.org/LIGO-T1200171) (acoustic isolation test of H2 enclosure, not H1)  elog #[7168](https://alog.ligo-wa.caltech.edu/aLOG/uploads/7168_20130722193254_PSL-HVAC-Instructions.pdf), How to run HEPA fans and AC in the LAE  Environmental testing/characterization (temperature, humidity, particulate levels, magnetic fields, etc.) – not measured |
| Optics table legs | Pre-aLIGO testing,  [iLIGO ilog 9/12/2010](http://ilog.ligo-wa.caltech.edu/ilog/pub/ilog.cgi?group=detector&date_to_view=09/12/2010&anchor_to_scroll_to=2010:09:12:13:35:09-robert) | [H1 test results](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=2068), which are brief and rely on:  [H2 test results](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=1426)  [L1 test results](https://alog.ligo-la.caltech.edu/aLOG/index.php?callRep=357) |
| IO | IO components on the PSL/IO optics table | All IO testing for components & assemblies on the PSL/IO optics table are collected at [T1300365](https://dcc.ligo.org/LIGO-T1300365) | |
| EOM | [E1300758](https://dcc.ligo.org/LIGO-E1300758) | |
| IO Power Control | No documentation on testing of the rotation stage  test of the liquid cooled beam dump design (not specifically the H1 unit) is documented in [E1300444](https://dcc.ligo.org/LIGO-E1300444) | elog #[8731](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=8731): PSL rotation stage functional and ready to go elog #[12820](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=12820): PSL rotation stage calibrated elog #[13254](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=13254): IMC locked, PSL at 56 mW  elog #[13554](https://alog.ligo-wa.caltech.edu/aLOG/index.php?callRep=13554): IMC power increased to 10 W  No documentation found on the high power testing of the PSL beam dump. Added to punchlist. |
| PSL Beam Jitter | NA (must be performed installed) | [T1300378](https://dcc.ligo.org/LIGO-T1300378) |
| PSL Mode Matching | NA (must be performed installed) | [T1300379](https://dcc.ligo.org/LIGO-T1300379) |

# 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 |
| 10 | Closed | Fixed | Throughput of PMC degrades over time |
| 15 | Closed | Fixed | PSL cooling water flow causes frequency noise in acoustic band |
| 23 | Closed | Fixed | ECR: change the IO\_MB\_M2 beam splitter on the PSL table to increase power for ALS |
| 40 | Closed | Fixed | Need housing, power, network for rotation stage Beckhoff modules |
| 56 | Closed | Fixed | There is no systems wiring diagram for the PSL. |
| 88 | Closed | Fixed | Remove some PSL quick-connect water fittings to reduce vibrations caused by water turbulence |
| 93 | Closed | Fixed | open lid of PMC tank E1300284-v1 |
| 139 | Closed | Works | PSL tripped due to Beckhoff remote client 'glitching' |
| 194 | Accepted | Pending | addition of a light shield to the IO/PSL periscope & differences in the periscopes |
| 482 | Accepted | Pending | ECR: ODC changes in SUS, SEI, HPI and PSL |
| 484 | Accepted | Pending | ECR: Adding h1psl0 to the Dolphin network |
| 491 | Assigned |  | ECR - PSL channels in the science frame |
| 590 | Accepted | Pending | IO PDs monitoring power at the EOM and at the periscope |
| 619 | Assigned | Hardware installed. | Implementation of interface for PSL temperature box and replacement of reference cavity heater power supply |
| 644 | Accepted | Pending | checking electronics modules without visible over-current protection |
|  |  |  |  |