

E1000304-v3 aLIGO SEI Testing and Commissioning Overall Plan

- **Components and Sub-Assemblies Testing**

Electronics

Actuators

Sensors

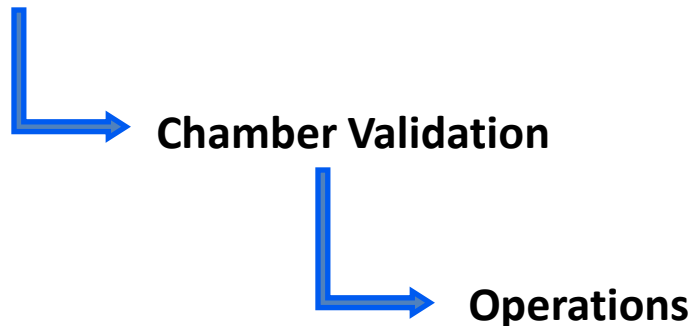
Vacuum Pods

- **Modules Testing (HEPI, HAM-ISI, BSC-ISI)**

Phase I: Assembly Validation

Phase II: Integration

Phase III: Control Commissioning



Components and Sub-Assemblies Testing

- **Electronics:** E1100876 - [aLIGO SEI Electronics Testing Reports and Procedures](#)
T1100453 - [Ham 2&3 System Test Plan](#)
S1105160 - [LHO ISI Test Stand Results](#)

- **Inst. Main Page:** E1100786 - [aLIGO SEI Instruments, Testing Documents and Tracking Lists](#)

- **Actuators:** E1100338 - [aLIGO LHO HEPI Actuators Tests Results](#)
T1100234 - [aLIGO Small Actuator Test Results from Qinetiq](#)
T0900564 - [aLIGO Large Actuator Test Results from Qinetiq](#)
E1100741 - [aLIGO BSC-ISI, Actuators Installation Location](#)

- **Sensors:** E1000257 - [aLIGO HAM-ISI Capacitance Position Sensor Testing](#)
E1100231 - [aLIGO BSC-ISI Capacitance Position Sensor Testing](#)
E1100326 - [aLIGO T 240 seismometers for BSC-ISI](#)
E1100397 - [aLIGO GS-13 testing](#)
E1000136 - [aLIGO L4C Status Chart](#)

- **Pods:** E1100396 - [aLIGO Seismometer Pods Neon Leak Test Results](#)

- **Instrumentation:** E1100740 - [aLIGO BSC-ISI, Seismometers Installation Location](#)
E1100770 - [In-Vacuum Cabling Status for BSC6, BSC8, HAM2, HAM3](#)
E1100822 - [aLIGO BSC-ISI, Cables inventory and Installation Location](#)

Modules Testing Overview

HEPI Modules (33)

Phase I: Assembly Validation

- Mechanical Assembly
- No particular testing
- Install Leads Validate

Instrumentation

Phase II: Integration

- Check HEPI is ready to receive an ISI platform (Stack, HAM-ISI or BSC-ISI)
- Install ISI platform on HEPI
- Leveling
- Connect Actuators
- Generic procedure to check and validate HEPI
- Phase II finishes when we close the chamber.

Close the chamber

Phase III: Control Commissioning

- Generic Step by Step procedure
- Acceptance criteria

Meet acceptance criteria.

Operation

HAM-ISI Modules (15)

Phase I: Assembly Validation

- Full Assembly
- Generic procedure
- Validated per test results and report

Transport to IFO

Phase II: Integration

- Simplified side chamber testing if no instrumentation change after Phase I.
- Thorough side chamber testing if instrumentation modified after Phase I.
- Insertion in the chamber
- Integration with optical components
- Unit specific testing, function of optics installation sequence.
- Phase II finishes when we close the chamber.

Close the chamber

Phase III: Control Commissioning

- Generic Step by Step procedure
- Several levels of performance
- Acceptance criteria

Meet acceptance criteria.

Operation

BSC-ISI Modules (15)

Phase I: Assembly Validation

- Full Assembly
- Generic procedure
- Validated per test results and report

Transport to IFO

Phase II: Integration

- Install on stand, balance and check functionalities
- Integration with optical components
- Unit specific testing, function of optics installation sequence.
- Cartridge installation
- Post insertion testing
- Phase II finishes when we close the chamber.

Close the chamber

Phase III: Control Commissioning

- Generic Step by Step procedure
- Several levels of performance
- Acceptance criteria

Meet acceptance criteria.

Operation

Phase I: Assembly Validation

■ HEPI

Overview: Mechanical assembly (no Instruments)

No particular tests (rigid connection between cross beams and piers). No report.

Final check is the leveling.

Assembly validation is responsibility of SEI installation lead (Jeremy @ LLO, Hugh @ LHO)

■ HAM-ISI

Overview: Sub-assembly check, Inventory, Balancing, Check & adjust gaps, Range of motion, Static tests, Linearity tests, Power spectrums, Transfer functions...

Main page: E1000305 - [aLIGO HAM-ISI Testing and Commissioning Documentation](#)

Procedure: E1000309 - [aLIGO HAM-ISI, Pre-integration Testing Procedure, Phase I \(post-assembly\)](#)

Report Example: E1000326 - [aLIGO HAM-ISI, Pre-integration Test Report, Phase I, LLO Unit #2](#)

■ BSC-ISI

Overview: Similar to HAM-ISI. Twice many stages.

Main page: E1000306 - [aLIGO BSC-ISI Testing and Commissioning Documentation](#)

Procedure: E1000486 - [aLIGO BSC-ISI Testing Procedure, Phase I \(Post-assembly\)](#)

Report Example: E1100294 - [aLIGO BSC-ISI, Pre-integration Test Report, Phase I, LHO Unit #1](#)

Phase II: Integration

Everything between the end of the module assembly and closing the chamber.

In other words, all the testing related to merging with other modules

■ HEPI

Overview:

Check that HEPI is ready to receive an ISI or Stack (Stops, Leveling...)

Check actuators and sensors (L4C power spectrums, IPS DC values...)

Install ISI (or passive stack)

Unlock HEPI. Monitor dial indicators, load cells.

Level HEPI.

Connect actuators.

Set IPS gaps.

Check the control software (SEI and SUS Watch dogs)

Test HEPI (Range of motions, Transfer functions, turn on low performance loops)



Leveling, alignments.

Report and validation of phase II.

Phase II: Integration

Everything between end of the module assembly and closing the chamber

In other words, all tests related to merging with other modules

■ HAM-ISI

Phase II starts when the HAM-ISI unit is mounted on a stand in the observatory (LVEA or End Station)

Two-case scenario:

1. Assembly already completed and fully tested in the assembly building (i.e. HAM-ISI 8 & 9 @ LHO)
⇒ Minimum side chamber testing before insertion (DC values of CPS, power spectrums of GS13s...) . Could be done without electronic rack if not available. Testing completed after the chamber is closed.
2. Assembly completed in LVEA or End Station (Install GS13, CPS Shield...)
⇒ Need Side Chamber Testing before Installation.

After installation in the chamber:

- Platform is being populated with optics
- Testing sequence to be detailed chamber per chamber.
- Report, Validation
- Close the chamber: End of Phase II




Phase III: Control Commissioning

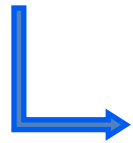
Phase II: Integration

Everything between end of the module assembly and closing the chamber

In other words, all tests related to merging with other modules

■ BSC-ISI

- Phase II starts when the BSC-ISI unit is mounted on stand in the observatory (LVEA or End Station)
- Check functionalities (Static Tests, Transfer functions). Compare with measurements after assembly (Phase I)
-  Test control functionalities (Damping, Level 1 control...)
- Integration with optical components. Testing is chamber specific, function of the optics installation sequence.
- Installation in the chambers
- Test basic control functionalities in the chamber (Damping, Level 1 control...)
- Report, Validation
- Close the chamber: End of Phase II



Phase III: Control Commissioning

Phase III: Control Commissioning

Everything after closing the chamber and before hand-off to operations

- **HEPI:** Control strategy developed for iLIGO
Detailed step by step procedure based on the BSC-ISI model
Being tested at LASTI
Procedure being written
- **HAM-ISI:** Control strategy developed for eLIGO
Step by Step procedure based on the BSC-ISI model
Being tested at LASTI
Procedure being written
- **BSC-ISI:** Control strategy developed on ETF and BSC-ISI prototype
Step by Step procedure
Tested at LASTI

Performance Levels

- **HEPI**

Basic control functionality tests during HEPI checkout (Phase II)

Regular performance control loops, Sensor Correction (Phase III)

- **HAM-ISI and BSC-ISI**

Low Frequency control:

High Blend:	Low performance	~ 1 Hz Blend frequency	Phase II
Medium Blend:	Medium Performance	~ .3 Hz	Phase III
Low Blend:	High Performance	~.1 Hz	Phase III

High Frequency Control:

Control Level 1 :	Low performance	~ 10 Hz Unity gain frequency	Phase II
Control Level 2 :	Medium Performance	~ 20 Hz Unity gain frequency	Phase III
Control Level 3 :	High Performance	~ 30 Hz Unity gain frequency	Phase III