

**Changes¹ to the
 “LIGO Seismic Isolation System: Fabrication Process Specification”,
 Hytec document LIGO-TS-03, LIGO Project document LIGO-E970063-01-D, 11 Aug 97.**

The basic nature of the changes to the process specification are as follows:

- a) No clean room classification is called out for any process steps. A clean room (defined as having non-shedding surfaces and HEPA-filtered air supply) is used for final cleanliness inspection and double wrapping.
 - b) only monitoring hydrocarbon level in the cleaning area (i.e. no requirement to maintain hydrocarbon levels below 15 ppm)
 - c) eased handling restrictions during fabrication
 - d) the duration of the wash/rinse cycles is reduced by a factor of about 5
 - e) no raw material pickling
 - f) no pre-welding cleaning
 - g) the total number of FTIR samples per SEI unit (each comprised of three weldments) is reduced from 16 to 11
 - h) clarification: the FTIR tests are called out only after washing and before baking (not after baking as well)
1. Section 3.2, Figure 1, Make the following changes:
 - a) delete the “raw material preparation/clean” step
 - b) delete the “weld pre-cleaning” step
 - c) revise the step after “bake” from “cleanliness inspection & test” to “cleanliness inspection”
 2. Section 4.2, “Protection from Contamination”

Delete the first 2 paragraphs (the third paragraph remains), and replace with the following:
 No carbon steel hooks, fork lift forks, grapples or chains shall be allowed to contact the category 1 stainless steel material.
 3. Section 4.3 Cleaning Environment

Remove references to clean room classification and maintaining a hydrocarbon level, so that the section reads as follows:
 “Cleaning is to be performed in a clean area separated from all other operations. This space should have non-shedding floors, walls and ceiling. The area used for cleaned part inspection and double wrapping (a) should have non-shedding floors, walls and ceiling and (b) must have an air supply which does not exchange directly with the shop floor area, is carbon and HEPA filtered and monitored with a hydrocarbon meter.”
 4. Section 4.4, Fabrication Environment

Strike the following: “(Class 100,000 to 200,000) with outside air purge to minimize contamination. Welding gases shall be collected in exhaust systems and vented outside.” The section now reads as follows:
 “Raw materials shall be protected from contamination throughout the fabrication process. All

1. When these changes are incorporated, the specification will be revised to version 02, i.e. document number LIGO-E970063-02.

welding and fitting shall be done in a clean manufacturing space.”

5. Section 4.5, Smoking and Airborne Contamination

Change from:

“Gases and vapors containing hydrocarbons shall be limited to 15 ppm, as measured by a hydrocarbon meter, in environments in which a cleaned category 1 part may be exposed (prior to double wrapping).”

to:

“Gases and vapors containing hydrocarbons shall be monitored and recorded periodically with a hydrocarbon meter, in environments in which a cleaned category 1 part may be exposed (prior to double wrapping).”

6. Section 4.7, Grinding & Abrasive Cloth/Paper

Strike the current text and include the following:

“Grinding (with abrasive wheels, cloth or stones) or use of abrasive cloth or paper is permitted on category 1 components if the ground or impacted surface is subsequently skimmed with a carbide tool to remove any residual contaminants. The use of oil free Arkansas stones are also approved to remove slight imperfections in the machined surfaces. The use of clean stainless steel brushes is also permitted.”

7. Strike section 5.1.3 (which calls for cleaning before welding)

8. Correct section 5.2.1 to read as follows:

“Comply with the welding environment requirements of Section 4.4”

9. Section 5.2.5 should read:

“Grinding shall comply with the requirements of Section 4.7.”

10. Add section 5.2.7:

“5.2.7 Welds may be repaired if incomplete penetration or blow-through occurs.”

11. Correct section 5.4.1.3 to read as follows:

“Comply with the cleaning environment requirements of section 4.3.”

12. Section 5.4.2.4, Table 2 should be replaced with the following table:

Table 2. Wash and Rinse Requirements

Component Area	Minimum Duration per Cycle (minutes) ^a		Number of Wash/Rinse Cycles	Final D.I. Rinse Duration (minutes)
	Spray Wash	Spray Rinse		
Exterior Surfaces	1	1	2	3
Interior Cavity Surfaces (e.g. optics table eggcrate cavities)	1	1	3	3

Table 2. Wash and Rinse Requirements

Thru Holes (tapped or clear)	1	1	3	3
Blind Holes (tapped or clear)	1	1	4	3

a. Alternatively, if the time required to raise the temperature of the part to 130F (from room temperature) is shorter, then this temperature criteria can be used to set the duration.

13. Section 5.4.2.6.2 change

“... the numerous blind tapped holes of the optics tables while the table is inverted, i.e. so that debris and chips from the tapping operations are flushed out of the blind holes.”

to read as follows:

“... the numerous tapped holes of the optics tables.”

14. Section 5.4.2.9.4 change

“Obtain an alcohol sample for FTIR analysis from 10 representative blind tapped holes in the optics table, from...”

to read as follows:

“Obtain an alcohol sample for FTIR analysis from 5 representative tapped holes in the optics table, from...”

An interpretation for the SEI in-vacuum hardware is indicated in the following table:

SEI Unit	Weldment	Number of FTIR samples			
		external surface	internal cavity	tapped holes	total
HAM SEI	Optics Table	1	1	5	7
	Support Table	1	1		2
	Support Tube	1	1		2
total FTIR samples per HAM SEI unit					11
BSC SEI	Downtube	1	1	5	7
	Support Table	1	1		2
	Support Tube	1	1		2
total FTIR samples per BSC SEI unit					11

15. Delete section 5.5.1

16. Section 5.5.2, change “oven” to “oven (or container in which the component(s) is (are) placed into the oven)” in all instances of the word “oven”.

17. Section 5.6.1 change "clean room" to "cleaning area".

18. Section 5.6.2 change

"During cleaning of parts, use a fabric Vidaro Glove..."

to:

"During cleaning with solvents of parts, use a fabric Vidaro Glove..."