LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

LIGO-T1000041-v1 *ADVANCED LIGO* 10 June 2009

Electrostatic Drive Soldering Procedure

Mark Barton, Rich Mittleman, Brett Shapiro, Bob Taylor

Distribution of this document:
DCC

This is an internal working note
of the LIGO Project.

California Institute of Technology
LIGO Project – MS 18-34
1200 E. California Blvd.
Pasadena, CA 91125
Phone (626) 395-2129
Fax (626) 304-9834
E-mail: info@ligo.caltech.edu

Massachusetts Institute of Technology
LIGO Project – NW22-295
185 Albany St
Cambridge, MA 02139
Phone (617) 253-4824
Fax (617) 253-7014
E-mail: info@ligo.mit.edu

LIGO Hanford Observatory
P.O. Box 1970
Mail Stop S9-02
Richland WA 99352
Phone 509-372-8106
Fax 509-372-8137

LIGO Livingston Observatory
P.O. Box 940
Livingston, LA 70754
Phone 225-686-3100
Fax 225-686-7189

http://www.ligo.caltech.edu/

1 Procedures

1.1 Joining the ESD Cables to the Compensator Plate

1.1.1 Preparing the ESD cables for soldering

Step	What	Where	Time	People	Tools
1	It is recommended that this procedure is practiced on some spare cable all the way through before being attempted.				
2	Repeat the steps below for all ESD cables involved.		1 hour	1	
3	Check the electrical continuity of the ESD cables. (The cables are *extremely* prone to failure at the end where the gold connectors have been crimped on.)			1	ohmmeter
4	Remove a length of shield approximately 25 mm (1'') long from the end of the coax, exposing the (very delicate) central conductor and inner insulation. If using the Stripall-Plus thermal stripper listed on the right, setting 1 (the lowest setting) provides sufficient heat.			1	24 gauge mechanical stripper or thermal stripper Thermal stripper used at LASTI: Teledyne Interconnect Devices, Stripall-Plus, model #TWC-1
5	Cut away the braided shield with an X-Acto knife. Trim back the residual threads with wire cutters. It is important to make sure the braided shield will not short to the ESD pattern. A magnifying glass and a bright light makes this delicate work more precise.			1	X-Acto knife, wire cutters, magnifying glass, light
6	Using (only) the thermal wire stripper, remove about 6 mm (0.25'') of			1	Thermal Stripper,

Step	What	Where	Time	People	Tools
	the inner Teflon insulation from the core wire. Mechanical strippers can damage the fragile core wire threads. Use setting 1 if using the Stripall-Plus. Inspect the strip with the magnifying glass and check with the ohmmeter. If not done properly it is possible to melt the Teflon into the threads of the core wire.				magnifying glass, ohmmeter
7	Tin the stripped core wire with some Indium solder. It is important to use 97 % Indium, 3% silver alloy. Alloys with tin are exceptionally bad as tin can dissolve gold and make a brittle connection. The solder at LASTI came from the Indium Corporation of America.			1	Solder: 97 In, 3 Ag Iron at LASTI: Weller WD1001 solder station

1.1.2 Preparing the ESD tab/cable assemblies for the CP

Step	What	Where	Time	People	Tools
8	It is recommended that this procedure is practiced all the way through before the first 'real' attempt. The procedure gives the choice of using copper tabs or gold tabs. If using copper, flux must be used when tinning the tab. Subsequent cleaning and baking is then needed. There is no obvious benefit of flux with the gold tabs, provided they are clean. These steps can be performed away from the optic.				
9	If using copper (OFHC) tabs, sand off the oxide.		5 min	1	Fine sand paper, such as grit size 400
10	Repeat the steps below for all cables (and spares) involved		2 hours		
11	Cut tabs to appropriate size: width 6 mm (about the same as the traces in the ESD mask), length about 15 mm. Bob Taylor ordered 0.25'' wide, 0.016'' thick gold stock from Surepure Chemetals.			1	Au or Cu foil [Au 0.016'' thick, Cu 0.008'' thick], ruler
12	Scratch 2 pairs of demarcation lines on one surface of the tab. One pair 2 mm and 4 mm from one end, the other 3 mm and 6 mm from the other end. These will help guide where folding and soldering occurs. Tab Terminology (See Figure 1): the inside end has the 2 mm and 4 mm lines; the outside end has the 3 mm and 6 mm lines; the bottom surface is the lined surface, the top surface is the smooth surface.			1	X-Acto knife, tweezers, ruler
13	If using copper, clean the tab with flux first and then clean the flux off the copper with a solvent. The flux used at LASTI is from the Indium Corporation of America. The identification name is FC-WS-LT-A (FC: flip-chip, WS: water soluble, LT: low temp, A: lowest viscosity). This flux was chosen because its water solubility and low viscosity makes it easy to clean. There may be other fluxes equal to or better for this application.			1	Flux, solvent such as methanol or acetone

Step	What	Where	Time	People	Tools
14	If using copper place another dab of flux on the 230 C soldering iron tip. 230 C is the limit of the flux used at LASTI, otherwise more heat is acceptable. The main limit is the FEP Teflon insulation, which melts at 260 C. Tin the scratched side in the center between the inner demarcation lines. This side is the bottom surface and will make the joint with the pattern. A large solder tip helps distribute the heat and wet the solder.			1	Flux, iron with a large solder tip, 97 In 3 Ag solder, tweezers Iron at LASTI: Weller WD1001 solder station, with a 3.99 mm chisel solder tip.
15	If using copper place another dab of flux on the 230 C soldering iron tip. Flip the tab over and tin about 4 mm of the length of the top surface on the inside end. The inside end will make the electrical connection with the coax. Clean any remaining flux off the solder tip.			1	Flux, iron with a large tip, 97 In 3 Ag solder, tweezers
16	For copper tabs, send the tab through the class A cleaning procedure. This will probably involve vacuum baking for 48 hours.			1	Class A cleaning procedure, related tooling
17	Fold 3 mm of the outside end of the tab, at the demarcation line, over towards the top surface and crimp it over the outside shielding of the coax cable. Let 1 to 2 mm of outer insulation stick out the bottom of the fold. Make sure the orientation is such that the cable goes towards the top of the CP. Tabs on different sides of the CP need opposite orientations.			1	Crimping tool, such as needle node pliers or anything that can squeeze the folds together, tweezers
18	Fold 2 mm of the inside end of the tab over the same way and crimp the free end of the core wire of the coax cable inside this fold. There should be solder inside this fold surrounding the core wire if done properly.			1	Crimping tool, tweezers

Step	What	Where	Time	People	Tools
19	See the complete tab/cable assembly in Figure 2.				
20	Check the conductivity of the tab/cable assembly. Check for shorts to the shield.			1	ohmmeter

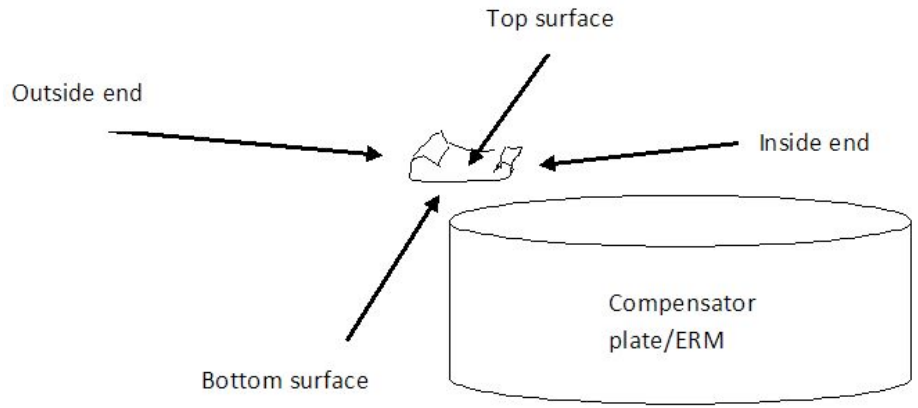

Figure 1: Tab terminology used in the procedure.

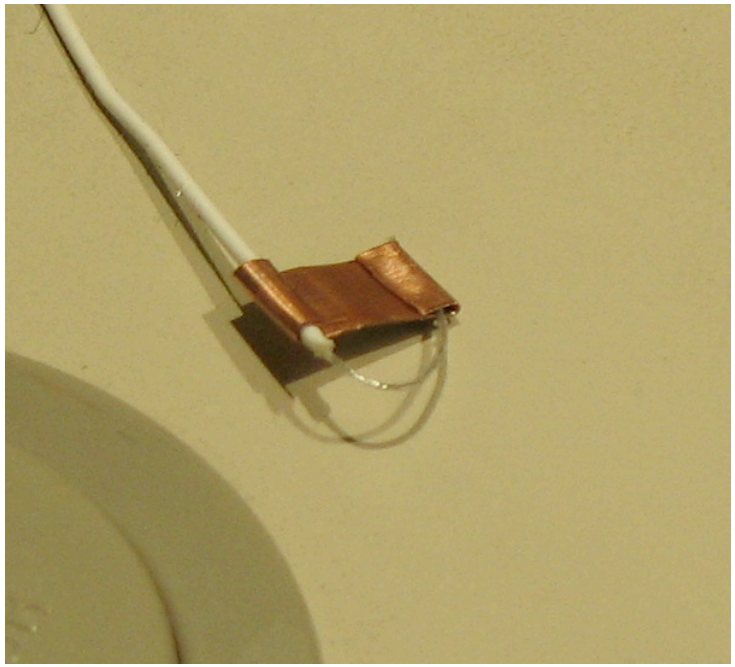

Figure 2: Complete tab/cable assembly. Not shown is the tinned surface underneath.

1.1.3 Soldering the ESD tab/cable assemblies to the CP

Step	What	Where	Time	People	Tools
1	It is recommended that this procedure is practiced with a dummy ESD pattern first. This procedure also does not say where to solder the tabs since the pattern is likely to change.				
2	Set up a bottle of clean, dry nitrogen with a regulator and nozzles to direct a flow of nitrogen across the work area.			1	N2 bottle, regulator, nozzles
3	Take the CP out of its case, remove the face-plate from the ESD side, and lay it with the ESD side up in a clean room. [It was very difficult to remove the face plates because they were quite tight and there were no vent grooves in them.]			2	
4	Carefully wipe the face and sides of the optic with lint-free wipes moistened with methanol [acetone?] to remove dust and dirt.			1	solvent (acetone, methanol), wipes
5	Repeat the following steps for each cable.				
6	Just before tinning the pattern, turn on the nitrogen flow and wipe again the specific location where the tab will go.		1 hour	1	solvent (acetone, methanol), wipes
7	Set the soldering iron between 230 C and 250 C (FEP Teflon insulation melts at 260 C). Tin the pattern in this location. A large solder tip helps wet the solder.			1	Iron with a large tip, 97 In 3 Ag solder, Iron at LASTI: Weller WD1001 solder station, with a 3.99 mm chisel solder tip.
8	Place the tab over the pattern and heat them together. Make sure the coax cable points up the CP. DO NOT let more than 1 mm stick out beyond			2	Iron with a large tip, solder, tweezers.

Step	What	Where	Time	People	Tools
	the glass, to prevent it from being knocked off. It helps to put a little solder on the iron tip to make a better thermal connection. Heat the inside lip of the tab simultaneously so that the solder wets the core wire. It may help to have a second person support the tab while the other solders. Again, use a large soldering iron tip.				
9	See the complete assembly in Figure 3.				
10	Check the conductivity from the pattern to the end of the cable. Check for shorts to the shield. Give the assembly a 'soft' tug to make sure it is on. Note, mechanically it is most likely to fail by peeling off, hence the reason for a maximum of 1 mm sticking out from the glass.			1	ohmmeter

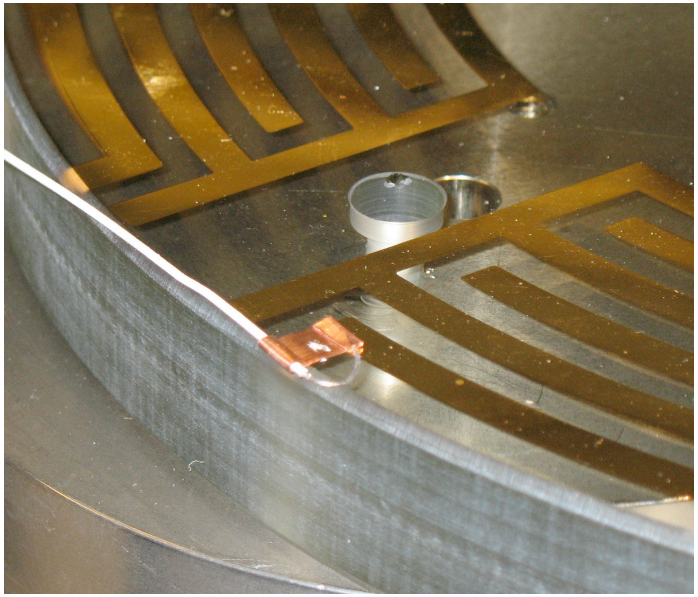

Figure 3: The completed tab/cable assembly soldered to the ESD pattern. This picture was taken from a practice setup, so the CP will look slightly different.