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Preparation of an end or input penultimate mass
(ETM/ITM PM)
(Hydroxide-Catalysis Bonding of ears and gluing prisms
and magnet flags)

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1 Introduction

1.1 Purpose and Scope

This document goes through the procedure for preparing an ETM/ITM penultimate mass (D080128-v1 and D080117-v1) for installation into the quadruple suspension structure. The procedure consists of three steps:

- 1) Hydroxide catalysis bonding on a fused silica ‘ear’ (suspension element according to D090007-v1) to each of the surfaces S3 and S4 in a well-defined location. General hydroxide-catalysis bonding procedures are detailed in E050228.
- 2) Attaching a sapphire wire break-off prism (D080479-v3) to each of the surface S3 and S4 in a well-defined location using EP30-2 adhesive.
- 3) Attaching 4 magnet-flag bases with magnets for the magnet flag assemblies into the counter-bored holes on surface S2. The magnet assemblies for the penultimate mass consist of 7 parts:
 1. Magnet flag - D070235
 2. (Mass)
 3. Magnet base – D1001124
 4. 3x Steel disc – D070238
 5. 2x Magnet - D0901345

The steel rings serve as attraction base for the magnets and are to be glued into the magnet flags on both ends and into the magnet base (Figure 1.1).

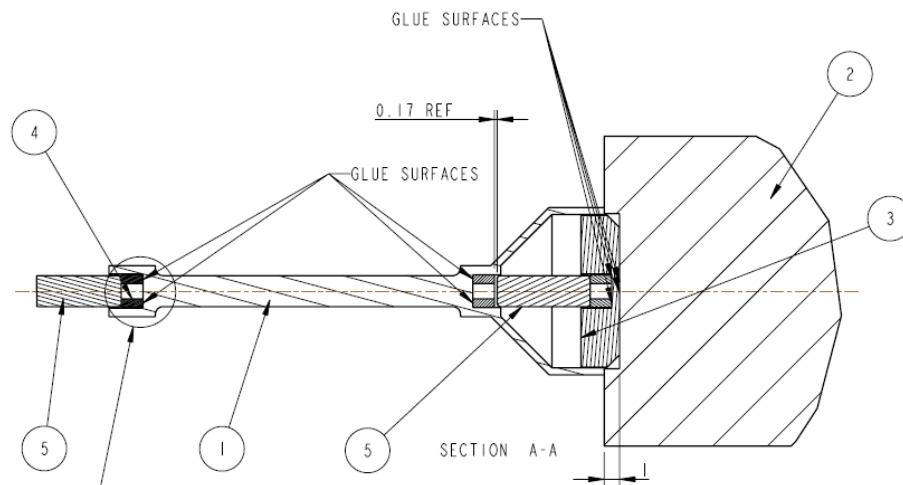


Figure 1.1 Cross-section of the magnet assembly (D070234)

The procedure ends with storing the mass. The procedure assumes the penultimate mass has been fully prepared. It includes handling the mass using the ergo-arm. Mirror handling procedures with the ergo-arm are detailed in T1000082.

It assumes that the mass has been stored in a COC ETM storage container or ‘cake-tin’ (D0902146). The procedure starts from the point of removing the mass from the ‘cake-tin’ using the ergo arm. The procedure includes the 4-week curing period needed to cure the ears. The test mass is stored back into the cake-tin container during this curing period.

The adhesive Masterbond EP30-2 is used to glue the prisms and the magnets and magnet flag bases to the penultimate mass as per the 3rd November 2010 in E960050-v9. The adhesive procedure is detailed in E1000386 (as stated in E960022).

The procedure does not include cleaning and/or baking procedure prior to inserting the mass into the structure. On the date this update was written this was not considered as part of the procedure for the silica masses.

The document starts with giving an overview of the required lab-settings and tooling followed by giving the relevant documentation.

It then discusses the detailed steps of the procedure including location, timing, number of personnel needed and tooling needed.

1.2 Low detail time schedule

	Day 1	Day 2	4 Weeks	Day 31	Day 32	Day 33	People required
Unpack mass and measure width	■						Yes
Bond ear 1		■					Yes
Bond ear 2		■					Yes
Curing			■				No
Glue prism 1				■			Yes
Initial cure glue					■		No
Glue prism 2					■		Yes
Initial cure glue						■	No
Glue magnet flag base plates						■	Yes
Full cure							No

1.3 Required lab-settings

The surfaces must be free of particles, thus, the bonding must take place under a Class 100 laminar flow bench or in a Class 100 clean-room.

Operator must be dressed in clean room attire: overall, boots, head cover, facemask, and approved cleanroom gloves are required.

This clean-room has a sink with running DI water with a resistance of 18 M Ω . It also has two tables of normal height (between 70 and 75 cm).

1.4 Equipment and Materials

- Filtered dry nitrogen
- Air gun or unplugged (De-)Ionizing gun (unplug at least 5 minutes before use.)
- High intensity light source (ideally handheld battery supported)
- DI water 18 M Ω resistance
- Pipettor with tip ejector - variable volume, 2-20 μ l, Eppendorf 2000 - (VWR Cat. No. 53511-588)
- Microcentrifuge tubes - Eppendorf, 1.5 ml - (VWR Cat. No. 20901-551)
- VWR® MiniFuge Microcentrifuge - 120V, 50/60Hz - (VWR Cat. No. 93000-196)
- Microcentrifuge tubes storing rack - (VWR Catalog No. 20901-675)
- Centrifuge tubes - polypropylene, graduated, 15 ml – (VWR Cat. No. 21008-103)
- Centrifuge tube's rack – (VWR cat. No. 21008-485)
- Medical Filter: Whatman Filter Uniprep 0.2UM PK50 UN113ENYL Filter
- Eppendorf* epTIPS* Pipette Tips – Sterile PCR Clean Filter Tips, 2-20 μ l, 10 Racks of 96 Tips – (VWR Cat. No. 47745-092)
- Alpha 10 wipes - case – (VWR Cat. No. TWTX1010)
- Gloves - VWR Certi-Clean Class 100 Latex Gloves or Accu Tech Ultra Clean 91300 Gloves.
- Methanol – Spectroscopic grade
- Acetone – Spectroscopic grade
- Sodium bicarbonate (= Bicarbonate of soda)
- Cerium oxide polishing compound
- Micro 90® detergent (International Products Corporation)
- Sodium Silicate Solution – from Sigma-Aldrich 338443-1L (~10.6% NaOH, ~26.5% SiO₂ by weight)
- Ultrasonic cleaner - BRANSON 8510
- 2x V-block - D1001685
- Bonding jig - D1001592
- Prism holder assembly – D1001623
- Metric slip gauges

- Allen key for #2-56 socket-head cap screw
- Digital calipers – with metric setting
- EP30-2 Adhesive
- UHV aluminium foil
- Uncoated copper wire \varnothing 0.5 mm
- 2x Heat lamps on stands
- Glass petridishes
- Magnifying glass
- First contact
- Ergo-arm

1.5 References

<i>Design documentation ‘glass’ essentials</i>	
D080128	ALIGO ITM Quad penultimate mass
D080117	ALIGO ETM Quad penultimate mass
D090007	aLIGO SUS ETM/ITM Quad PM Production Ear with Recess
D1001035	aLIGO SUS ITM Production Penultimate Mass WITH PRISMS AND EARS ASSEMBLY
D080479	aLIGO SUS ETM ITM QUAD PM Wire Break-off Prism
<i>Design documentation metal essentials</i>	
D070234	Pen Re Mass Magnets (External Shielded Magnets)
D070235	Pen Re Mass Magnets, Magnet Holder (External Shielded Magnets)
D1001124	Pen Re Mass Magnets, Magnet Base (External Shielded Magnets)
D070238	Pen Re Mass Magnets, Steel Disk (External Shielded Magnets)
D0901345	2MM DIA X 6MM MAGNET
<i>Design documentation of the alignment jigs</i>	
D0901592	ASSEMBLY DRAWING – NP-type bonding jig
D0901591	Baseplate – NP-type bonding jig
D1000128	Penultimate mass prism holder
<i>Measurement reports on ‘glass’ essentials</i>	
Q10xxyy	Relevant penultimate mass control measurements
Q10xxxx	Relevant ear control measurements of ears

Q10zzzz	Relevant prism control measurements of prisms
Back ground documents	
E050228	(Specification) Silicate Bonding Procedure
T0900402	Enhanced LIGO core optic drag wipe cleaning procedure
E0900394	aLIGO Optic Container Shipping Procedure
E1000079	Advanced LIGO First Contact procedure for large optics
T1000114	ALIGO NP-type: - Report on Ear Bonding at LASTI 27 th August – 31 st August
T0900447	Ear fabrication readiness review
M080134	ETM/ITM and BS/FM pitch frequencies and d-values
T1000534	Ergo-arm users manual
T1100238	Report on hydroxide catalysis bonding done at LHO in March and April 2011
D0902146	ASSEMBLY, ETM, COC OPTIC CONTAINER, ADVANCED LIGO
D1100555	Metrology baseplate for ear and prism position measurements
E1000079	First Contact Application and Removal Procedure
F1000006	Bond quality monitoring form
E1000265	Jig-settings calculation sheet
E1000386	Material Qualification RGA Test Results: MasterBond EP30-2 epoxy
E960022	LIGO Vacuum Compatibility, Cleaning Methods and Qualification Procedures
E960050	LIGO Vacuum Compatible Materials List

1.6 Version history

04/08/10: Requested DCC number for the document

08/04/10: Release v1 onto DCC

02/19/11: Release v2 onto DCC

31/03/11: Release v3 onto DCC – added a small overview schedule at the start of the document

02/08/11: Release v4 onto DCC – added procedural steps to check the position of the ears and prisms on the mass, a flag to slant the mass slightly to prevent the ear from drifting away from the jig

26/08/11: Release v5 onto DCC - Correction of step 2 in the procedure on which side of the jig to use for which surface

31/08/11: Release v6 onto DCC – correction of equation in step 43.