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Test prism glueing on disc insert plates

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Rev 00	*5th February 2008*	*First draft of report for comment (M. van Veggel, L. Cunningham, H. Armandula, M. Barton)*
Rev 01	*7th February 2008*	*Added test with 4th prism*

Introduction

This document discusses some experiments done with glueing prisms onto disc insert plates using Vac-Seal as a preparation to delivery of glued prisms onto the LASTI penultimate masses and the reaction mass that will be done from 11th to 17th of February 2008.

The glueing procedure is an adapted procedure from E970154-00-D. The main difference is that the glued prisms are not cured by placing the disc insert plates in a vacuum oven to cure the adhesive. In stead the adhesive is cured by heating the freshly glued prism with a heat lamp.

3 prisms were glued with three different curing times under the heat lamp: 2, 4 and 10 hours. A 4th prism was cured for 4 hours, but the adhesive was spread out in a cross-shape over the bonding surface.

1 Reference documents

Design documentation of the alignment jigs	
D070391-05-D	NP-type ear bonding jig GA
D070505-00-D	NP-type penultimate mass prism holder
Back ground documents	
E970154-00-D	Large optics suspension balancing: component specification

2 Log

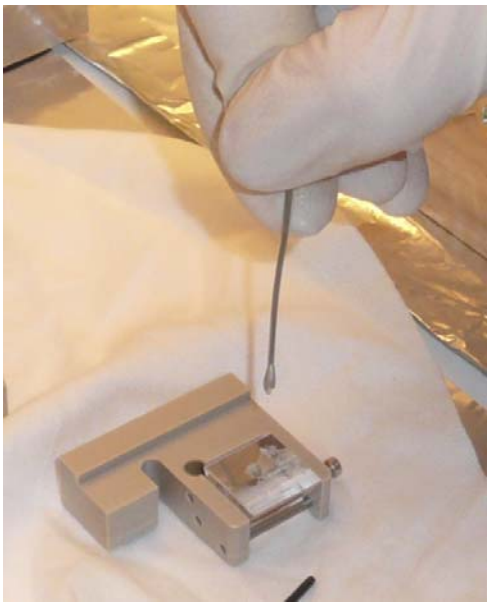
- Laboratory temperature: 20°C. Temperature in the flow cabinet: 21°C.
- Used prisms that were used for groove development research. These prisms had some chipper corners.
- Set d-slider on the penultimate mass bonding template to 20.4 mm, which corresponds to a 7 mm distance of the top of the prism from the fiducial line (Centre of Mass). This could comfortably be done.
- Disc insert plates that were used are displayed in the first column of Table 2.1.

Table 2.1 Glueing and curing information for the three disc insert plates

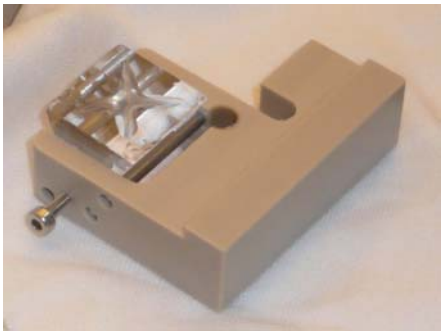
Disc insert plate	Time glued	Hours curing	Temperature at bond	Observations after curing
AA018/BB020	04/02/08, 15.30	2	50°C	Clear and transparent bond. A few smaller bubbles were visible. The squirted adhesive looked clear under heat lamp, but went white when heat lamp was turned off. It seemed that the adhesive was still a bit soft.
AA013/BB003	04/02/08, 17.45	4	60°C	Clear and transparent bond. No bubbles. The squirted adhesive looked white under the heat lamp. Stayed white when heat is turned off.
AA005/BB009	04/02/08, 21.30	11	40°C	Clear and transparent bond. Bubbles visible. The squirted adhesive looked clear under heat lamp. It went white when heat was turned off.
AA007/BB008	06/02/08, 14.00	4	50°C	The glue spread out to the corners without applying much pressure. No bubbles. The squirted adhesive looked clear under heat lamp. It went white when heat was turned off.

- Wiped the silica disc insert surface with methanol
    - Noticed that the disc inserts were slightly dusty: managed to wipe off the visible dust, but it is difficult to wipe underneath the ear weld horns. Therefore blowing away dust with the nitrogen gun is a recommended change to the glueing plan.
- Wiped prism with methanol
- Inserted the prism into the prism holder and tightened the gripping screw slightly
- Wiped 0.7 mm copper wire with acetone and methanol

- Mixed the Vas-Seal in the package by squeezing it for 2 minutes.
- Opened the package using a razor blade and squeeze the adhesive onto an aluminium boat.
    - Noticed that the adhesive has a large number of small bubbles.
- Dipped the copper wire in the Vac-Seal and retracted such that there was a good drop hanging from it.
    - Noticed that the amount of adhesive on the copper wire could not be controlled very accurately using this method.
- Inspected prism for dust.
- Applied the drop to the centre of the prism (Figure 2.1 a).
    - Mariëlle applied the drops for plate AA018/BB020 and AA005/BB009, Liam applied the drop for plate AA013/BB003.
    - The drop for plate AA013/BB003 seemed slightly smaller and was not applied quite to the centre of the prism.
    - The drop for plate AA007/BB008 was spread out towards the corners (Figure 2.1 b) to make the adhesive flow to the corners more easily when putting it down.



a) Plates AA018/BB020, AA005/BB009, AA013/BB003



b) Plate AA007/BB008

Figure 2.1 Appying drop of adhesive to prism

- Inspected the disc insert for dust.
- Lowered the prism holder with prism onto the disc insert
    - Significant pressure was applied to the prisms of plates AA018/BB020, AA005/BB009 and AA013/BB003 for about 30 seconds to the prism to spread the adhesive Figure 2.2). The adhesive was not eager to run to the corners. However, the adhesive squirted out slightly along the edges for all prisms (Figure 2.3).

- There was no need to apply significant pressure to the prism of plate AA007/BB008. The adhesive spread to the corners easily. The adhesive squirted out along the edges anyway.

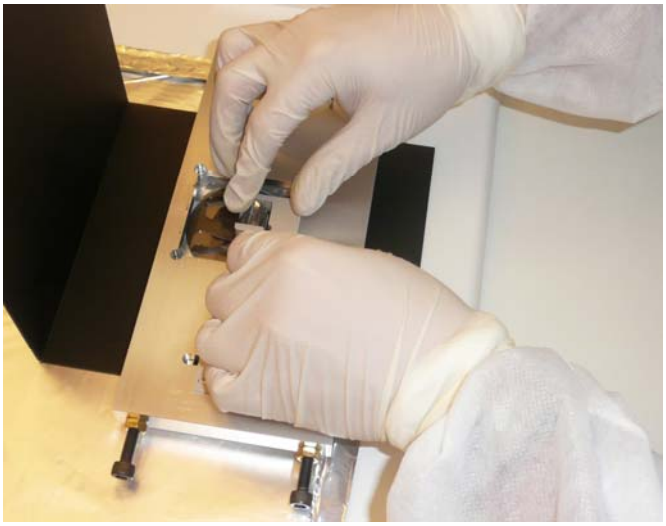
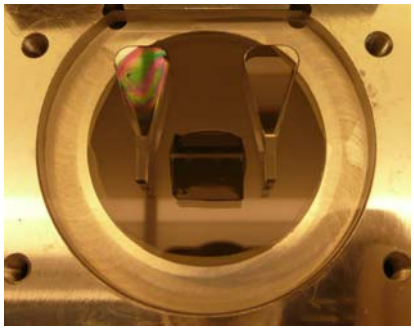
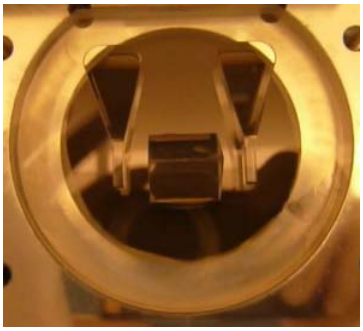


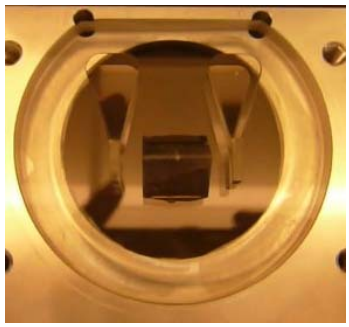
Figure 2.2 Applying pressure to prism holder with prism



a) Plate AA018/BB020, 2 hrs curing



b) Plate AA013/BB003, 4 hrs curing



c) Plate AA005/BB009, 11 hrs curing

d) Plate AA007/BB008, 4 hrs curing

Figure 2.3 Squirted out adhesive for the three different plates

- Placed the heat lamp next to the disc insert plate and shine towards the bonded area. The distance between the plate and the bonded area was approximately 20 cm.
  - The lamp was slightly closer by for plate AA013/BB003.

- Noticed that the adhesive then became runnier and pulled to the corners with slight persuasion. This might suggest that heating the adhesive slightly when applying it, might reduce the drop size, and make the adhesive so much runnier that less pressure needs to be applied.

Figure 2.4 Heat lamp shining at glued prism

- The approximate temperature at the glued area was measured using an infrared thermometer. The temperature measured at the end of the curing time for the different plates is shown in the 4th column of Table 2.1.
- The prisms were cured in the lamp heat for 2 hours, 4 hours and 11 hours as shown in column 3 of Table 2.1. Observations on the glued areas are shown in Table 2.1.
  - All bonded areas looked clear after curing.
  - Bubbles were visible in the bond for the plates that were bonded by Mariëlle and cured for 2 and 11 hours. Also for these the squirted out adhesive looked clear when still under the heat lamp.
  - The squirted out adhesive went white after turning of the heat lamp for all.
  - The squirted out adhesive still seemed slightly soft after 2 hours of curing.
- Remove prism holders.
  - The prism holders were loose for plate AA018/BB020 (2hrs curing) and for AA005/BB009 (11 hrs curing) after curing. The prism holder for plate AA013/BB003 (4 hrs curing) was still fastened and needed to be unscrewed.
  - The prism holder for plate AA005/BB009 (11 hrs) has rotated counter-clockwise by ~1 degree during curing. Might have been caused by applying pressure and not paying enough attention to the alignment.
- Testing the strength of the adhesive bonds by pulling on the bonds by hand.
  - All prisms do not move/are firmly fixed to the disc insert.

3 Conclusions and recommendations

- The general procedure seems fine. Some slight adaptations are needed.
- A backing pump is needed to remove the bubbles from the adhesive before glueing.
- The amount of adhesive applied should be slightly smaller to prevent squirting.
- Spreading the adhesive in a cross shape reduce the need for applying pressure to spread the adhesive.
- Two hours of curing is possibly too short, because the adhesive does not seem to be fully cured. 4 hrs seems long enough, however for safety 11 hrs can be taken as a baseline.
- All bonds are strong enough to withstand manual strength tests.
- We must be careful to check the alignment after applying the prism.