



LIGO Laboratory / LIGO Scientific Collaboration

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Recommendations from the Team Investigating the PUM Crack

Norna A Robertson for the team.

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1 Introduction

On Thursday 20th June 2013, as reported in LHO alog [6831](#), while welding was being carried out on the ETM-X suspension, a fracture was observed in the penultimate mass (PUM) adjacent to the sapphire prism which serves as wire standoff. Welding was halted. A bug report was started – see bugzilla [195](#) - and a discussion was held the following day to consider what happened and how to proceed. The decision was taken to proceed with welding that mass, following procedures as noted in comment 2 of the bugzilla report. Any further welding was put on hold. In parallel, a team was set up to carry out further investigations of what may have happened and to develop procedures to minimize the chances of such an event occurring again. These investigations have now taken place and we present here our recommendations for how to proceed with further welding. Full details of experiments and finite element analysis modeling which have led to these recommendations will be given elsewhere.

2 Recommendations

- 2.1 Sapphire prisms will be glued to the PUM with an increased thickness of glue joint. This will be achieved by using 120 micron glass beads mixed into the EP30-02 glue. The beads will be supplied to the sites, along with revised procedures for gluing and curing including detailed instructions on how to use the beads. All personnel who will do such gluing must practice mixing and using the bead-loaded glue on test pieces such as microscope slides before carrying out gluing of a PUM.
- 2.2 During welding, use the copper shield (D1300612) which attaches to the weld hub and sits over the sapphire prism to reduce the incident radiant heat from the silica welding region.
- 2.3 Take all practicable steps to check that there is no contact on the prism from the gold-coated copper weld mirror or copper shield. This will remove any heat conductive path or lateral force on the prism. The use of a shim may be helpful in this regard when first setting up the mirror.