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Acid Etching of Aluminum Standoffs for Magnets on Suspended Mirrors

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1 ABSTRACT

In an attempt to reduce the breakage of OSEM fins from suspended mirrors, various surface treatments of the aluminum standoffs were investigated. The treatment found was a 10 second bath in an acid dichromate etch.

2 KEYWORDS

Standoffs, suspension, mirrors, OSEMs, magnets

3 INTRODUCTION

One of the problems we suffered while hanging the PNI's suspended mirrors was the repeated breakage of OSEM fins off of the mirror. We noticed that the fin assembly usually broke at the point where the aluminum standoff was glued to the optic with Vac-Seal epoxy. Since the Vac-Seal would remain on the optic and not on the standoff, we developed a surface treatment for the aluminum which would improve the epoxy's performance.

4 TEST SETUP

The test setup was quite simple. For each surface treatment, we glued several standoffs to a piece of glass, and pulled sideways on the free end of the standoff with increasing force until the standoff broke loose. A spring was used to apply force to the standoff. One end of the spring was attached to a small cap placed over the free end of the standoff and the other end of the spring was attached by a single thread (to eliminate torsion from spring extension) to a linear translation stage. The stage was slowly moved by a micrometer screw (extending the spring) until the standoff broke loose, then the force was computed using Hooke's law, $F = k \cdot \Delta x$.

The rods were attached to the glass with Vac-seal epoxy, and were held firmly against the glass by a small jig while the epoxy cured.

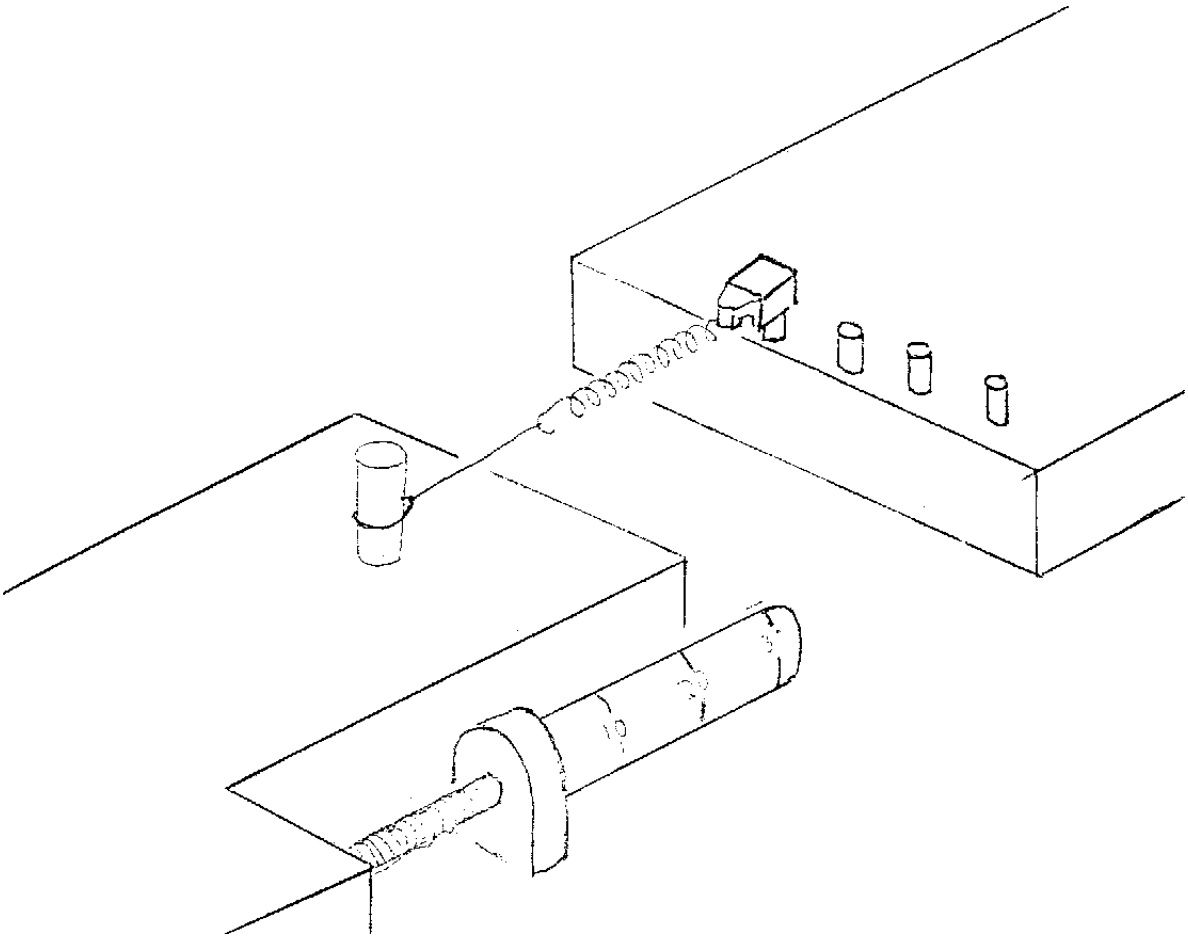
There were five different test subjects: smooth, rough, 10 second etch, 20 second etch and quartz rods. All the standoffs were first waxed into a small jig and lapped so that the ends were flat and the corners were square. The smooth standoffs were finished with 1000 grit wet sandpaper. The rough standoffs were finished with 500 grit wet sandpaper. The quartz rods were finished with 500 grit wet sandpaper. The etched rods were finished with 1000 grit paper and then etched.

The etchant was Iridite 14-2, a commercial acid dichromate etch for aluminum. The bath was 4 grams of Iridite and 200 ml of water. The rods were first cleaned with hot water and Boraxo to remove the wax, then trichloroethane (a degreaser), then with the Isoprep cleaner (from the Iridite kit) and then dropped into the etchant solution for either 10 or 20 seconds. After etching, the rods were put into clear water to stop the reaction. The rods turned a pleasant light copper-brown color.

The results in figure 2 show that the best treatment was the 10 second etch. Surprisingly, the other treatments had comparable breaking strengths to each other, and the 10 second acid etch was about twice as strong. Examination of the broken bonds showed that the epoxy remained almost exclusively on the glass.

This work was undertaken when I saw that the Tra-Con adhesives catalog[1] (manufacturers of Vac-seal epoxy) recommends that when epoxying aluminum for military applications, the surface be degreased with toluene, cleaned with Turco Aviation Cleaner[2], and treated with an acid dichromate etch.

Figure 1: Experimental Setup



1. Available from Tra-Con, Inc. Resin Systems Division, 55 North St., Medford MA 02155, (617) 391-5550
2. Available from Elf Atochem North America, Inc. Cornwells Heights, PA, or Brian Lantz at MIT-LIGO, note that although I acquired some of this cleaner, I never used it.

Figure 2: Test Results