

## MEMORANDUM

**To:** R. Fata  
**From:** J. Zajac  
**Subject:** Materials Tests  
**CC:** D. Fabricant



28 October 2007

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This memo summarizes the testing on materials for compatibility with Cargille Laser Liquid 5610. Strict quality control in handling the samples was observed in order to prevent false readings due to cross contamination. Tests were done that looked for an index or transmission change in the fluid and also for a change in the material durometer.

### **RTV/Couplant Reactions**

Initially, our intent was to bond the lenses in bezels using a standard RTV adhesive. Several years ago, GE 560, GE655 and Sylgard 184 RTV's were considered for this task and were soaked in couplant. In the spring of 2004, these samples were examined and the results caused us to rethink this lens mounting approach. The GE560 got very soft, and the GE655 and Sylgard 184 contaminated the couplant, causing its index of refraction to increase from 1.50000 to ~1.51.

We have the refractive index of our samples measured by Cargille Laboratories, manufacturers of the LL5610 and index matching fluids. Cargille's measurement accuracy is ~0.0001 in refractive index. Cargille also has a spectrophotometer that can be used to measure the transmission of the LL5610 test samples as a function of wavelength.

This index change is likely caused by leaching of some component of the RTV into the couplant. Both the couplant and RTV are silicone based. The primers needed for the RTV's were also tested; they did not contaminate the couplant.

### **Bezel/Couplant Reactions**

The lens bezels will be made out of aluminum. Bare aluminum and nickel plated aluminum were soaked in couplant for 3 years with no interaction

### **Silica Doped Epoxy**

Loctite Hysol 9313 epoxy doped 80% by weight with silica powder (Siltex 44) has proven to be a preferred adhesive for bonding optics. We plan to use this mixture to bond the lenses to their aluminum bezels. This mixture was soaked in lens couplant with no change in either the couplant or the durometer of the epoxy.

A sample mixture was prepared October 5, 2004 and cured for 8 days onto there 1 inch diameter by 0.070” thick disks. The samples were then immersed in LL5610. After one month, the LL5610 from one test sample was drained and sent to Cargille for evaluation. No changes in refractive index (to ~0.0001) or transmission were observed.

**After 14 months of immersion in the LL5610, an epoxy sample was tested for hardness changes using a calibrated Shore D durometer gauge.**

Table 1 indicates there was no interaction between the LL5610 and the epoxy. Our samples mixed with Siltex 44 do not achieve the Shore D hardness of 76 from the Hysol 9313 specification sheet.

**Table 1. Epoxy Hardness Testing**

Sample	Shore D Hardness
2A Hysol 9313 w/Siltex 44	47.6
2B Hysol 9313 w/Siltex 44	47.0
LL5610 Soaked Hysol 9313 w/Siltex 44	47.0

### **Outgassing of LL5610**

By experiment, bubbles that occur during filling the gap between a doublet can be significantly reduced by outgassing the LL5610. A sample of outgassed LL5610 has been sent to Cargille for an index of refraction change and transmittance measurement.

### **Salt Lenses**

The optical design includes a NaCl lens. Handling these elements will be a challenge since they should not be exposed to humidity > 60%RH for more than an hour. A humidity controlled glove box was set up to handle sample windows. Relative humidity in the glove box dropped from 62% ambient to 11% with the humidity control, and the dewpoint dropped from 17°C to -12°C in 7 hours using air circulation through dessicant.

Strick air quality control was maintained during the NaCl couplant soak test. The sample vials were filled to the top inside the glove box then they were capped and placed in a sealed bag with more dessicant. The test results show no visible changes in the NaCl lens and no contamination of the couplant.

## Summary Table of Material and Couplant Tests

**Table 2. Summary of Material Tests**

Test Material	Test Dilution in <sup>2</sup> /in <sup>3</sup>	Approx Soak Time Months	Reaction
Bare Aluminum	19.4	36	None
Ni Plated Aluminum	"	"	None
Bare Aluminum w/4120 Primer	"	"	None
Ni Plated Aluminum w/4120 Primer	"	"	None
Bare Aluminum w/Primecoat	"	"	None
Ni Plated Aluminum w/Primecoat	"	"	None
GE655 RTV	"	"	Index 1.5000 -> 1.5133 & Transmission Change
Sylgard 184 RTV	"	"	Index 1.500 -> 1.5110 & Transmission Change
GE560 RTV Red	"	"	Durometer 55-> ~30
Dupont 500HPP-ST Corona Treated	7.2	3	None
Dupont 500C20 Teflon Corona Treated	7.2	3	None
Dupont 500JP Formable Polyimide	7.2	3	None
Dupont 500A FEP Teflon Film	7.2	3	None
Teflon Coated O-Ring 1	1.0	2	None
Sylgard 184 JZ Batch 21	>19.4	4	Index 1.5000->1.51126 & Transmission Change
Sylgard 184 JZ Batch 22	>19.4	4	Index 1.5000->1.51365 & Transmission Change
NaCl Windows	1.2	5	None
Viton O-Ring	5.7	2	None
Buna-Nitrile O-Ring	5.7	2	Transmission Change
Teflon O-Ring CE	3.2	2	None
Hysol 9313 w/Siltex 44 Epoxy	6.4	1	None
FEP Formed Seal	TBD	1	None
FEP Formed Seal Chemically Etched	TBD	1	None