INVESTIGATION of POTTING COMPOUNDS for HERMETIC FEEDTHROUGH APPLICATIONS

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OVERVIEW

• The Hires spectrograph in the Keck telescope is having an upgrade in its electrical parts.

• The feedthroughs concerning this upgrade need to be customized to be hermetic for vacuum applications.

• Potting compounds were found to be the ideal solution for this problem.
KECK Telescope

- Biggest telescope in the world!
- Performs at nanometer precision.
- Located at Mauna Kea, Hawaii.
- Primary Mirror has a 10 meter diameter.

Fig. 1 Keck Observatory
High Resolution Echelle Spectrometer

- Also known as HIRES.
- Most mechanically complex instrumentation in Keck Telescope.
- Works in the 0.3-1.1 micron range.

*micron = one thousand of a millimeter
UPGRADE - Couple Charge Device

- **CCD**: “Transformer” of the image into electrical charges.

- **System of 3 CCDs of 2k x 4k pixels**: denser device provides better image.

- **Kept at high vacuum environment and temperature of ~130°C**.
UPGRADE - Feedthrough Connectors

- Transports the CCDs’ electrical charges from vacuum to atmosphere.
- Must be HERMETIC.
- Customized for desired size and function.
UPGRADE - Feedthrough Connector

Fig. 5 PAVE Connector

Potting Compound

Pins
POTTING COMPOUNDS

- Commercially available connectors made hermetic with quality Potting Compounds.

- Research among MANY providers:

  - Henkel Technologies
  - PAVE Technology Co.
  - Epoxies, Etc...
  - Loctite
  - TapeCase
  - kra
    www.kranderson.com
POTTING COMPOUNDS - Possible Candidates

KL 320K
Viscosity: +100000cP
Price: $71.00/pkg
Shelf Life: 4-5 months

Hysol ES4412
Viscosity: 10000cP
Price: $45.68/qrt
Shelf Life: 12 months

Hysol EA9396
Viscosity: 3500cP
Price: $15.71/4g
Shelf Life: 12 months

EP-1 432037
Viscosity: ≈270000cP
Price: $15.00/4oz
Shelf Life: 36 months

*1 cP = 0.01 Poise
TEST PREPARATION - Sample Piece

- O-Ring
- Gold Plated Pin
- Potting Compound
- Aluminum Connector

Fig. 6 Autocad Inventor Test Sample
TEST PREPARATION - Procedure

- Manufacture and assemble test piece.
- Allow curing time.
- Ultra Sonic Wave cleaning.
TESTS - Leakage

- Varian 959D Turbo Dry Leak Detector.

- Acceptable leakage rate: $1 \times 10^{-9}$ cc/s

- Thermal Cycle for high and low temperatures.
# TESTS - Leakage Results

<table>
<thead>
<tr>
<th>Test Sample</th>
<th>Average Leak Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Cycle</td>
<td>Thermal Cycle Low: -5°C</td>
</tr>
<tr>
<td>KL 320K</td>
<td>1.6 x 10^{-9} cc/s</td>
</tr>
<tr>
<td>Hysol ES4412</td>
<td>1 x 10^{-9} cc/s</td>
</tr>
<tr>
<td>Hysol EA9396</td>
<td>Big Leakage</td>
</tr>
<tr>
<td>EP-1432037</td>
<td>1 x 10^{-9} cc/s</td>
</tr>
</tbody>
</table>

Table 1. Average leak test results
Graph 1. Leakage Results

Leak Rate (x10^-9 cc/s)

KL320K  ES4412  EA9396  EP-1 432037
CONCLUSIONS

- Observatories need upgrades constantly, therefore, having the materials to customize electrical parts is essential.

- Potting compounds are the key to make commercially available connectors hermetic.

- Out of all the compounds tested the best ones are: KL 320K and EP-1 432037. Although highly viscous, they have lowest leakage rate.

- Hysol products are not good for hermetic applications

Future testing:

- Experiment among the many epoxies, adhesives, hysol, and potting compounds in the market.
- Perform more electrical and mechanical tests including testing for outgassing rate using residual gas analyzer.
- Test Hysol EE4215/HD3561 believed to be ideal compound.
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