

# 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

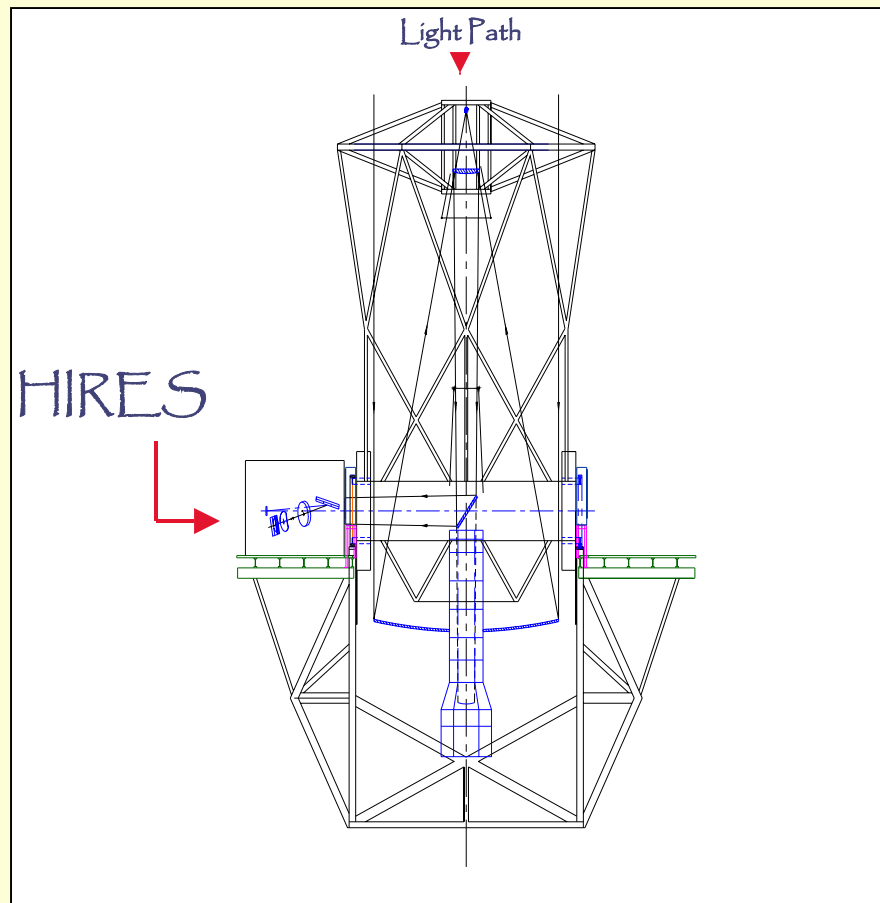


Fig.2 Keck General Assembly

- 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  $\sim 130^{\circ}\text{C}$ .

3 CCDs

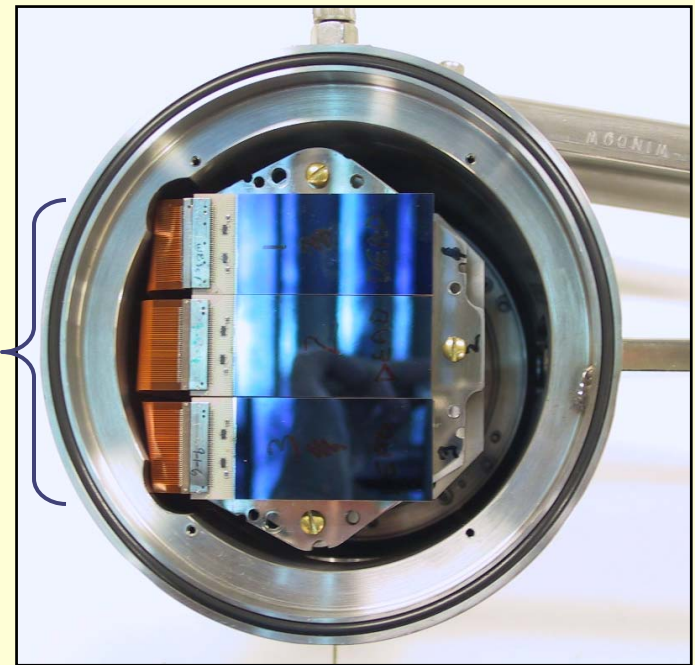
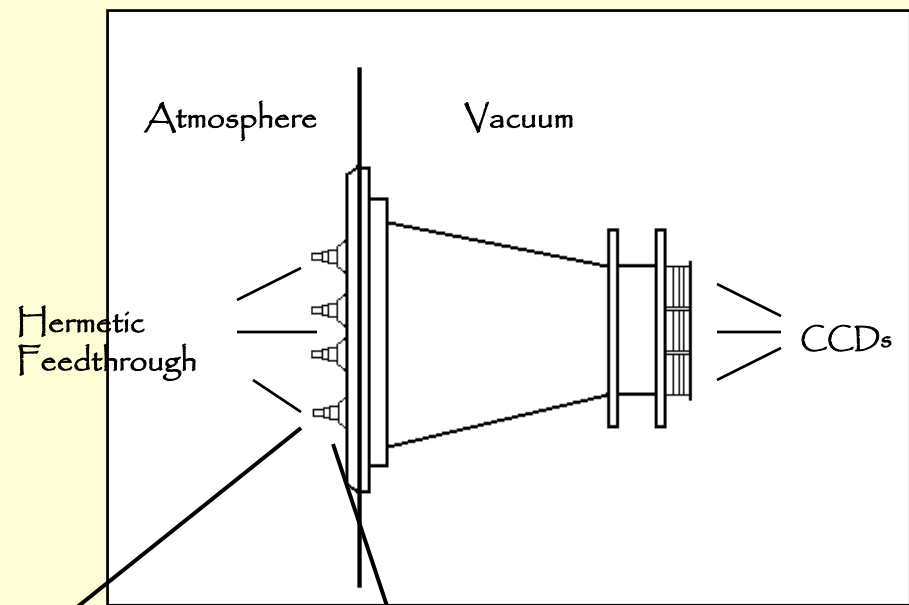


Fig. 3 CCDs: Top View

# UPGRADE - Feedthrough Connectors

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



# UPGRADE - Feedthrough Connector

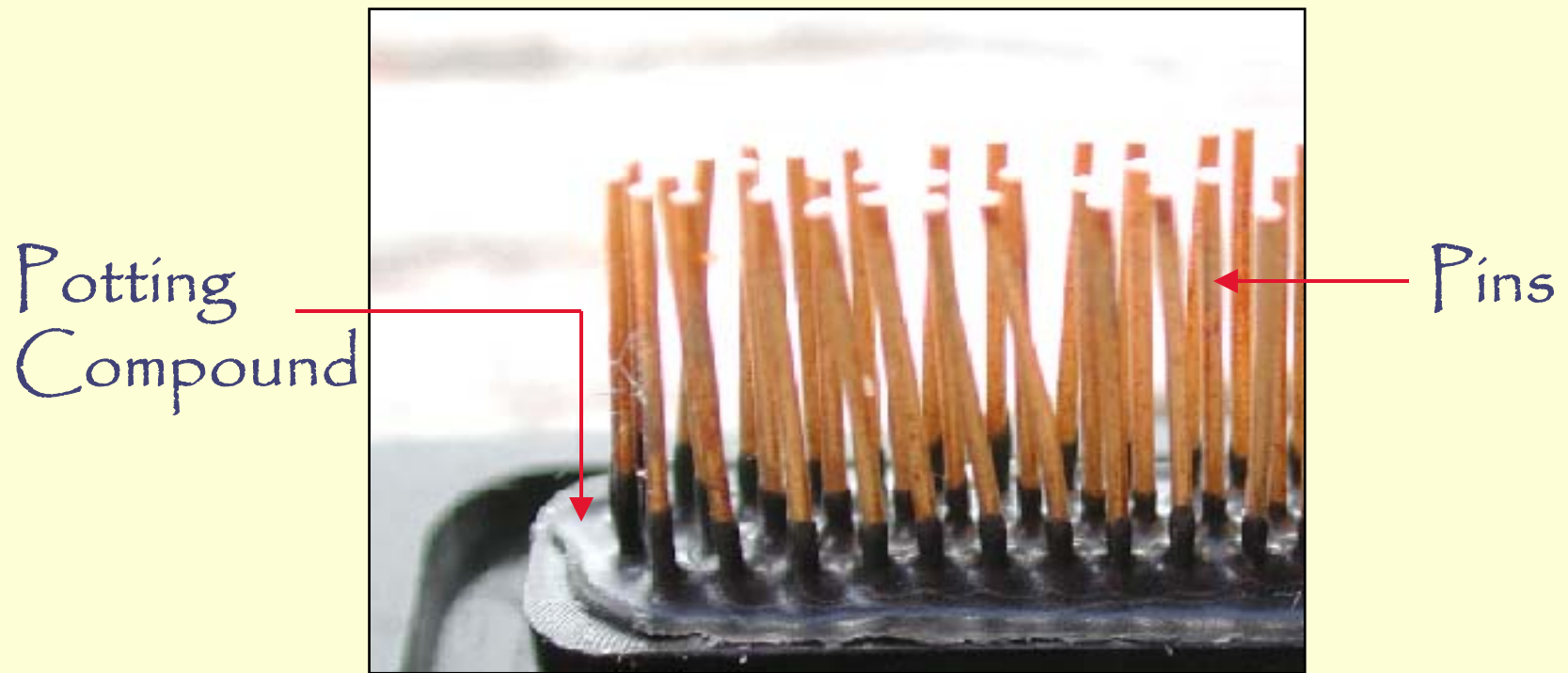
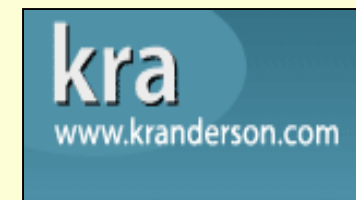
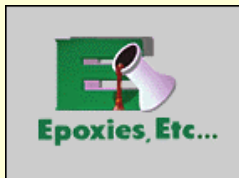


Fig.5 PAVE Connector

# POTTING COMPOUNDS

- Commercially available connectors made hermetic with quality Potting Compounds.
- Research among **MANY** providers:



# 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

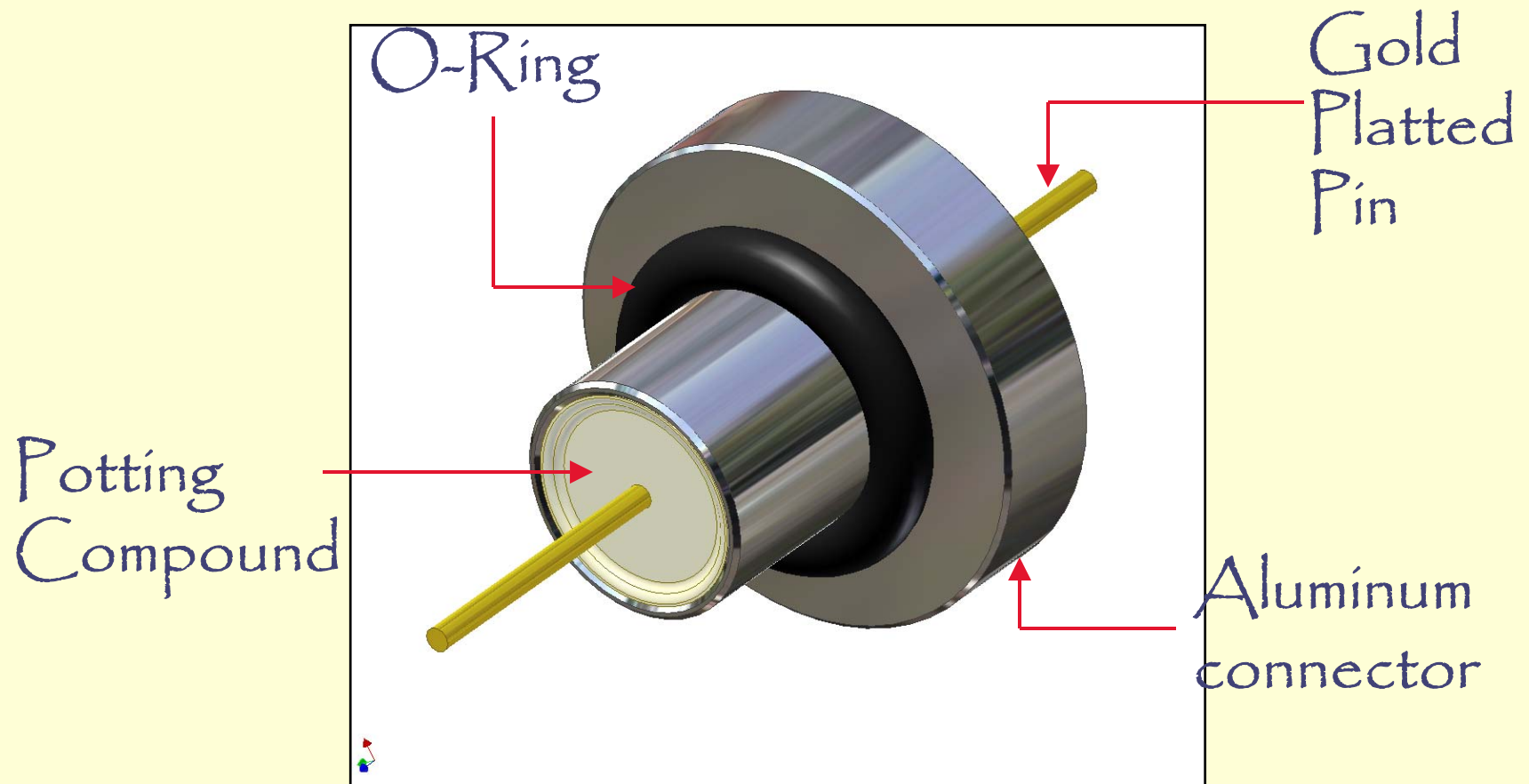


Fig. 6 Autocad Inventor: Test Sample

# TEST PREPARATION - Procedure

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



Fig. 7 Dispensing the potting compound.



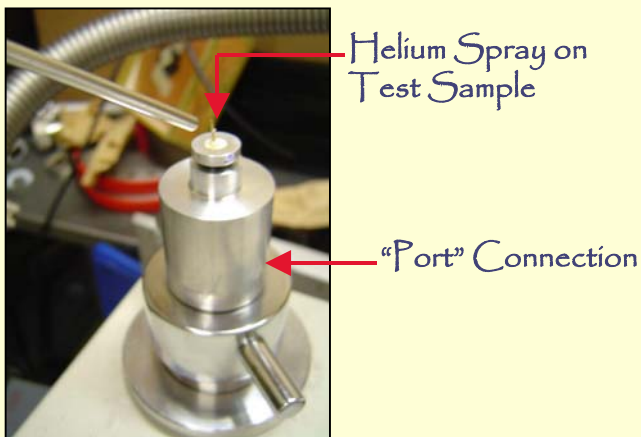
Fig.8 Ultra Sonic Wave Cleanser

# TESTS - Leakage



Fig. 9 Leak detector and helium tank

- Varian 959D Turbo Dry Leak Detector.
- Acceptable leakage rate:  
 $1 \times 10^{-9} \text{cc/s}$
- Thermal Cycle for high and low temperatures.

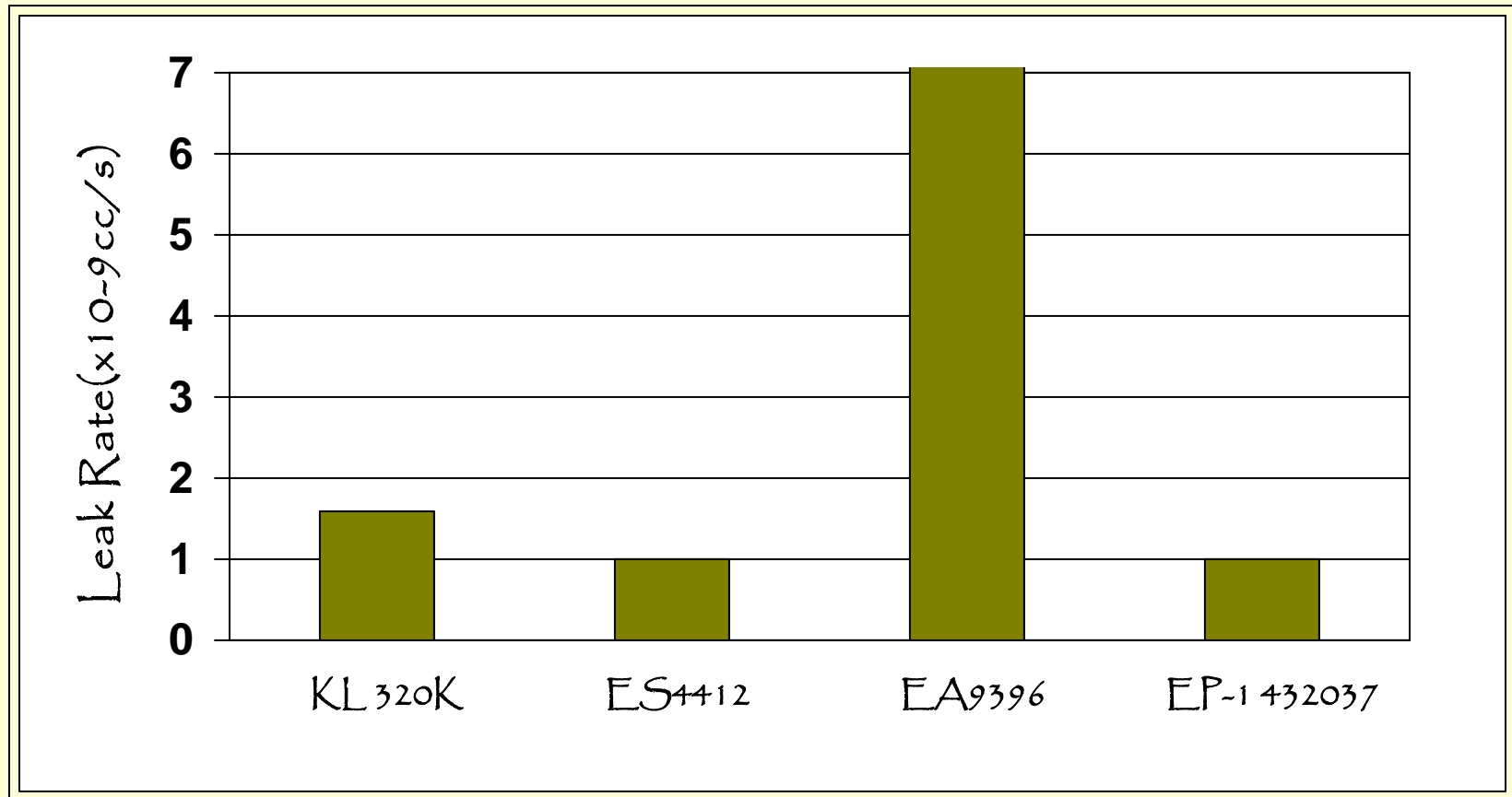


# TESTS - Leakage Results

Test Sample	AVERAGE LEAK RATE		
	Before Cycle	Thermal Cycle	
		Low: -5°C	High: 65.6°C
KL 320K	$1.6 \times 10^{-9} \text{cc/s}$	$2 \times 10^{-10} \text{cc/s}$	No Leakage
Hysol ES4412	$1 \times 10^{-9} \text{cc/s}$	No Leakage	No Leakage
Hysol EA9396	Big Leakage	FAILED	FAILED
EP-1 432037	$1 \times 10^{-9} \text{cc/s}$	No Leakage	No Leakage

Table 1. Average leak test results

# TESTS - Leakage Results




Graph 1. Leakage Results



# 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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