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Subject: LIGO Parts: Molecular Contamination Analysis

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Purpose

Part surfaces were swab-sampled and submitted for chemical analysis. This was to determine the level and identity of molecular (oily) contamination on the surface. In addition, an "All Foil" UHV rated foil was similarly tested for residue.

Method

The analytical swabs consisted of extracted fiber-free lens tissue using dichloromethane solvent. The low volatility residue was analyzed using Diffuse Reflectance/ Fourier Transform Infrared (DRIFT/FTIR) spectroscopy. FTIR provides chemical functional group information for quantitative analysis and qualitative identification of materials. The analysis followed the ACL-120 procedure that complies with Mil-STD-1246C Notice 3 and is sensitive to the most stringent level (A/100).

Results and Discussion

The parts were very clean in terms of oily residue. However, the swabs removed some dark insoluble material that gave it a contaminated appearance. The dark material was fine particles (likely metallic) and this common on machined parts.

The "All foil" UHV foil was very clean and is a remarkable product.

Sample	Chemical Functional Group	~Amount,
Part1, 1A PN 50156	Mainly AHC	0.04 micrograms/cm ²
Part 1, 1B Tapped Hole PN 50156	AHC	~ 1.0 microgram total
Part 2, 1A, PN 50156	AHC	~ 0.04 micrograms/cm ²
Part 2, 1B Tapped Hole PN 50156	AHC	2.7 micrograms total
Part 3, 1A, PN 50156	AHC	0.03 micrograms/cm ²
Part 3, 1B Tapped Hole PN 50156	AHC	1.6 micrograms total
Part 4, 1A, PN 50156	AHC	~ 0.02 micrograms/cm ²
Part 4, 1B Tapped Hole PN 50156	AHC	1.5 micrograms total
UHV Foil	Trace AHC, very clean	~ 0.005 micrograms/cm ²

*A 1.0 microgram per square centimeter level is a 10-nanometer average film thickness (density of 1.0).
AHC = Aliphatic hydrocarbon, common lubricant*