



## Process Traveler Quad N-P Type Sleeve

DCC Number: E070336-00-X

Date Prepared: 12-06-07

Originator	Cognizant Engineer	Ext./Phone#	Project	Account Number
Ian Wilmut	Same	011-44-1235-446972		

Dwg/Part Number	Rev	Part Description	Serial Number	Qty
D070552-A		QUAD N-P TYPE SLEEVE	001	1

Used In (next higher assembly):

Vendor Name	PO/Contract Number
NTE Vacuum Technology	

**Data Package, Receiving/Inspection Remarks:**

Inspection Required Y/N	Visual Damage Y/N	Comments	Name/ Initials	Date Comp.
YES	NONE			

**Process Flow:**

#	Operation	Start Date	Work Area	Instructions	Name/ Initials	Date Comp.
1	Re-Clean		CIT	per E960022, with the following special instructions or cautions:	R. Taylor	
2	Re-Air Bake		CIT	per E960022 to a temperature of 120C	R. Taylor	
3	Control Point		NA	Review/approve FTIR Report # E070348-00-D	D. Coyne	

N.B.: A copy of this traveller must be submitted to the DCC each time the original is shipped with the associated part(s) and when the traveller has been completed.



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#	Operation	Start Date	Work Area	Instructions	Name/ Initials	Date Comp.
4	Control Point		NA	Review/approve RGA scan #N/A	D. Coyne	
5	Control Point		NA	Review/approve RGA scan #N/A	D. Coyne	
4	Wrap & Tag vacuum clean parts per E960022-A		CIT	Wrap (UHV foil) and bag (CP Stat or equiv.) per E960022.	R. Taylor	
5	Deliver/File paperwork		CIT	Make 2 copies of the Traveler. File one copy with the DCC.	R Taylor	
6.	SHIP TO			Please send to: When cleaned these parts need to go to MIT  <b>Note: Ship original traveler with these parts.</b>	R Taylor	

END: Go to Traveler or procedure associated with next higher assembly processing

**Special Instructions (Handling/Packaging Constraints, Remarks, etc.) or Notes:**

1. FTIR Test Done by Mark Anderson at JPL.
2.
3.
4.

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**To:** Robert Taylor, Helena Armandula 12/14/2007  
**From:** Mark S. Anderson  
**Subject:** LIGO Contamination Analysis, Quad N-P Type Sleeve Samples SL1 & 2  
 Dark Powder Identification On Bright Dip  
 Test Sample 3

### Purpose

Part surfaces were swab-sampled on site and submitted (12/13/07) for chemical analysis. This was to determine the level and identity of molecular (oily) contamination on the surface of parts.

### Method

The analytical swabs consisted of extracted fiber-free lens tissue using Freon-TF solvent. The low volatility residue (LVR) 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 (1). The analysis followed the ACL-120 procedure that complies with IEST-STD-CC1246D and is sensitive to the most stringent level (A/100). The powder elemental analysis was performed using an X-Ray Fluorescence Microscope ( $\mu$ XRF). This technique non-destructively excites the sample with high energy X-Rays and measures the energies and intensities of Fluorescence X-Rays emitted by the sample. This is sensitive to elements with the atomic number range from Na to U.

### Results and Discussion

The samples 1 and 2 had relatively low levels of oily residue (2). Sample 3 (with dark powder) had AHC, mixed silicate dust residue and possible reduced carbon. No significant amount of aluminum was detected in the dark powdery sample.

Sample	Chemical Functional Group	Amount $\mu$ g
SL 1	AHC	0.05
SL 2	AHC	0.06
3. with dark powder	AHC, Mixed silicate	~7 (AHC)

AHC: Aliphatic hydrocarbon, base oil of common lubricants

Mixed silicate: a mixture of silicates, a component of common dust

$\mu$ g: micrograms

### References

1. M. S. Anderson et al "Analysis of Semi-Volatile Residues Using Diffuse Reflectance Infrared Fourier Transform Spectroscopy" in *Optical System Contamination: Effects, Measurements, and Control VII*; July 2002, edited by Phillip T. C. Chen and O. Manuel Lee; Proceedings of the SPIE, Vol. 4774, pp. 251-261, (2002).

2. The last mono-molecular layers are more complex to describe when cleaning or analyzing. Carbon/hydrocarbon based substances are known to rapidly (~1 hour) accumulate on most, if not all, freshly exposed surfaces. This “adventitious” carbon is well documented in clean rooms and vacuum systems and compositionally varies by environment. Adventitious carbon is a discontinuous layer of approximately ~0.2-1 nanometers thick or ~**0.02** to 0.1  $\mu\text{g}/\text{cm}^2$  (for  $\rho = 1$ ). The last mono-layer fractions may in some cases be strongly adsorbed to the surface as a “corrosion” layer. Therefore solvent based sampling methods may not remove these corrosion fractions. This is further complicated if the surface is porous. When specifying cleanliness level to less than level A/10 IEST-STD-CC1246D (0.1  $\mu\text{g}/\text{cm}^2$ ) these monolayer effects become more significant. See also: H. Piao and N. S. McIntyre, “Adventitious carbon growth on aluminum and gold–aluminum alloy surfaces”, *Surface and Interface Analysis*, *Surf. Interface Anal.* 2002; 33: 591–594.

3. A typical solvent wipe has a detection limit of ~0.005  $\mu\text{g}/\text{cm}^2$  of removed residue from a 100 $\text{cm}^2$  sample. Note this limit is well below the adventitious carbon level. Lower limits are possible using modified methods. The wipe blanks are at levels less than 10% the amount removed from the sample and this is subtracted from the reported sample amount. High blanks (greater than 10%) are noted in the report.

**NOTE; Sample 3 Dark Powder is a identification of a powder found on the test sample of Bright Dip Process.**

Control Point: Read BY:

Also note that the bright dip process sample has nothing to do with the quadruple pendulum suspension structure sleeve; The sleeve was not bright dipped.  
The contamination levels are expressed in micrograms (total) and not per unit area. If these are from typical 6 in. sq. sample areas (232  $\text{cm}^2$ ) then the contamination level is very low (more typically 0.02 to 0.05  $\mu\text{g}/\text{cm}^2$ ). If these are samples are from threaded holes, a typical clean value is ~5 micrograms (total).