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INCORPORATED

WILMINGTON, DELAWARE 19898

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October 14, 1981

F&F DEPARTMENT
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--For Ray Shuba--

ANALYTICAL METHODS FOR CLEAR COAT/COLOR COAT DEGRADATION STUDIES

As part of your program to evaluate available instrumentation for rapid durability testing, we examined five clear-coat/color-coat panels by Raman, specular reflectance infrared and X-ray photoelectron (ESCA) spectroscopies. A crude correlation between surface oxygen concentration (as determined by ESCA) and exposure times was found. Because of experimental difficulties with this coating system we were unable to obtain useful data by the Raman and infrared techniques.

The five panels examined were identified as follows:

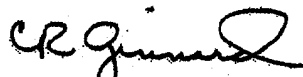
- | | |
|---------------|----------------------------|
| 1) 1783-179-3 | 6 months Florida black box |
| 2) 1783-179-6 | 12 months " " " |
| 3) 1783-179-5 | 2439 hours QUV exposure |
| 4) 1783-179-4 | 5226 hours " " |
| 5) 1783-179-2 | control, no exposure |

ESCA data from exposed sections of each panel show minor differences in surface composition which might be useful in identifying early stages of degradation. The carbon spectral regions are complex, indicating multiple chemical states for carbon at the surface. A spectral feature at 288-289 eV binding energy can be attributed to oxygenated carbon species, and is more prominent in the longest QUV exposure sample. The O_{1s} peak areas for these five samples are plotted in the attached figure as a function of exposure time, using the approximation that 1 year

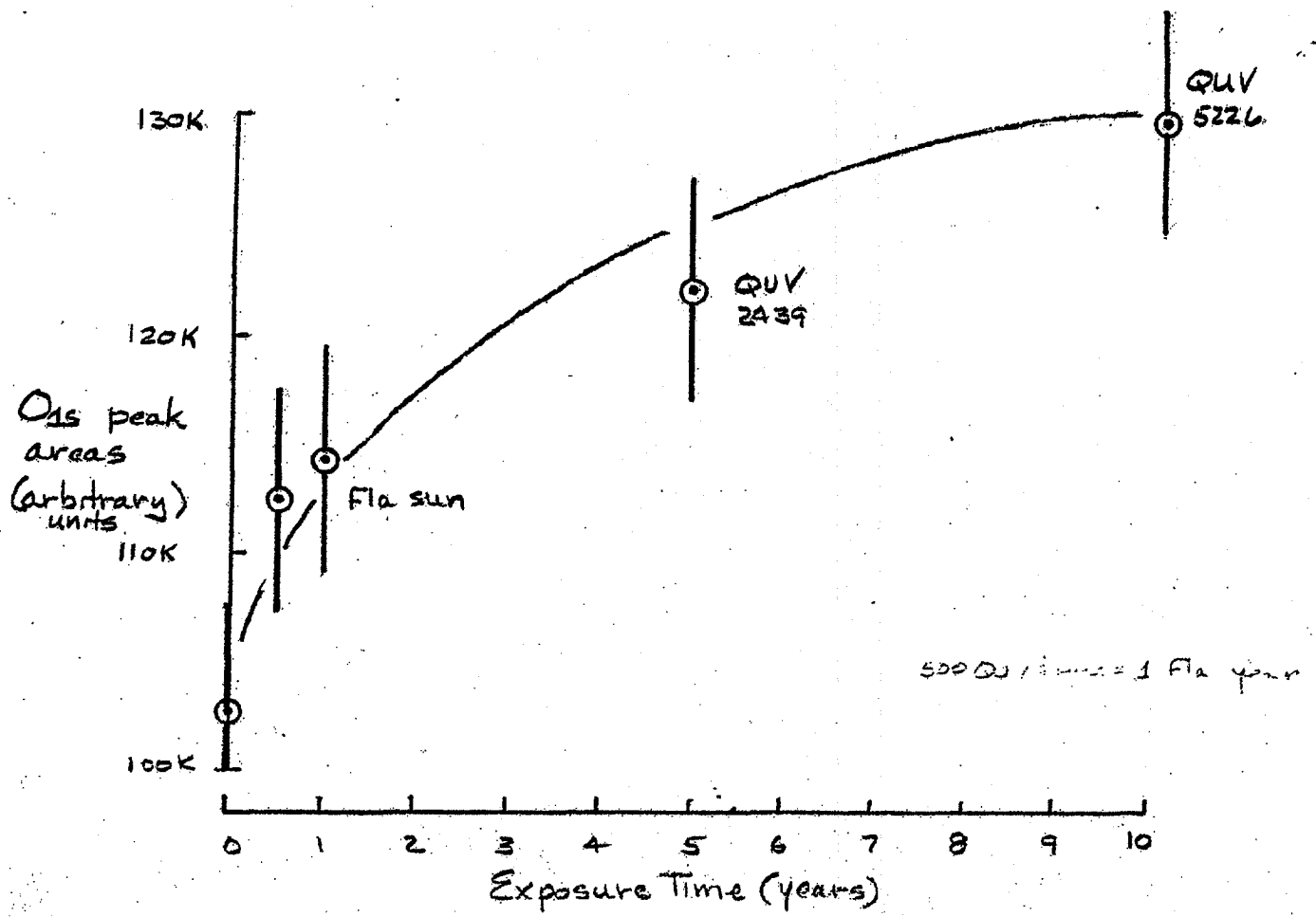
Florida black box exposure equals 500 hours of QUV exposure. The uncertainty associated with the ESCA oxygen areas is estimated to be $\leq 5\%$ relative. These data show an increase in oxygen content with exposure time. If this is a continuous function, the rate of change is probably highest in the initial stages of exposure. The small but significant difference between the low exposure samples (Florida black box exposure) and the control sample may be a useful screening factor. This should be studied more carefully with samples exposed to QUV conditions for short times (10-1000 hours).

A summary of our work with the Raman and specular reflectance infrared work is attached in the form of a DSI-WI from Dr. Bruce Chase of CR&D.

As part of our preliminary work a series of optical micrographs (50 x magnification) were taken. Since they show surface pitting and cracking even at the lowest levels of exposure these may be as informative as the ESCA data.


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Encl.



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