CHAPTER XI

CADMIUM-SULFIDE EXPERIMENT

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SECTION I - DESCRIPTION

The cadmium-sulfide sensors are designed to detect micrometeoroid particles too fine to damage heavy metallic hardware, but presumably present in sufficient numbers to damage sensitive surfaces. Cadmium-sulfide detectors of similar construction but of much smaller area have been used successfully on Vanguard satellites and on Explorer VII. On Explorer XIII, the useful area is 3.1 square inches or about 80 times that of the Vanguard cells.

Construction.- The construction shown in figure XI-1 is that of a mirrorized ellipsoidal flask; this geometrical body had two optical foci, so that a ray emanating from one focus would be concentrated at the second focus by the reflecting walls. To realize these conditions, the aluminized Mylar film was stretched in one of the focal planes while the cadmium-sulfide cell was mounted in the other. Should a micrometeoroid penetrate the opaque aluminized film, the rays from the sun would fall on the cell or be reflected on it from the mirrorized walls.

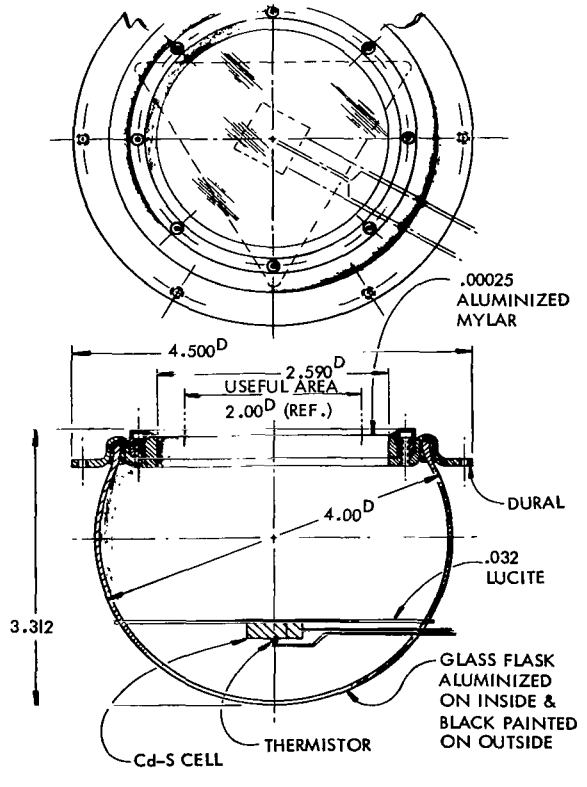

Figure XI-1.- Cadmium-sulfide-cell detector. All dimensions are in inches.

Calibration.- Each of the cells was calibrated as follows: The cell was covered by an opaque metallic cover provided with an elongated slot. The slot was then covered by a sliding blade pierced by a very small calibrated pinhole. Next, the assembly was mounted on a shaft actuated by a variable-speed motor and rotated in front of a Xenon-gas arc lamp to imitate the revolutions of the payload in the sun. A signal from the cadmium-sulfide cell, carried by collecting brushes and rings, indicated the response of the cell to the arc. (See fig. XI-2.) An investigation in sunlight verified the similarity between

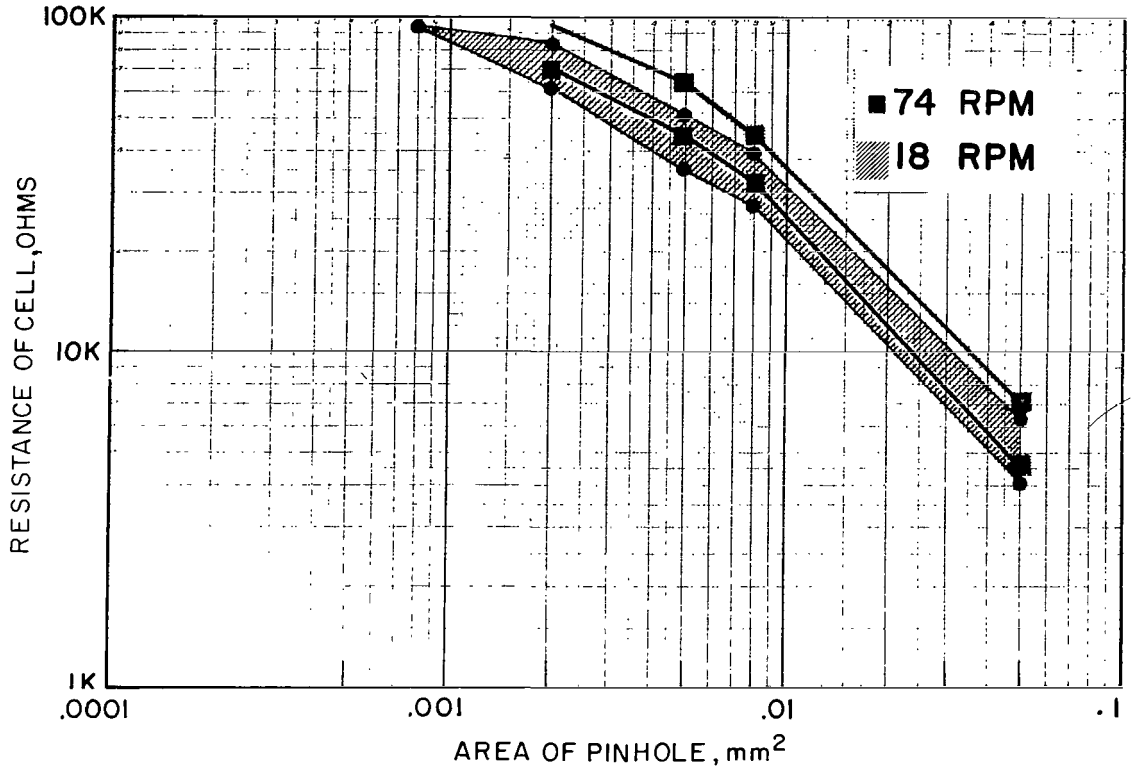

Figure XI-2.- Calibration of cadmium-sulfide cell.

the total radiant-energy input to the cell from the sun and from the arc. The slide with the pinhole was moved 1/4 inch at a time all the way across the diameter of the glass globe, and the response of the cell was noted at each stop. In order to diffuse the direct light from the pinhole to the cell and to equalize the sensitivity of the system from edge to edge, some white paint was applied to the front side of the cell.

SECTION II - RESULTS

The sensitivity of the cells was such that a particle about 1 mil (25 microns) in diameter could be detected. It was estimated that one hit by a particle this size would occur in about 20 days. As stated earlier in the report, the Mylar film ruptured during launch, and admitted a large amount of sunlight thus making the experiment inoperative. Postflight analysis and tests indicated that probable cause of failure was due to improper flask venting.

The glass flask described previously represents a volume of air that has to be evacuated as the satellite leaves the atmosphere. For this purpose a

vent hole had been provided through the rear of the flask into the large telemetry chamber. This, in turn, was vented to the outer space by series of large holes. Preliminary ground tests indicated that the aluminized Mylar film would not be torn by the expanding air, and that venting was adequate. A better plan has now been devised wherein the air is vented from the cell directly into the outer space. Ground tests have shown this new design to be adequate.