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This is an unscheduled ATM providing the results of a shirt sleeve test performed in the Bendix Mission and Crew Laboratory. The purpose of the test was to determine if shortening of the aided assist boom arm would affect the clearance between the ALSEP packages and the Landing Radar Antenna.

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A. Introduction

The purpose of this test was to determine if the ALSEP packages would clear the LM Landing Radar Antenna if the boom used in the aided assist was shortened from its current length. This test was performed as the result of a request from the Structural/Thermal Group for information concerning potential problems which might arise from shortening the boom as dictated by GAEC studies.

The following sections of this report will contain a description of the hardware used, test results and conclusions and recommendations for further testing.

B. Hardware

The following Crew Engineering mockup hardware was used in performing the test:

1. SEQ Bay Mockup - Set at the medium attitude with no tilt.

2. Bendix Boom - Shortened to trip the package at a 29.5 inch extension.

3. Package No. 1 Mockup - Lunar weight mockup with lanyards attached to top and bottom of package.

C. Test Method

A lanyard was attached to the ALSEP Package No. 1 mockup handle and tied to the boom lanyard to simulate the continuous loop device requested by the astronauts (see Figure #1). The boom on the LM mockup was reset to trip when the distance from the face of the SEQ Bay to the center of the tripping mechanism was equal to 29.5 inches. This dimension was provided over the telephone by Mr. T. Fenske during his visit to GAEC. The boom was slowly extended until it reached a point where further forward movement would result in actuating the release mechanism. With the lanyards slack (see Figures #2 and #3), the clearance between the landing

radar antenna and the package structure was checked. As can be seen in the photographs, the package hangs directly over the antenna. The lanyards were then pulled taut (see Figures #4 and #5) and the clearance was rechecked. Two different pull angles were incorporated during this time to determine the difference introduced by this variable. The pull angle was varied by the subject through the expediency of raising the arms under one condition and lowering them for the other. Figure #4 illustrates the clearance realized with a shallow pull angle (arms raised) while Figure #5 illustrates the interference with a deeper pull angle (arms lowered).

After these factors were investigated, the package was lowered to the ground four (4) times; each time using the shallowest pull angle (maximum clearance) possible. The rationale behind this was that if the best case condition resulted in non-clearance of the package with the landing radar antenna, the worst case condition would not require testing.

D. Results and Conclusions

Figures #6 and #7 illustrate the general results discovered during the test. During three of the four tests performed, the Package No. 1 structure failed to clear the antenna with the point of impact being approximately 4-6 inches below the upper rear edge of the magnetometer housing. The initial impact frequently caused the package to swing outboard and impact again on the edge of the LSM housing. In one instance, the package cleared the antenna with no interference.

It must be pointed out here that these are some dangers in drawing hard and fast conclusions from these tests. First, it is not known if the center of gravity of the mockup used accurately simulates the CG of the real package. This difference would result in the package assuming an unrealistic attitude prior to being lowered to the surface.

Second, the Bendix boom utilizes the automatic release feature, introducing oscillations into the package as the mechanism is actuated. These oscillations could cause the package to swing into the antenna.

Third, only a directly outward (from the face of the LM) pull was exerted on the package through the lower lanyard. A sideward force, nearly perpendicular to the corresponding face of the antenna might result in realizing the clearance needed.

Based on these contingencies, the following recommendations are proposed.

E. Recommendations

It is highly recommended that an escapement mechanism such as that used by GAEC be fabricated and incorporated into the Bendix Crew Engineering mockup. This will also entail the fabrication or incorporation of a cylindrical boom arm rather than the (in cross section) square arm currently used on the mockup. After the modifications are made to the Crew Engineering mockup, a series of tests should be performed wherein the attitude of the LM is varied in accordance with the limits established, pull angles (right or left of the centerline) be varied and a variety of procedures be tested to determine if some combination of events might not be found satisfactory. For example, when the LM is in a high attitude, the ALSEP packages might be lowered to a convenient height through the use of the aided assist technique and then manually manipulated to clear the antenna.

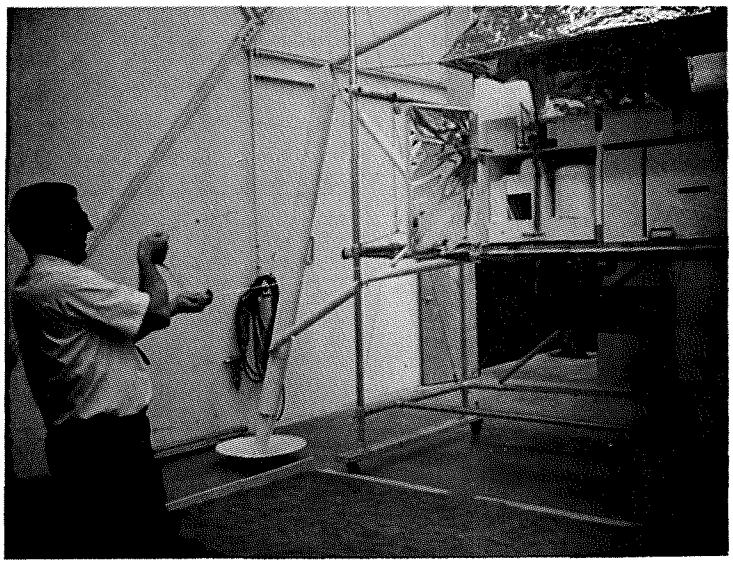

Figure #1 - Subject holding continuous loop lanyard to aided assist boom arm and ALSEP Package No. 1.

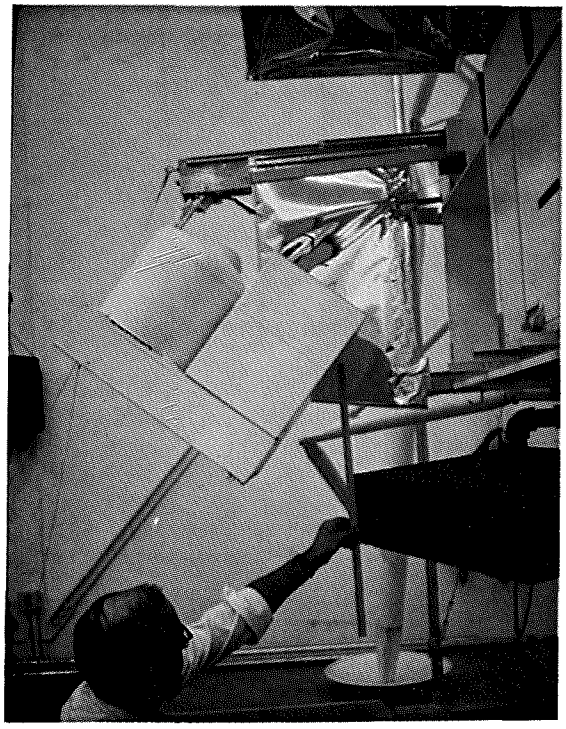

Figure #2 - Package No. 1 orientation relative to Landing Radar Antenna with boom arm extended 29.5 inches and extraction lanyards slack.

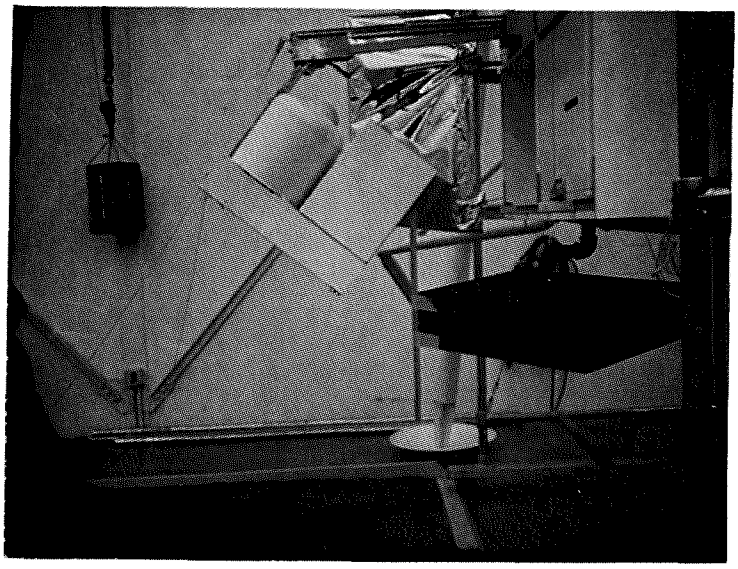

Figure #3 - Indicator marker taped to Landing Radar Antenna to illustrate relationship of package to antenna corner with extraction lanyards slack.

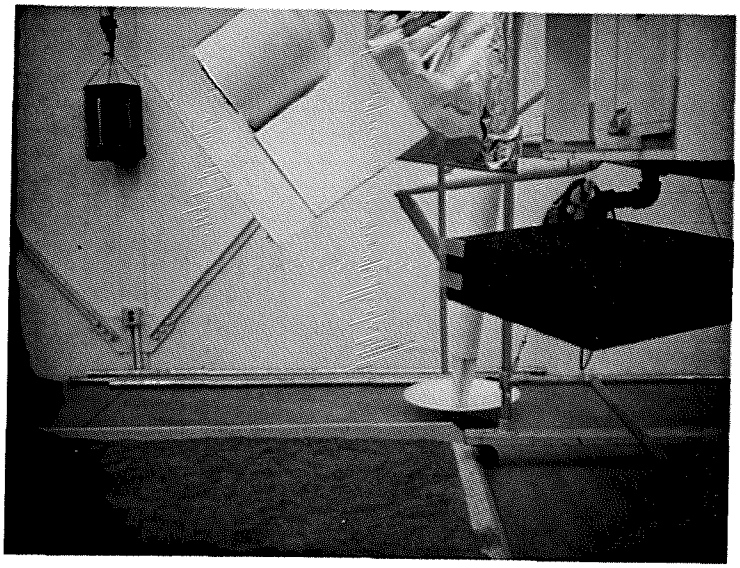

Figure #4 - Illustration of relationship of package to antenna corner with extraction lanyard pulled taut through shallowest pull angle possible.

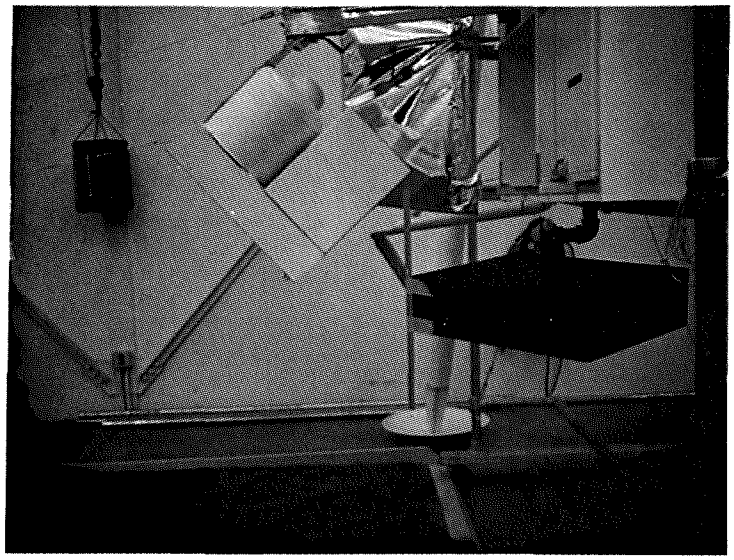

Figure #5 - Illustration of relationship of package to antenna corner with extraction lanyard pulled taut through steeper pull angle.

Figure #6 - Package No. 1 mockup descending to surface.

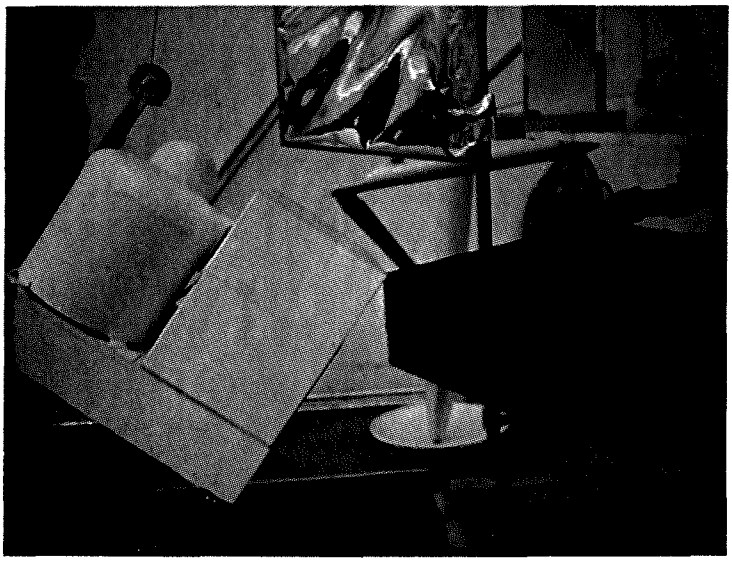

Figure #7 - Illustration of lack of clearance between Package No. 1 and Landing Radar Antenna.