



**Aerospace
Systems Division**

Results of CPLEE
Alignment Devices Tests

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This is an unscheduled ATM dealing with a test performed on the CPLEE to determine the adequacy of alignment techniques utilizing two shadow casting devices. The test was performed at the Crew Engineering facility by a suited BxA subject.

Prepared by: Angelo J. Micocci
Angelo J. Micocci, P. E.
Human Engineering Section
Mission & Crew Engineering

Approved by: F. E. Harrison
F. E. Harrison
Group Manager
Mission & Crew Engineering



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A. PURPOSE

This test was performed to determine the adequacy of either of two shadow casting devices for performing alignment of the CPLEE to the specified orientation. The two devices were:

1. Single leg casting a shadow against the vertical face of the experiment as an alignment indicator.
2. Use of the Experiment Handling Tool (EHT) as the gnomon to cast a shadow on the thermal plate dust cover.

As an adjunct to this test, a second EHT socket was attached between the two legs at one end of the CPLEE to determine if this aided in retrieval of the experiment from its in-flight stowage position.

B. TEST DESCRIPTION

1. Hardware -
 - a. BRLD E-2 Training Model mockup.
 - b. Mission and Crew Engineering soft mockup of the CPLEE.
 - c. Experiment Handling Tool.
 - d. One Thousand (1,000) watt collimated light source.
2. Facilities - Bendix Crew Engineering Laboratory simulated lunar surface with operations performed by a suited, pressurized subject.
3. Procedures - The first item tested was the potential use of the additional EHT socket mounted between the two legs of the experiment as an aid in handling (see Figure #1). The Crew Engineering soft mockup was used during these tests to preclude possible damage to the E-2 model. The mockup was retrieved from a simulated pallet representative of the height of the in-flight stowage by inserting the EHT into the second socket and lifting the experiment. The subject then grasped



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the shank of the EHT (see Figure #2) in order to extend the legs. After the legs were extended, the subject grasped one of these (see Figure #3) and inverted the experiment in order to insert the EHT into the socket located on the thermal plate face; thereby utilizing the same handling technique that is currently used in experiment deployment.

After the general handling tests were completed, the shadowgraph problem was approached. The collimated light source was emplaced to cast shadows with as well defined edges as possible. The E-2 model of the experiment was deployed in the light beam with the intent of testing two different alignment indicating techniques.

First, it was decided to retest the technique utilizing the single leg end of the experiment facing the sun and the leg itself as the gnomon to cast a shadow on the vertical face of the experiment. As can be seen in Figure #4, the combination of lightening holes in the leg plus the beads on the vertical face results in a distortion of the shadow. It was felt that this distortion was sufficient to preclude use of this device as the shadowgraph. Therefore, the decision was made to proceed with the test to the next step; that of utilizing the EHT as the gnomon to cast a shadow against the experiment dust cover.

The requirement imposed on the subject for this test was to align the CPLEE as closely to the E-W axis (represented by the direction of the light beam) as he could. Since the dust cover is transparent on the outer long edges with a wide strip of H-film between the trans-

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parent edges, it was decided to use the line formed at the interface of these edges as the target area. The experiment was carried into the light beam by the subject using the EHT and emplaced with a rough orientation. The subject then attempted to align the experiment so that the selected edge of the shadow cast by the EHT shank was coincident with the line formed at the H-film/transparent edge interface while maintaining the experiment within the leveling requirements.

This test was performed under both leg concepts, (1) ball joint leg operation as is currently employed and (2) simulated fixed position (single detent) legs.

The results of these tests may be found in the following sections of this ATM.

C. RESULTS

It was revealed during these tests that the use of an additional EHT socket anywhere along the bottom edge (upward facing during stowage) of the CPLEE does not aid the astronaut in retrieval of the experiment. In fact, it appeared to increase task difficulty in that the EHT had to be disconnected after the subject grasped one of the legs. The subject verified that the procedure felt more awkward when the second socket was utilized.

As was mentioned earlier in this report, the bead on the vertical face of the experiment and the lightening holes in the leg distort the shadow sufficiently to preclude use of this device as the shadowgraph.

On the other hand, the EHT shank was noted to cast a sharp enough shadow on the thermal plate to allow usage of this technique as the alignment method. During the tests, the subject was able to maintain the tolerances on leveling as well as alignment. However, he was able to level and align the instrument faster with the fixed position legs than with the ball joint type.



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D. RECOMMENDATIONS

Based on the results of these tests, the following recommendations are made:

1. To not incorporate an additional EHT socket on the CPLEE.
2. Utilize the EHT shank as the shadow casting device (gnomon) and incorporate the compass rose on the dust cover. This recommendation has already been incorporated into the CPLEE.
3. If a redesign occurs in the experiment, the single detent, fixed position leg should be considered as part of the effort.

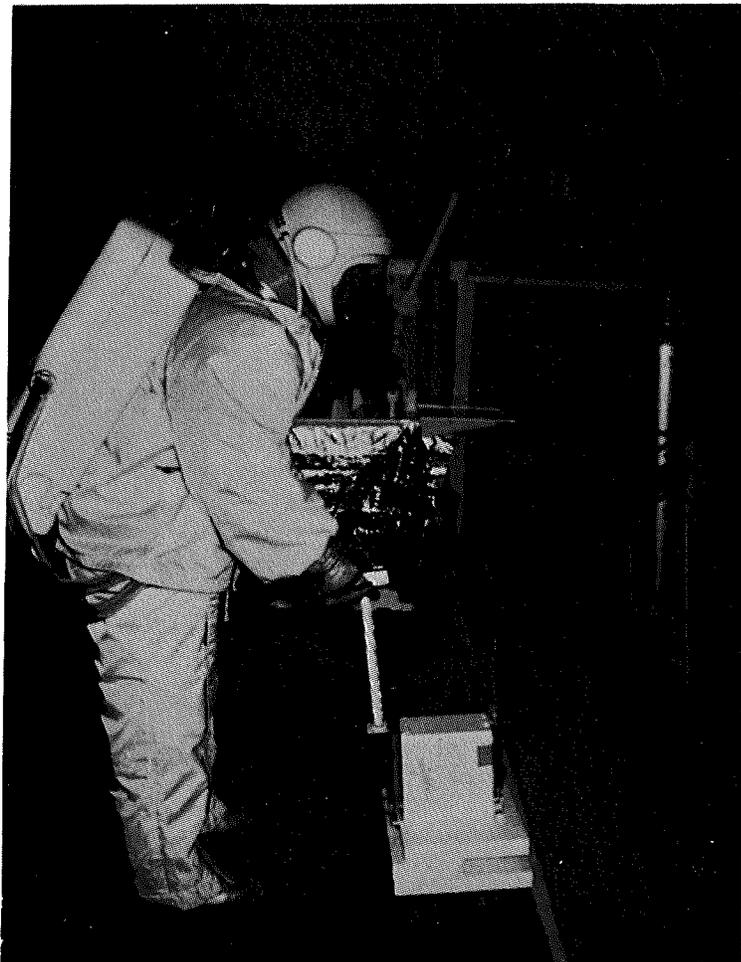


FIGURE #1 Retrieval of CPLEE mockup utilizing additional EHT socket.



FIGURE #2 Extension of CPLEE legs while holding EHT engaged in second socket.

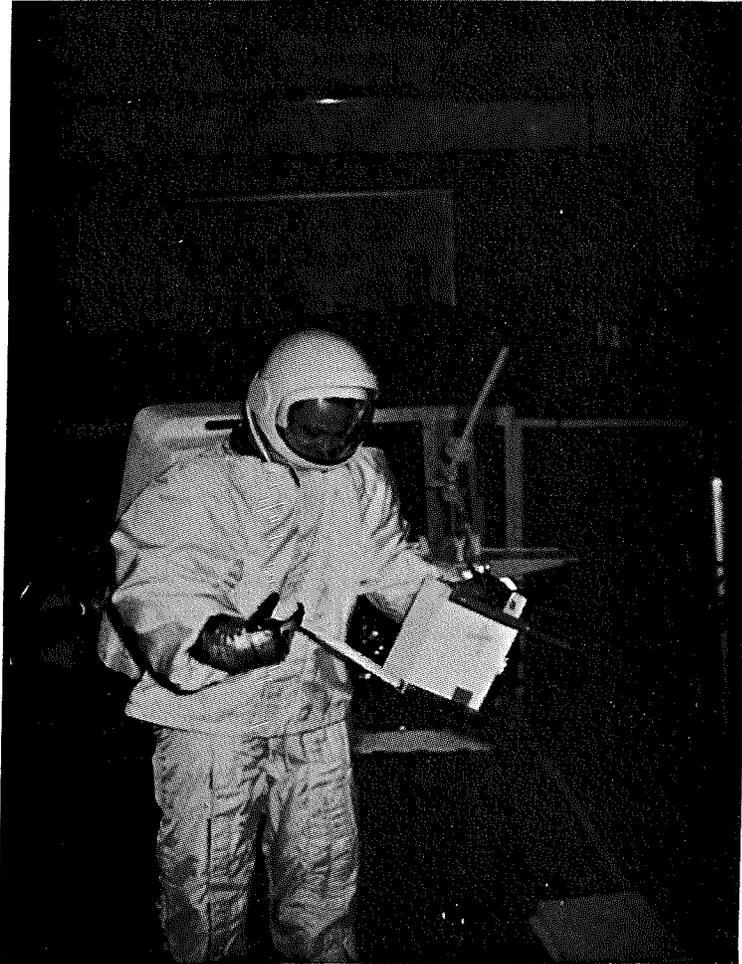


FIGURE #3 Inversion of CPLEE mockup to allow insertion of EHT in thermal plate socket.



FIGURE #4 Shadow cast on vertical face by CPLEE leg.



FIGURE #5 Use of EHT shank as gnomon for orientation of CPLEE to E-W axis.