This is an unscheduled ATM which delineates and describes Crew Engineering test objectives, hardware to be used, and the alternate methods to be employed in determining the optimum method for retrieval and handling of the Mortar Box Assembly during deployment of the Active Seismic Experiment.

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A. General

During the ASE CDR held at Bendix on 30 November 1967, there were some questions raised by the Astronaut Office, Flight Crew Support Division (FCSD) and Crew Systems representatives about the handling aspects of the Mortar Box Assembly (MBA) during retrieval of this element of the ASE as a prelude to deployment of the experiment. As a result of these questions, it was proposed (by MSC) that Bendix Crew Engineering submit a test plan detailing the approach to be utilized in performing the tests. This ATM will specify in the following sections (1) the objectives of the test, (2) the hardware to be used, (3) test conditions for each phase of testing proposed, and (4) the method or alternate methods which will be employed to arrive at a recommended scheme for handling.

B. Objectives

The objective of the tests to be performed are to evaluate those concepts for handling the MBA during the time when the astronaut is retrieving the assembly from the sunshield until he has attained the carrying position which enables him to traverse to the MBA emplacement site. The ultimate purpose of the tests will be to select the optimum concept of those proposed (see Methods section (E) of this ATM).

C. Hardware and Facilities

The hardware which will be utilized during the proposed tests includes:

1. Crew Engineering mockup of the MBA assembly modified as necessary to be as close to current design as possible, including legs, antenna, cable reel (antenna and data system) or other antenna in-flight cable restraint and safety pin.

2. Central station mockup with capability of simulating MBA tie-down.

3. Experiment Handling Tool (EHT).

4. Tie-Down Release Tool (TDRT).

5. Lunar Surface simulator (Crew Engineering Laboratory).

D. <u>Test Conditions</u>

Where multiple concepts are generated, preliminary tests will be performed by a subject operating under shirt sleeve conditions to determine feasibility of the approach. After a series of shirt sleeve tests have been performed to allow evaluation and selection of the optimum concepts, a suited test will be performed to allow evaluation of the selected approach to handling of the MBA. That approach will incorporate the optimum approach and, if satisfactory, will be recommended as the primary technique. The steps to be tested will follow the general sequence related to retrieval of the MBA from in-flight stowage, extension of legs, antenna deployment and safety pin release. Some of the concepts thus far generated for study will be discussed in the following section of this plan. It should be pointed out here that the current concepts for handling the MBA will be tested first to determine if problems exist. This will include pulling the pins which secure the legs and safety release pin removal as is (i.e., no lanyard). If problems occur during these tests, new concepts as described in the following section will be evaluated.

E. <u>Method or Approach to Testing</u>

Before specifying the approach which Crew Engineering proposes to follow during the tests, it is felt that a response should be made to the suggestions listed on RFC 07A-05 of the ASE CDR. The RFC was submitted by Mr. H. H. Schmitt and contains four (4) suggested concepts:

<u>Concept 1:</u> Automatic partial deployment of the top leg (stowed configuration) upon removal of tie-down plate and partial deployment of bottom leg when GLA is removed.

<u>Response 1:</u> Automatic partial deployment of either of the legs implies a spring or other mechanism which has inherently lower reliability, complexity and weight problems. Also, it is possible that such an arrangement might result in "cocking" of the MBA on its retention pins with a concomitant increase in difficulty of removal.

<u>Proposal 1:</u> Therefore, Crew Engineering proposes, during its tests, to remove the pins which tie the legs to the MBA structure and have them free to rotate only by their own weight. If this arrangement proves satisfactory,

it will be the recommended approach to solution of this problem and the suggestion will be made that the legs be restrained during vibration periods through compression on pads or other suitable device, if possible. This will allow the astronaut to have at least one leg partially extended for grasping purposes and reduces the time required for deployment since no pins would need to be pulled to free the legs.

If the leg that extends under this approach tends to "hang up" on primary structure, some means of detenting the leg prior to the time that this occurs will be tested. This will include slight tightening of the screws or pins at the pivot points, tape or other means until a feasible solution occurs.

Concept 2: Automatic deployment of handle on top of box (stowed configuration).

Response 2: Once again, an increase in mechanical complexity, decreased reliability and a weight increase. The handle would require extension to a height compatible with the astronaut minimum reach constraints and does not appear feasible.

Proposal 2: Crew Engineering proposes to test the handling concept which required the use of the EHT plugged into a socket placed at or near the center of gravity of the experiment. After lifting the experiment from the in-flight stowage location, the partially extended leg (per proposal 1) will be grasped and the MBA manipulated by that leg until a configuration is achieved which allows the astronaut to insert the EHT into the socket located near the safe-arm switches (emplacement attitude). If this technique proves satisfactory, it will be recommended as the primary handling mode.

Concept 3: Variations in tool socket orientation or position.

Response 3: This concept does not appear feasible because of the tie-down technique for the MBA. The MBA will be held onto the primary structure in compression over four (4) pins. These pins, when the compression load is removed, will float to prevent the MBA from being jammed if an inadvertent torquing motion is applied as the unit is lifted. A socket anywhere except very near or on the CG tends to aggravate the lifting motion by applying torque. An angled socket, even at the CG, creates the same problem.

Proposal 3: It is felt by Crew Engineering that this concept be considered only as a last resort item for the reasons mentioned above.

Concept 4: Delay deployment until central station is erected.

Response 4: The erector springs could not take the load of the MBA and data system antenna both. The weight of the assembly would be felt primarily on one spring near the forward right edge and the excess weight on that spring would tend to collapse it and damage the others.

Also, because of the tie-down arrangement as described briefly above, the MBA would be difficult to remove. It would impose a stringent task on the astronaut to insert the EHT into the (emplacement) socket (near the safe-arm switches and safety pin) and lift the MBA vertically from a raised sunshield.

Proposal 4: Crew Engineering proposes to test handling of the MBA as per the techniques mentioned in proposals 1, 2 and 3 above.

Specific Steps in Testing

Crew Engineering, based on the above comments, will:

1. Use the existing mockup modified to reflect current design or an existing MBA which is no longer in use.

2. An antenna and safety release pin will be fabricated for use with the MBA.

3. The mockup will be lifted from an in-flight stowage position from a central station simulator through the expediency of an EHT inserted into a vertically oriented EHT socket located at or near the center of gravity.

4. The experiment legs will have the pins removed and allowed to extend partially by their weight alone.

5. The subject will attempt to grasp the extended leg(s) and manipulate the MBA in a manner which allows him to retrieve the EHT from the lifting socket and insert it into the emplacement socket.

6. The subject will, if necessary, extend the remaining leg.

7. He will then deploy the antenna and set the MBA on the surface.

8. Finally, the subject will extract the safety release pin.

A concept proposed for extraction of the safety release pin is to provide a lanyard pull. This lanyard would extend from the point on the pin where an axial pull could be exerted to preclude a torquing action and this lanyard would run between this point (on the pin) and an antenna section which is high enough off the surface to allow the standing astronaut to grasp it. By applying a force against the EHT and a counterforce against the pin, the astronaut could extract the pin without significantly affecting the alignment of the unit.

This concept will be coordinated with both Experiments Engineering and with the Structural/Thermal Group.

The tests will receive photographic coverage and the results will be written in an ATM format for distribution.

Due to the manufacturing time required to update the assembly and to fabricate the parts necessary, including the antenna and safety release pin, these tests are expected to be performed toward the end of January, 1968.