



**Aerospace
Systems Division**

Evaluation of the Flight # 14
LR³ (Mock-Up) Design

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On March 25 the Crew Systems and Operations group performed a pressure suited, 1 G deployment of the LR³ Mock-Up.

The purpose of the test was to evaluate the astronaut interface in the areas of manipulative characteristics, reach parameters and emplacement, including leveling and alignment.

Prepared by:

Approved by:



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The concept mock-up presented a valid (configuration) design for C.S. & O. evaluation in the following areas.

1. Carry handle

The orientation of the carry handle (90° from existing ALSEP design) offers more grasping surface to the pressure glove, and added comfort due to the wider portion of the handle being next to the palm. The handle location is acceptable and common to the existing ALSEP design.

2. Universal Handling Tool Sockets

(Located on structure assembly and extension leg)

The sockets were not functional for this test however, the location were evaluated with the E2-C Trainer UHT. The socket located on the pallet will be primary with the extension leg socket adding flexibility for back up or crew preference. The angle of each socket should remain at 45°, and will require additional verification tests with functional sockets to verify the design. Both locations are acceptable for leveling and alignment, but as mentioned above the socket on the structure is the more desirable of the two.

3. Pull Pin for Extension Leg Release

The pull pin used for this evaluation did not reflect the flight design but did demonstrate an accurate location on the pallet; and is acceptable. The existing astronaut specification call for minimum "O" ring dimensions of 2 inches for pull pins. The LR³ pallet will not accommodate the minimum 2 inch "O" ring and any design modification in lieu of the 2 inch requirement must be coordinated with C.S. & O. personnel.

4. Extension Leg and lock mechanism

This particular task is analogous to the task associated with the hand tool carrier (HTC) and for a single (prime) site works very well. Spring resistance in the lower type locking device should be strong (stiff) enough to preclude accidental triggering, e.g. 5-15 lbs force.



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5. Emplacement

Three techniques were evaluated to lower the unit to the deployed position on the surface as follows, the UHT attached to the structure socket, the handle of the UHT in the carry handle opening, and lowering the unit by hand while standing to one side.

- a. Lowering the unit with the UHT in the structure socket. This technique is the most reliable due to the positive control it affords the crewman. The UHT is attached to the socket while standing on the array side of the package with one hand supporting the LR³ by the carry handle. Rotation to the deployed position is performed while the crewman is at one side. The UHT is immediately available at that time for lowering and alignment.

- b. Lowering the unit with the UHT engaged in the carry handle opening.

This technique is certainly reliable but offers less control during rotation. The UHT must then be attached after emplacement and requires one hand to secure the unit while attaching the UHT.

- c. Lowering the unit by hand

Lowering the unit by hand requires the crewman to release the handle before the extension leg foot pad reaches the surface. The "dropping" effect may cause some stability problems. To elaborate on this point, existing 1/6 G reach parameters suggest that tasks requiring any manipulation, such as grasping, be prohibited below 22 inches, and the height of the carry handle will be 17-18 inches above the lunar surface when deployed. The 5 to 6 inch drop may present some problems, including crew stability and before suggesting this technique, further tests should be performed (KC-135 Aircraft) to verify those reach parameters.

6. Array Dust Cover (Not available for this evaluation)

The dust cover design used on the Apollo #11 LR³ is planned for this model and is adequate. The pull ring/lanyard design should also be mounted on the carry handle as in the previous design.



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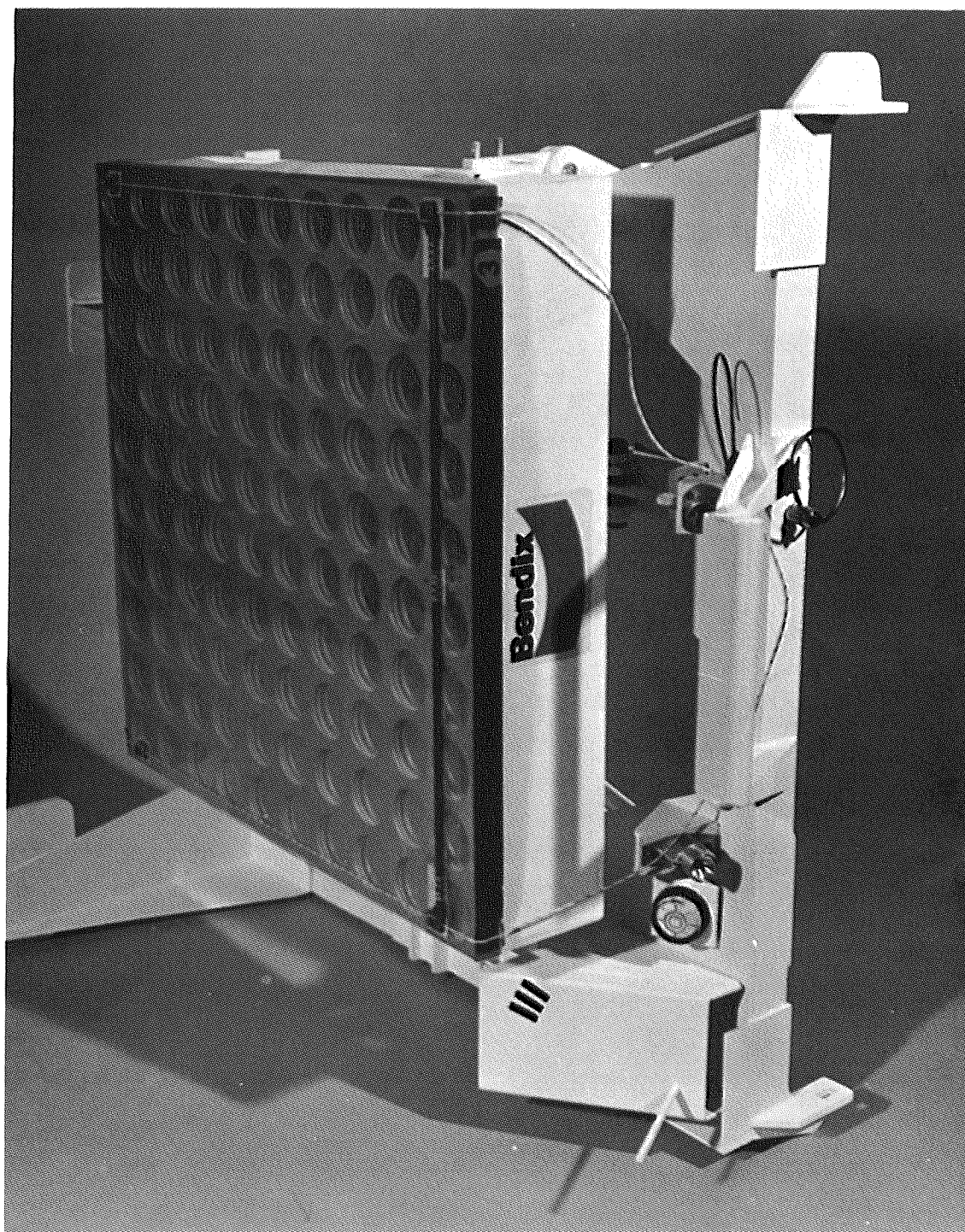
7. Back Support Structure (Not available)

During the review of concept prints, with R. Hill, C.S. & O. suggested that the back support structure be higher to allow for stability during temporary emplacement on the lunar surface while in the suit-case carry mode. The design as of 4-1-70 has a maximum height limitation of 12.5 inches on the left side and 8.25 inches on the right side of the structure. These heights will not allow for stability during temporary emplacement and with the existing design the unit must be supported by the crew, or it will probably topple, either on the array or pallet.

8. Sundial Alignment and Leveling, Prime Site

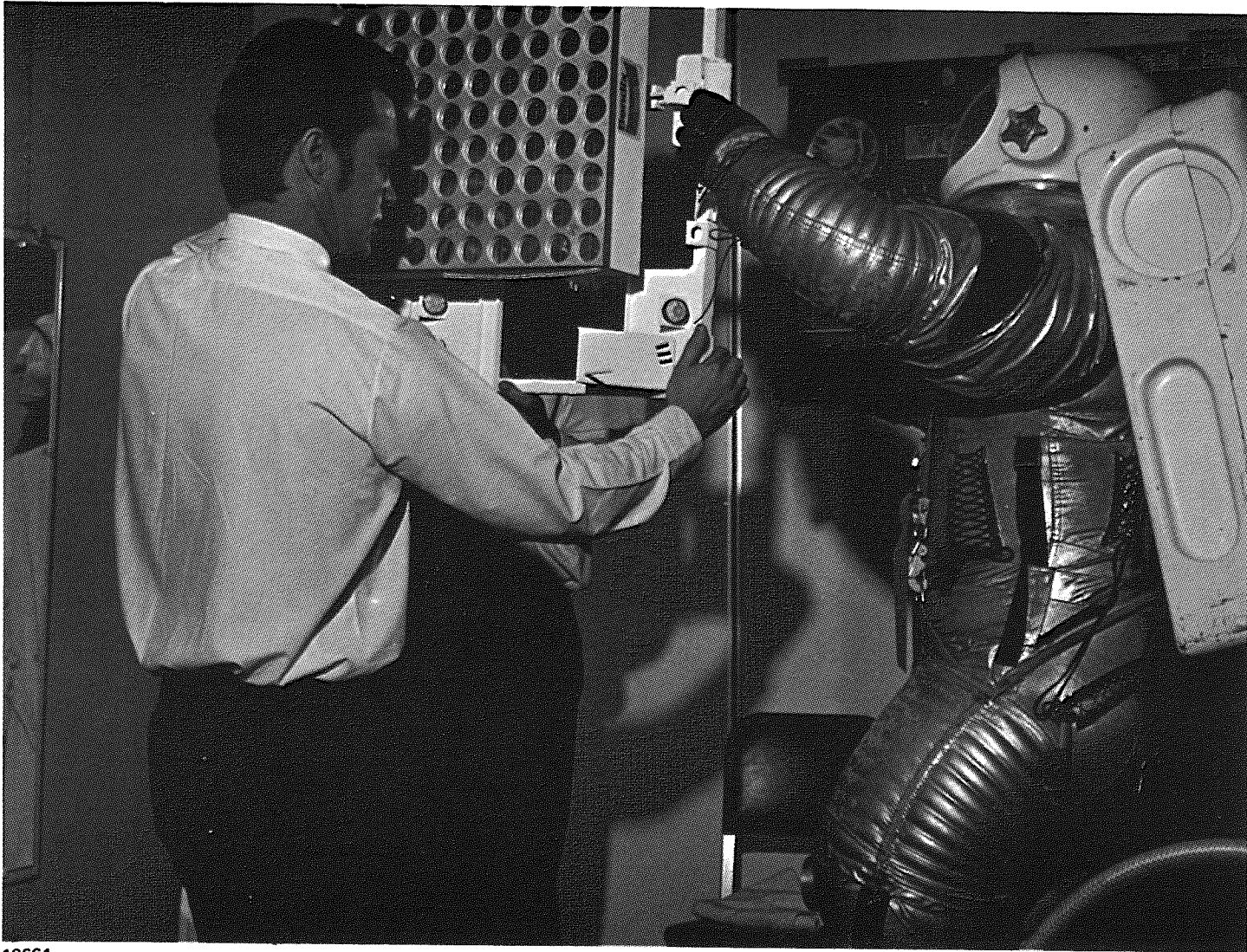
The suggested location and astronaut tasks are acceptable. The structure socket is suggested for leveling and alignment with the UHT, with the extension leg socket being secondary.

Figures 1 through 7 depict the LRRR concept mock-up in the stowed configuration, during various stages of the deployment sequence, and the deployed configuration.



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Figure 1 – LRRR (Stowed Configuration)



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Figure 2 — Test Subject Removes LRRR From "LM"



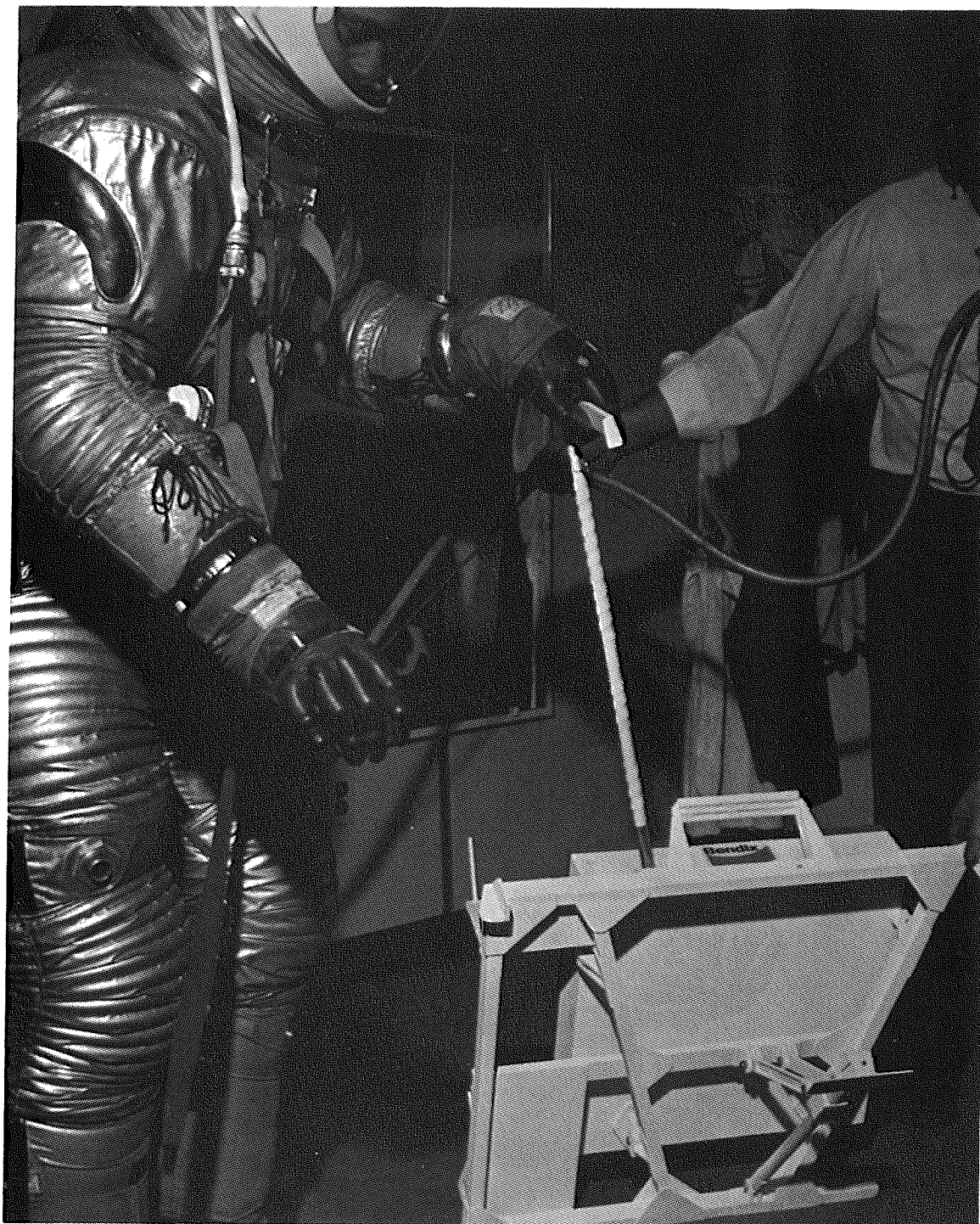
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Figure 3 – Test Subject Lowers LRRR



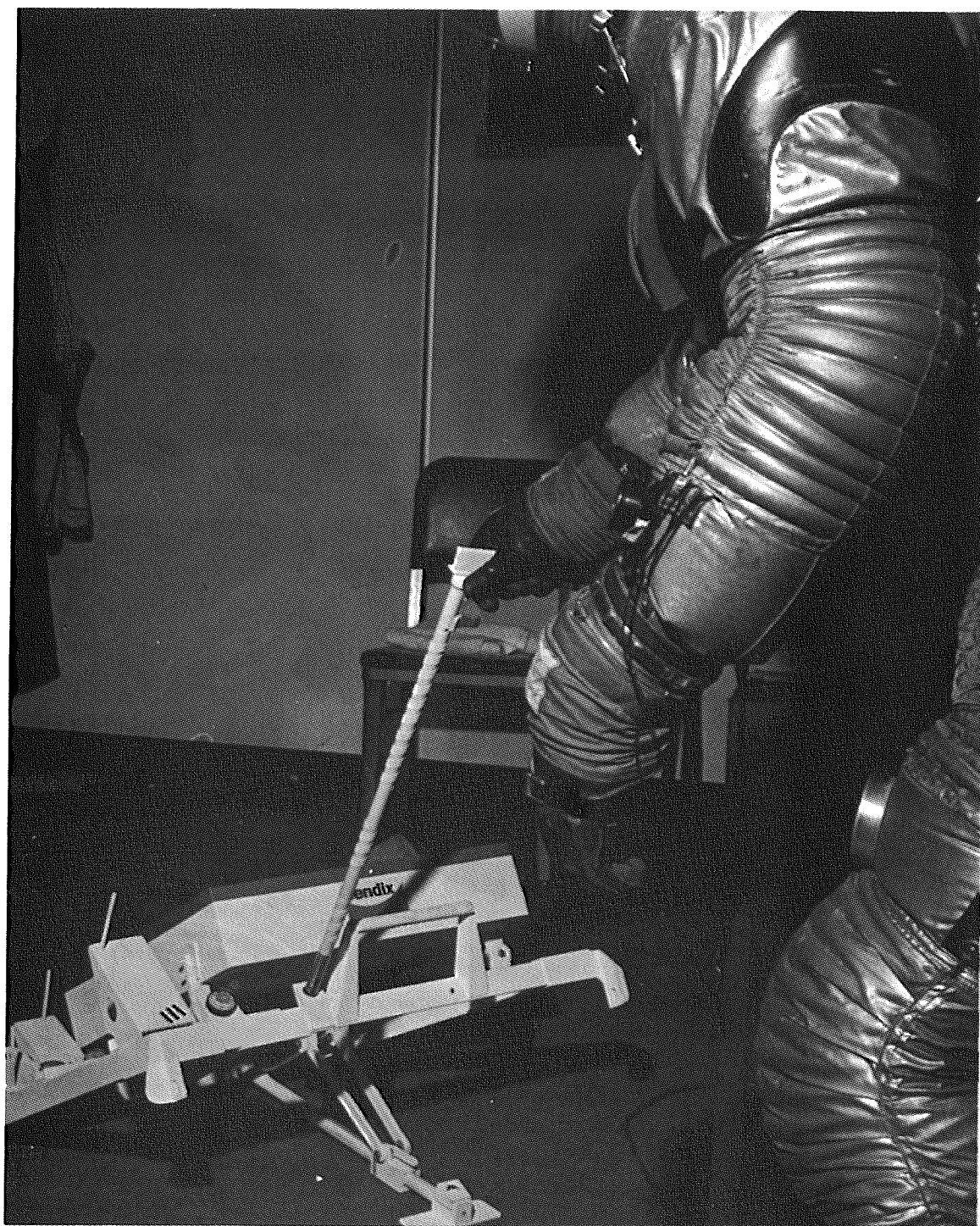
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Figure 4 — Test Subject Removes Leveling Leg Pull Pin



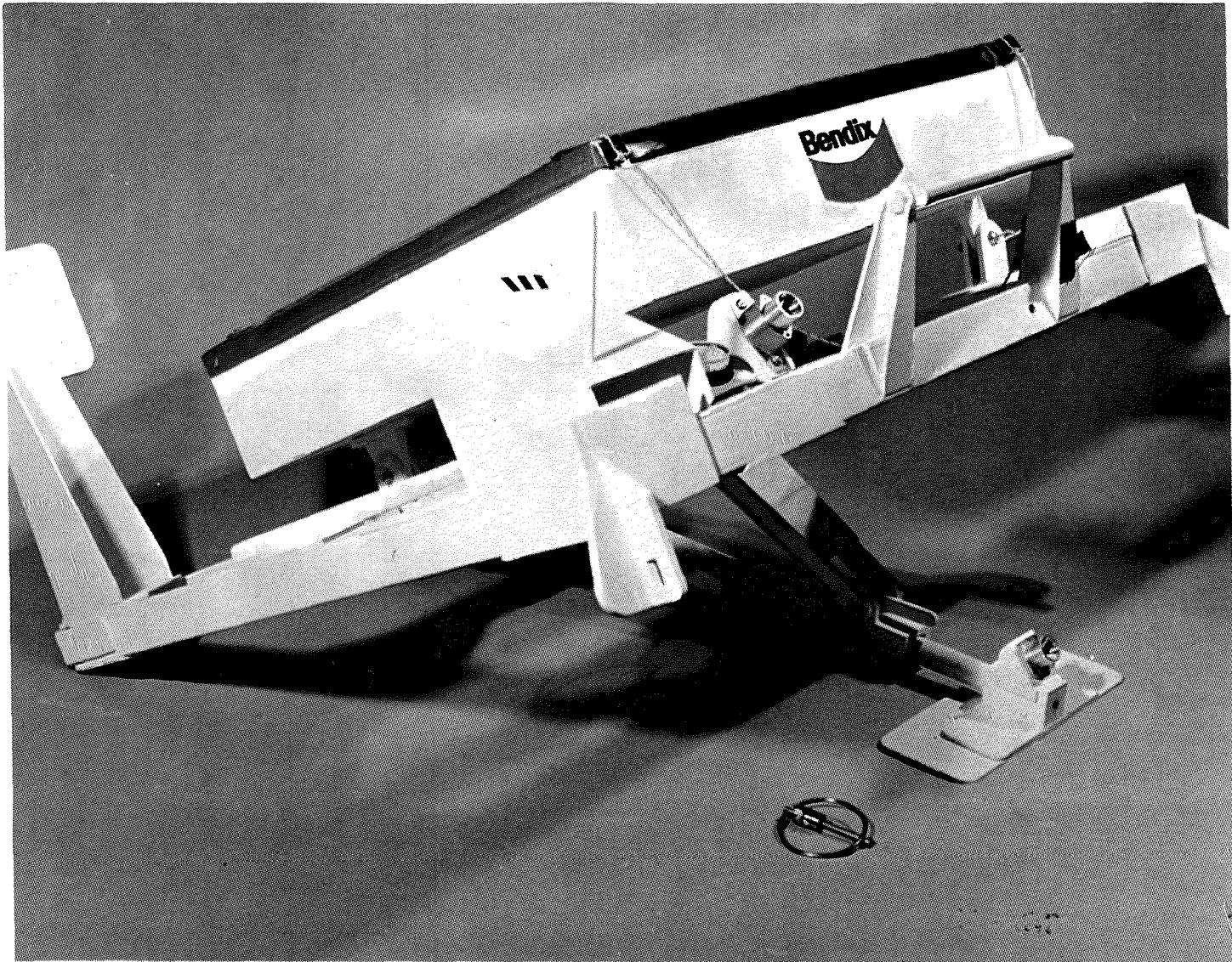
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Figure 5 — Test Subject Engages UHT in Socket



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Figure 6 — Test Subject Emplaces, Levels and Aligns LRRR



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Figure 7 — Deployed Configuration of the LRRR (Dust Cover is Still in Place)