Bendix

Aerospace Systems Division

Crew Engineering Evaluation
300C LRRR Concept Model

NO.	REV. NO.
ATM-938	A

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DATE 12 January 19

This ATM discusses the results of Crew Engineering deployment of the LRRR concept model by a pressure suited subject, and recommendations for design improvements. resulting from the evaluation.

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Crew Engineering performed a pressure suited, 1 G deployment of the 300C LRRR Mock-Up to evaluate the Astronaut interface in the areas of manipulative characteristics, reach parameters and emplacement including leveling and alignment.

The concept mockup presented a valid (configuration) design for CS&O evaluation in the following areas.

1. Carry Handle

   The orientation of the carry handle offers an adequate grasping surface to the pressure glove. The handle location is acceptable and common to the existing ALSEP design.

2. Pull Pins for Small Array

   The pull pin used for this evaluation demonstrated 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 LRRR pallet did accommodate the minimum 2 inch "O" ring. Crew Engineering will be recommending, for future designs, that all pull rings be painted International Orange.

3. Array Deployment

   The Array Knob works very well as a grasping surface and is acceptable to the limits of Pressure Suit reach mobility parameters. A positive lock feature is not incorporated (per design) and I felt the spring force to hold the panel (array) open is adequate.

4. Universal Handling Tool Socket

   (Located on structure assembly to left of carry handle.) The socket location was evaluated with the Crew Engineering UHT. The three position socket located on the handle will add flexibility for crew preference. The angle of each socket should remain at an angle which accommodates a 30" working height and will require additional verification tests with the Astro-trainer to verify the final design position. The location is acceptable for leveling and alignment. Engagement will be accomplished from the Array side of the experiment, while holding the carry handle.

5. Sun Dial Deployment

The Pull Pin length is excessive in the Concept Model (8 inches) however, the final design provides for incorporation of a 2 inch length.

The spring force for rotating the sun dial is acceptable. With ±5 degrees alignment and leveling the design as presented is similar to previous models.

6. Extension Leg and Lock Mechanism

This particular task is analogous to the tasks associated with previous LRRR designs and with consideration for multiple sites, works very well. The locking device on the leg is strong enough to prevent accidental collapse of the leg. The Crewmans positioning, to the side of the experiment, is acceptable when the leg is deployed.

7. Emplacement

Three techniques were evaluated to lower the unit to the deployed position on the surface as follows, the UHT attached to the handle 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 handle 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 LRRR 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 leveling 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 requring any manipulation, such as grasping, be prohibited below 22 inches, and the height of the carry handle may be 10-12 inches above the lunar surface when deployed. The 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.

8. Array Dust Cover

The dust cover design used on previous LRRR models is utilized on the 300C LRRR and is adequate. The pull ring/lanyard design should incorporate Velcro tiedowns and mount on the carry handle as in the previous design.

9. Back Support Structure

The height will allow for stability during temporary emplacement and with the existing design the unit will be supported by the loop type support structure.

10. Sundial Alignment and Leveling, Prime Site

The suggested location and astronaut tasks are acceptable. The handle socket is suggested for leveling and alignment, with the UHT handle in the Experiment Handle being secondary.

Additional design verification tests will be required to verify those tasks not evaluated and must be accomplished at a later date when the concept model reflects the completed design. C. S. & O. personnel will monitor the design effort to ensure timely inputs to 300C LRRR flight design.

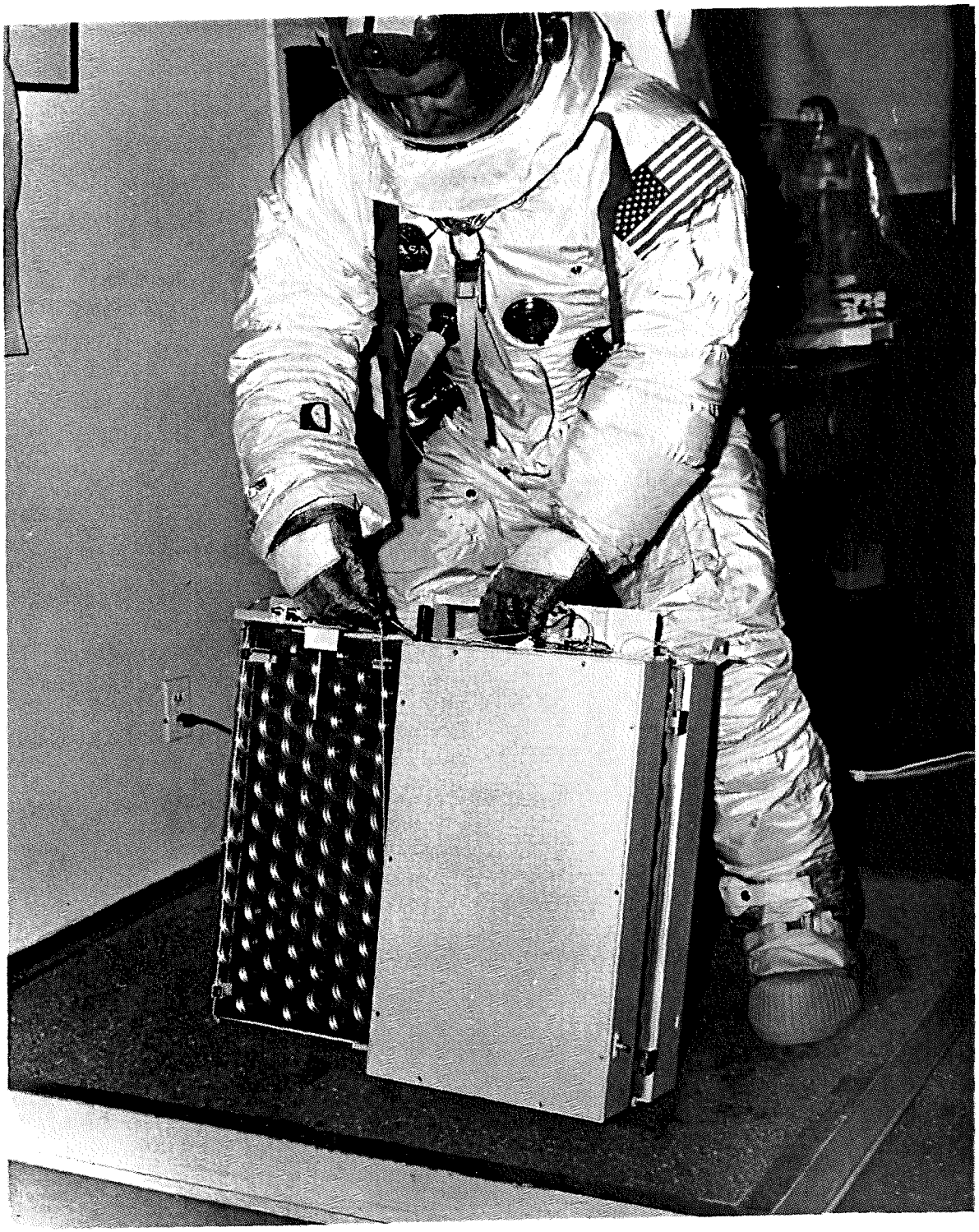

Figure 1. Removing Reflector Array Pull Ring/Pull Pins

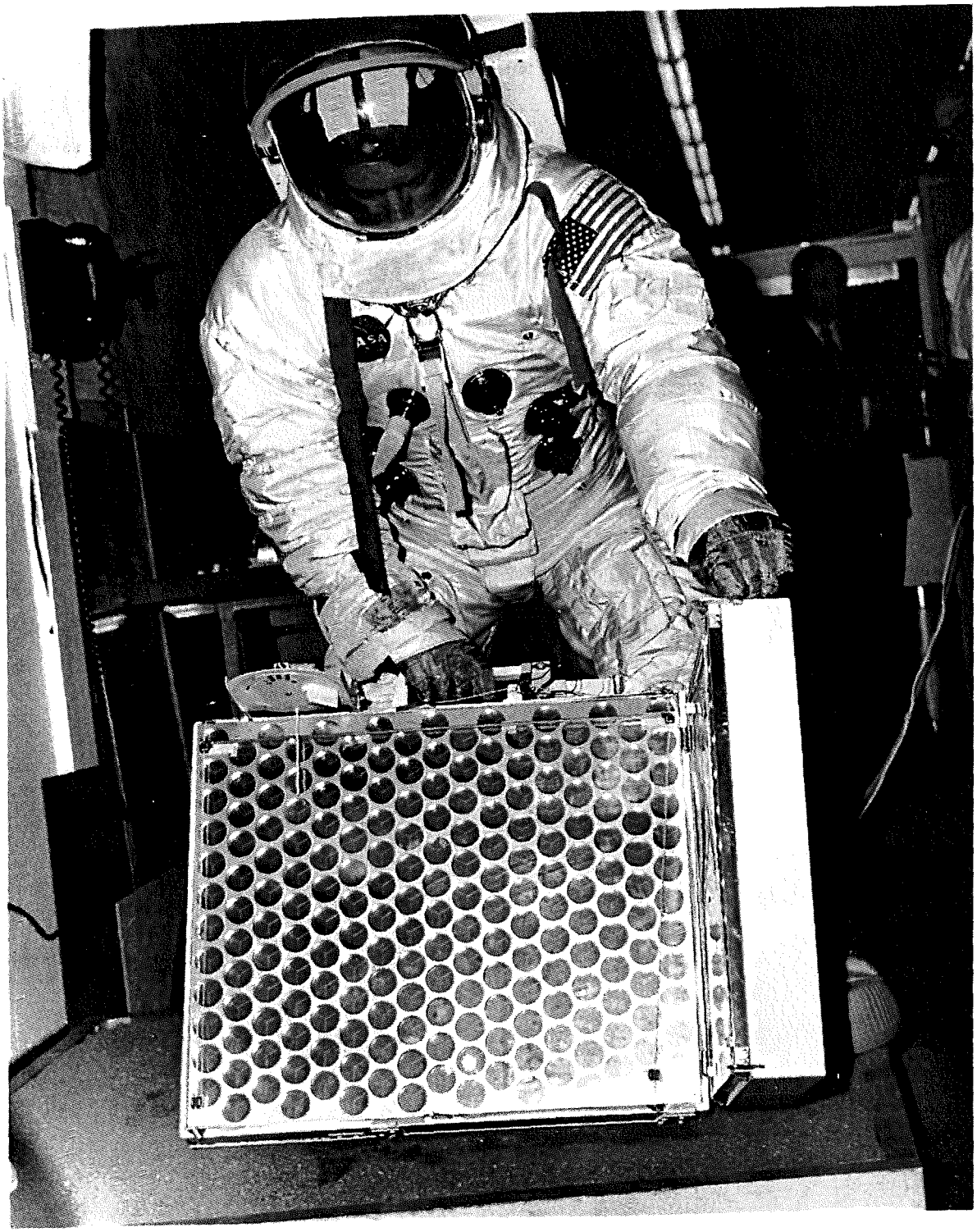

Figure 2. Deployment of Small Reflector Array

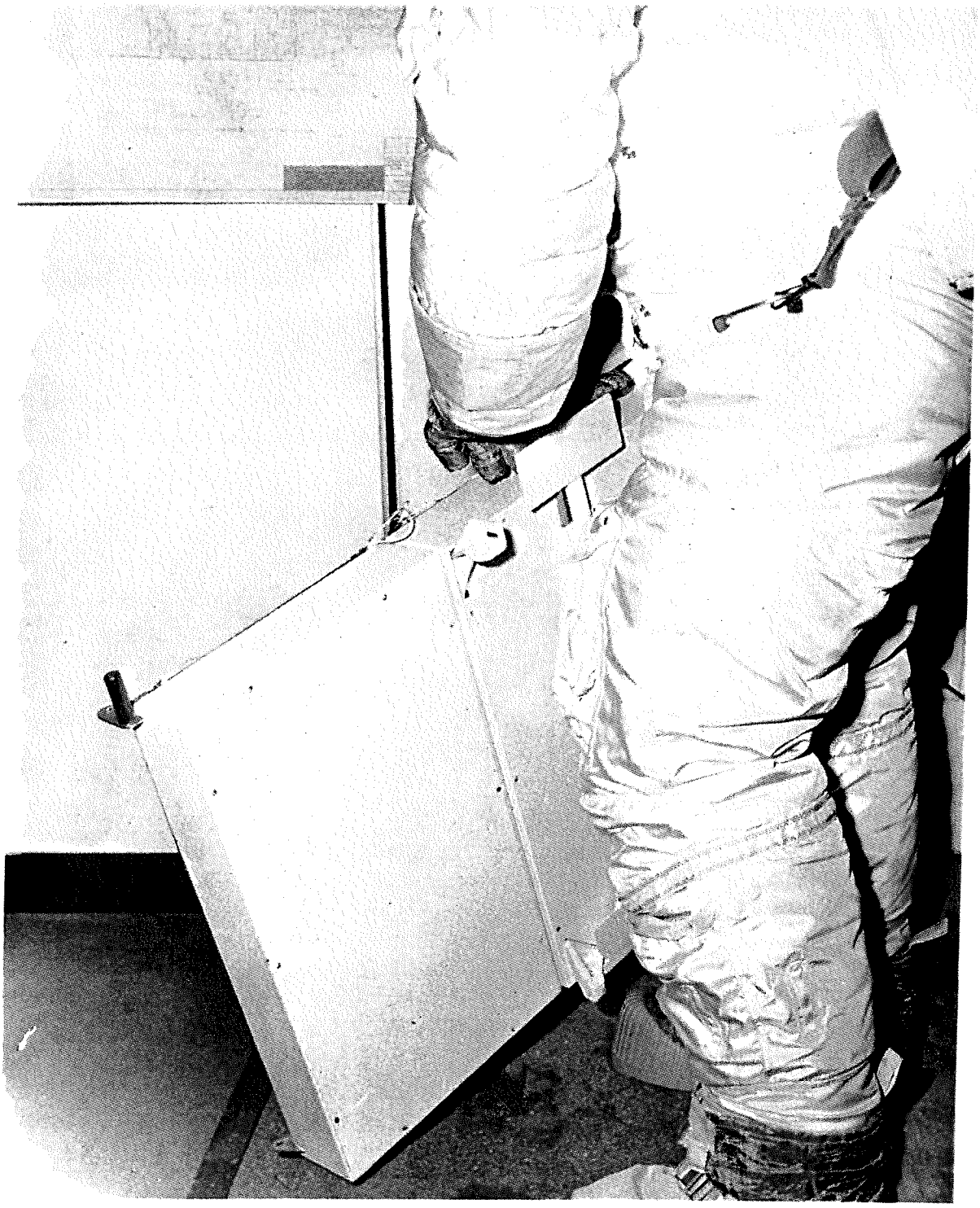

Figure 3. Removing leveling leg pull ring/pull pin.

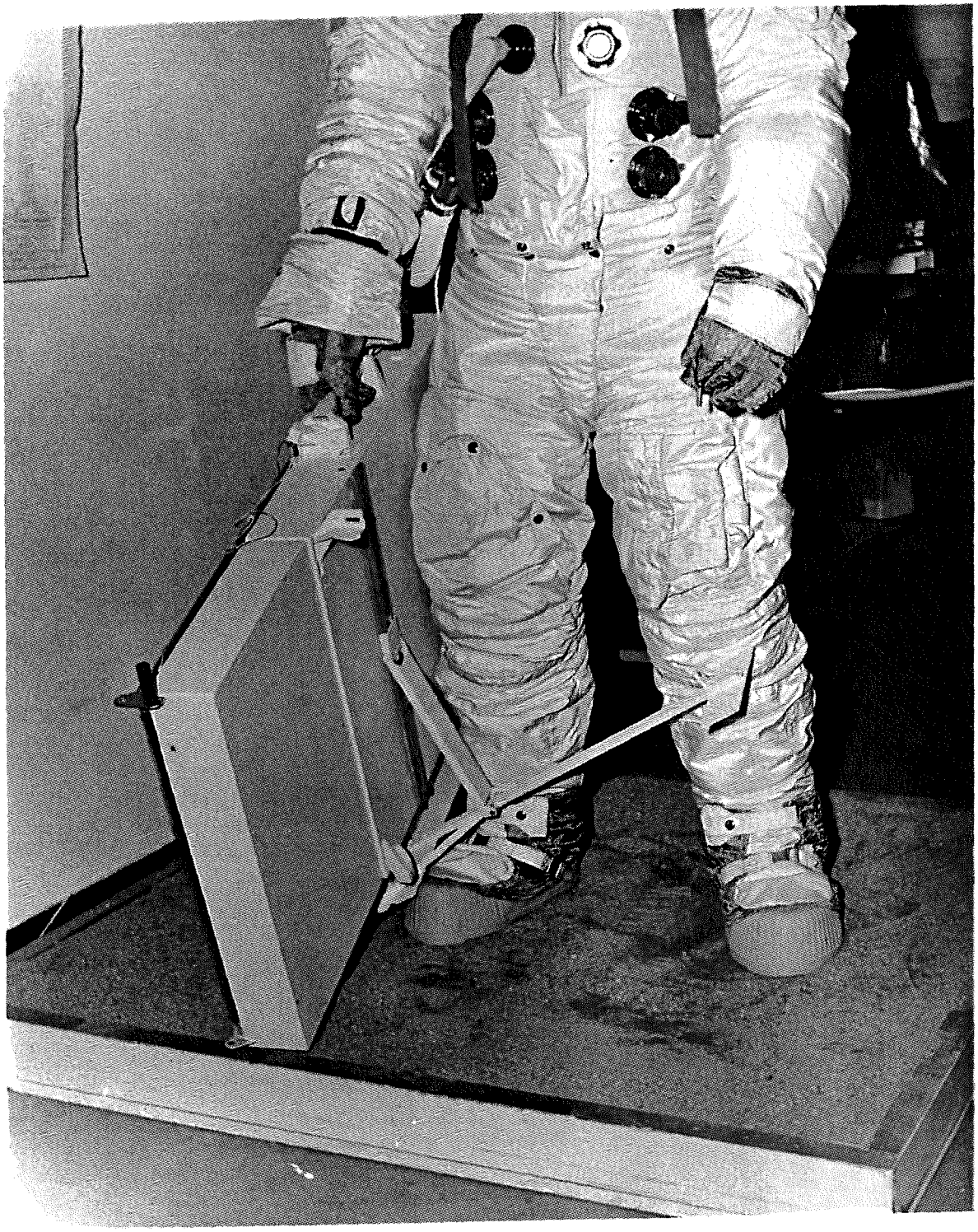

Figure 4. Leveling Leg Deployed

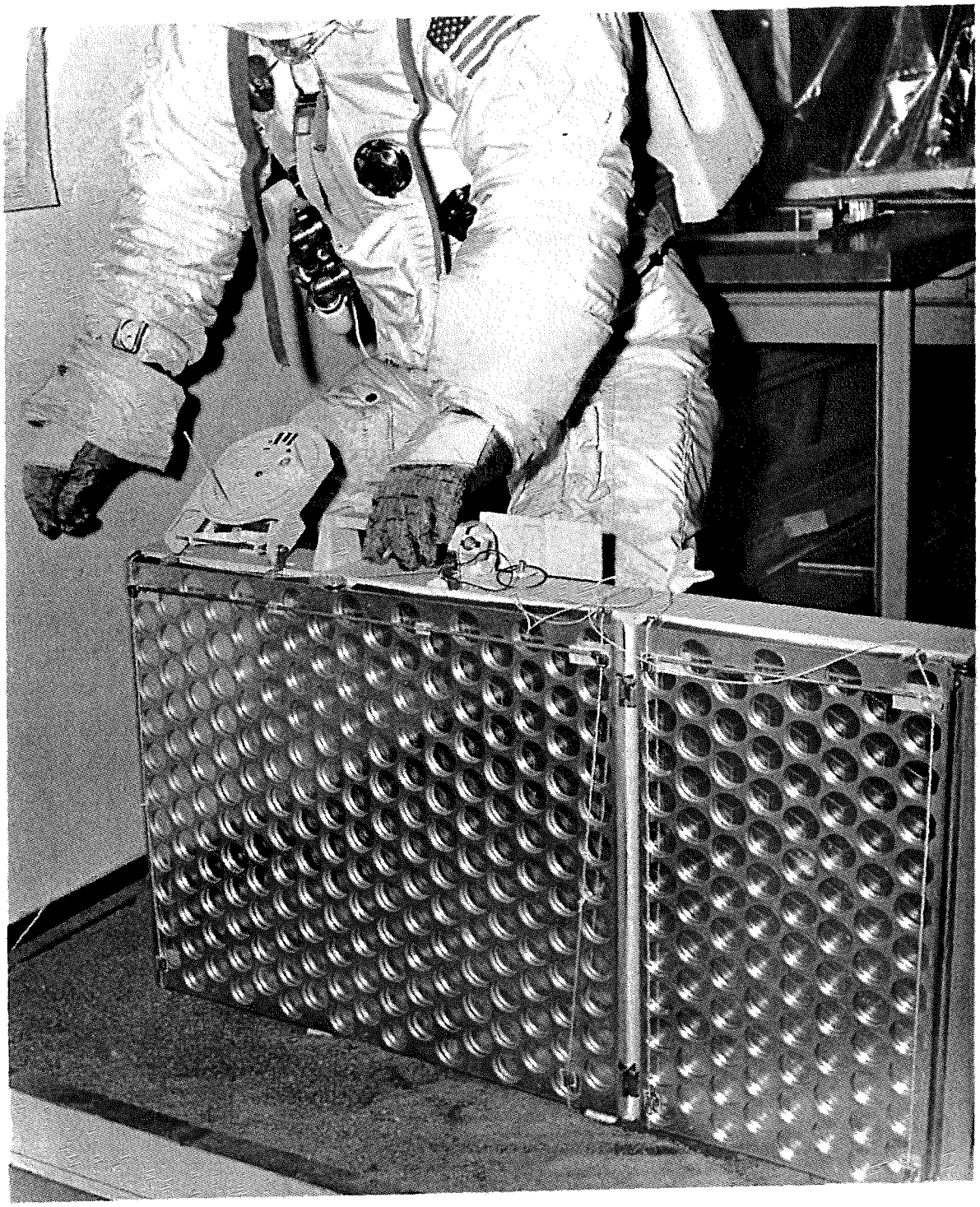

Figure 5. Removing Alignment Mechanism Pull Ring/Pull Pin

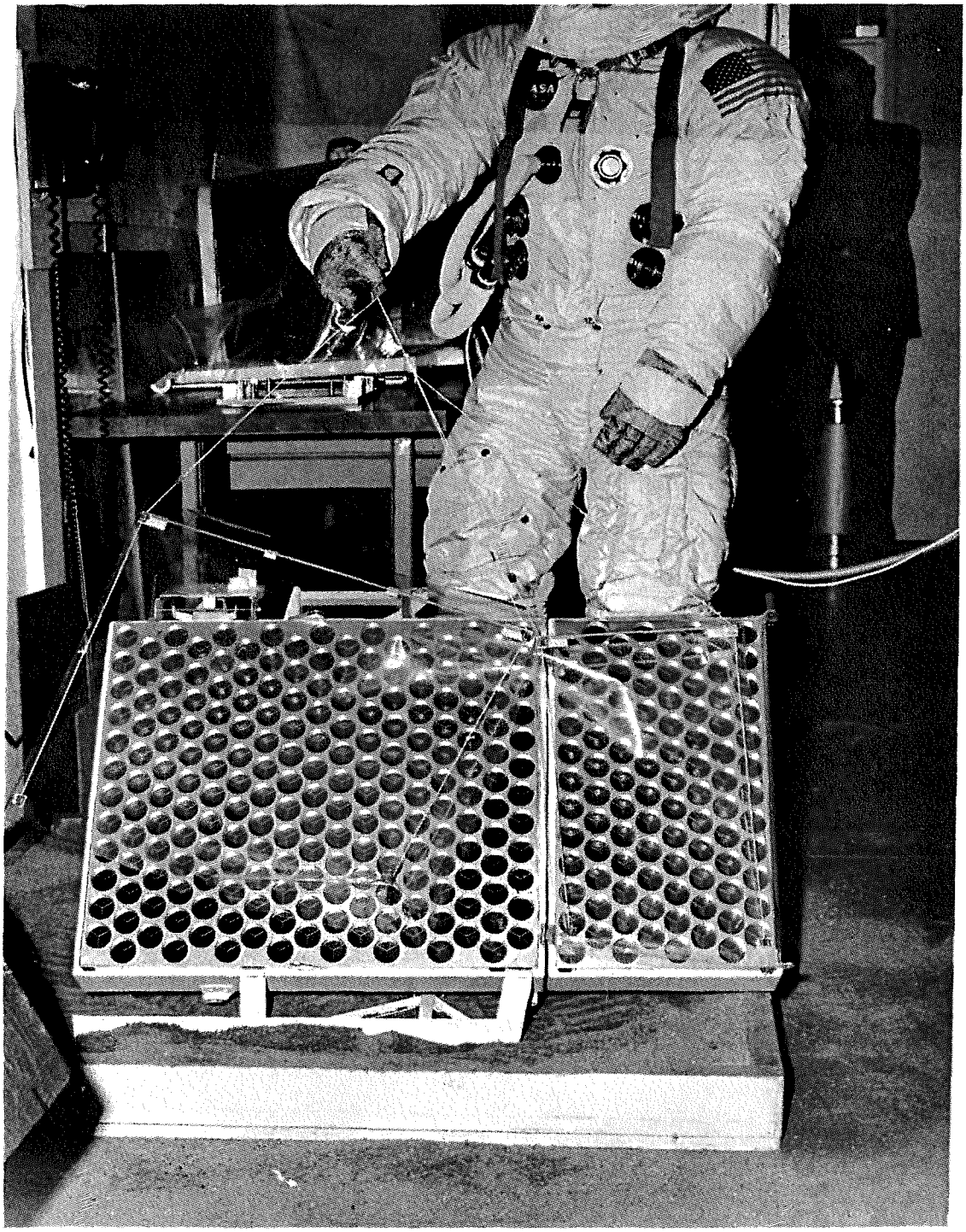

Figure 6. Removing Dust Covers

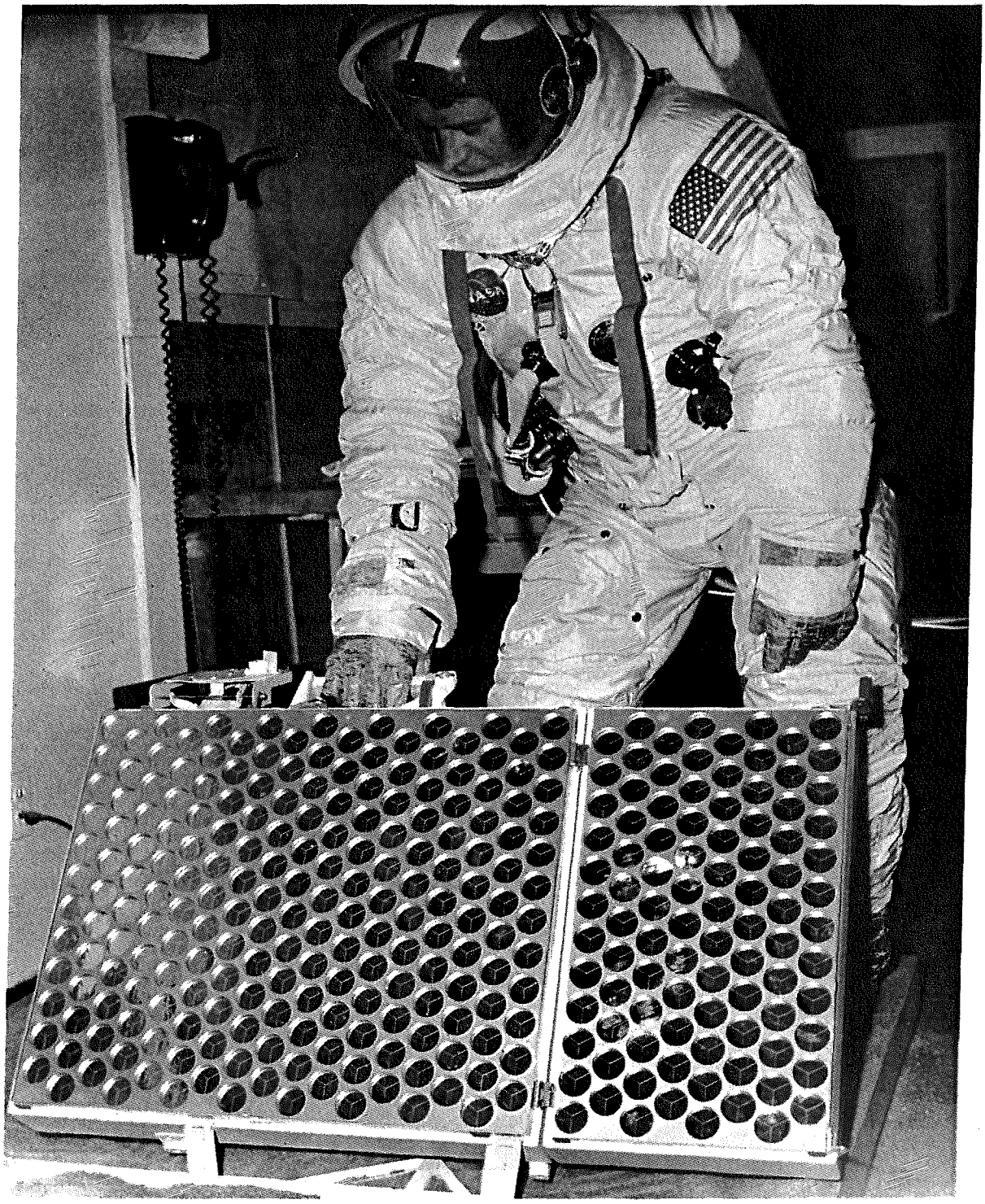

Figure 7. Leveling and Alignment.