Bendix

Aerospace Systems Division

Crew Engineering Evaluation of the Array E Antenna Aiming Mechanism Engineering Model

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This ATM documents the BxA Crew Engineering evaluation of the Array E Antenna Aiming Mechanism Engineering Model.

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I. INTRODUCTION

On July 8, 1971, shirtsleeve and pressure-suited evaluations of the Array E Antenna Aiming Mechanism Engineering Model were conducted by BxA Crew Engineering. Several modifications were incorporated, using art mockups, to represent changes made to those areas affecting the Astronaut interface subsequent to fabrication of the Engineering Model. These modifications are illustrated in Figure 1. Additional changes were not incorporated due to schedule and equipment constraints. These consisted of 135° counterclockwise rotation of the latitude override knob to optimize clearance with longitude offset knob; relocation of shadow adjustment override knob 90° counterclockwise to provide maximum bubble level visibility; presetting of Aiming Mechanism longitude and latitude settings for the intended landing site; and painting primary control surfaces international orange.

II. HARDWARE

- Modified Antenna Aiming Mechanism Engineering Model (Figures 2 and 3).
- Aiming Mechanism Housing Engineering Model.
- Array E Subpackage #1 Crew Engineering Mockup.
- Antenna Mast Crew Engineering Mockup.
- Collimated light source.

III. FACILITIES

BxA Crew Engineering Laboratory.

IV. PROCEDURES

Evaluations of the primary, worst case primary, and contingency modes of operations were accomplished during the shirtsleeve and pressure-suited tests. The procedures used for these evaluations are listed below.

A. Primary Mode.

The primary mode evaluation was conducted with the Aiming Mechanism preset to zero and installed in its housing.

1. Release 2 boydbolts securing Aiming Mechanism Housing to LEAM Subpallet (Simulated).

2. Engage UHT handle in Housing handle and remove from LEAM Subpallet (Simulated).

3. Grasp Housing handle and transfer Aiming Mechanism/Housing to Subpackage #1.

4. Release dust cover lanyard/pull ring.

5. Remove dust cover from Housing (Figure 4) and hand to technician.

6. Install Aiming Mechanism on Antenna Mast (Figure 5).

7. Remove pin securing Aiming Mechanism in Housing (Figure 6) and hand to technician.

8. Remove Housing from Aiming Mechanism (Figure 7) and hand to technician.

9. Remove Foam packaging halves from Aiming Mechanism (Figure 8) and hand to technician.

10. Retrieve Antenna and install on Aiming Mechanism (Figure 9).

11. Enter longitude offset (Figure 10). Note: For flight, longitude offset will be preset to the site coordinates.

12. Enter latitude offset (Figure 11). Note: For flight, latitude offset will be preset to the site coordinates.

13. Level Aiming Mechanism (Figure 12).

14. Align Aiming Mechanism (Figure 13).

15. Verify longitude, latitude, level and alignment settings (Figure 14) and repeat steps 11 through 14 if required.

Repeat steps 11 through 15 for additional site coordinates with Aiming Mechanism reset to zero prior to each trial.

B. Worst case primary mode.

Pretest analysis indicated that the extreme settings of longitude, latitude and alignment represented the worst case. The possible extreme settings for alignment were evaluated in combination with the extreme settings for latitude and East and West longitude. In each case the prescribed order of longitude offset, latitude offset and alignment was followed. Each trial was conducted with the Aiming Mechanism in place on the Antenna Mast and the Aiming Mechanism preset to zero.

C. Contingency mode.

Evaluated with Aiming Mechanism in place on the antenna mast and preset to zero.

1. Disengage longitude override knob (supporting Antenna with other hand).
2. Enter longitude offset by manually positioning Antenna (Figure 15).
3. Engage longitude override knob (supporting Antenna with other hand).
4. Verify longitude offset (repeat steps 1 through 3 if required).
5. Disengage latitude override knob (supporting Antenna with other hand).
6. Enter latitude offset by manually positioning Antenna (Figure 16).
7. Engage latitude override knob (supporting Antenna with other hand).
8. Verify latitude offset (repeat steps 5 through 7 if required).
9. Disengage alignment override knob (supporting Aiming Mechanism/Antenna with other hand).
10. Rotate Aiming Mechanism/Antenna until gnomon shadow aligns with appropriate index mark (Figure 17).
11. Engage alignment override knob (supporting Aiming Mechanism/Antenna with other hand).
12. Verify alignment (repeat steps 9 through 11 if required).

Repeat steps 1 through 12 for additional site coordinates with Aiming mechanism reset to zero prior to each trial.

V. RESULTS AND RECOMMENDATIONS

A. Primary Mode.

1. Boydbolt release.

   (Simulated).

2. Removal from LEAM Subpallet.

   (Simulated).

3. Transfer to Subpackage #1.

   Handle design was not optimum for grasping, handling and carrying the Housing. The small diameter of the handle provided minimal control while transporting the unit. The handle has been changed to increase the effective area and facilitate these operations.

4. Lanyard/Pull ring release.

   Acceptable.

5. Dust cover removal.

   Acceptable.

6. Antenna Aiming Mechanism installation.

   It was difficult to determine the proper Aiming Mechanism orientation for installation. A decal will be provided to indicate the sun direction and enable proper orientation. This will be accomplished at the same time the other decals are installed.

7. Pin removal.

   Acceptable. Flight pin will be somewhat tighter due to preloading which was not present on the Engineering Model.

8. Housing removal.

A reach height of approximately 67 inches was required to remove the Housing from the Aiming Mechanism. While this exceeds the 66 inch maximum design goal it was judged acceptable by the test subject.

9. Foam removal.

Acceptable. Foam halves were easily removed. However, the Flight unit will be preset for the appropriate site coordinates and the foam will therefore be different.

10. Antenna installation.

Acceptable. Reach height, visibility and clearance for antenna installation were good.

11. Longitude offset.

Acceptable. Clerance, visibility, legibility and ease of manipulation were good and the accuracy of the settings was within the 0.25^{o} requirement.

12. Latitude offset.

Acceptable. Clearance, visibility, legibility and ease of manipulation were good and the accuracy of the settings was within the 0.25^{o} requirement. One latitude scale was partially obscured by the latitude override knob. The planned orientation of this knob to increase clearance with other controls will maximize latitude scale visibility.

13. Leveling.

Acceptable. One level is partially obscured by the shadow alignment override knob. The planned relocation of the knob will eliminate this problem. Clearances, visibility, discriminability and ease of manipulation are good. Enough light is reflected by the suit to preclude any potential shadow problems.

14. Alignment.

Acceptable. The latitude adjustment knob was inadvertently bumped while reaching for the shadow alignment adjustment knob. Since it is not possible to relocate either control due to clearance and packaging constraints it will be necessary to exercise care when performing alignment. Otherwise, clearance, visibility, discriminability and ease of manipulation were considered good by the test subject.

15. Setting verification.

Acceptable. Visibility and legibility good.

B. Worst case primary mode.

Acceptable. Clearance, visibility and ease of manipulation were good for all the worst case combinations of longitude, latitude and alignment settings.

C. Contingency Mode.

1. Longitude override operation.

Acceptable. Clearance, visibility and ease of manipulation were good. Setting accuracy was within the limits of the equipment itself for the contingency mode.

2. Latitude override operation.

Acceptable. Clearance, visibility and ease of manipulation were good. Setting accuracy was within the limits of the equipment itself for the contingency mode.

3. Shadow alignment override operation.

Acceptable. Clearance, visibility, ease of manipulation and accuracy were good.

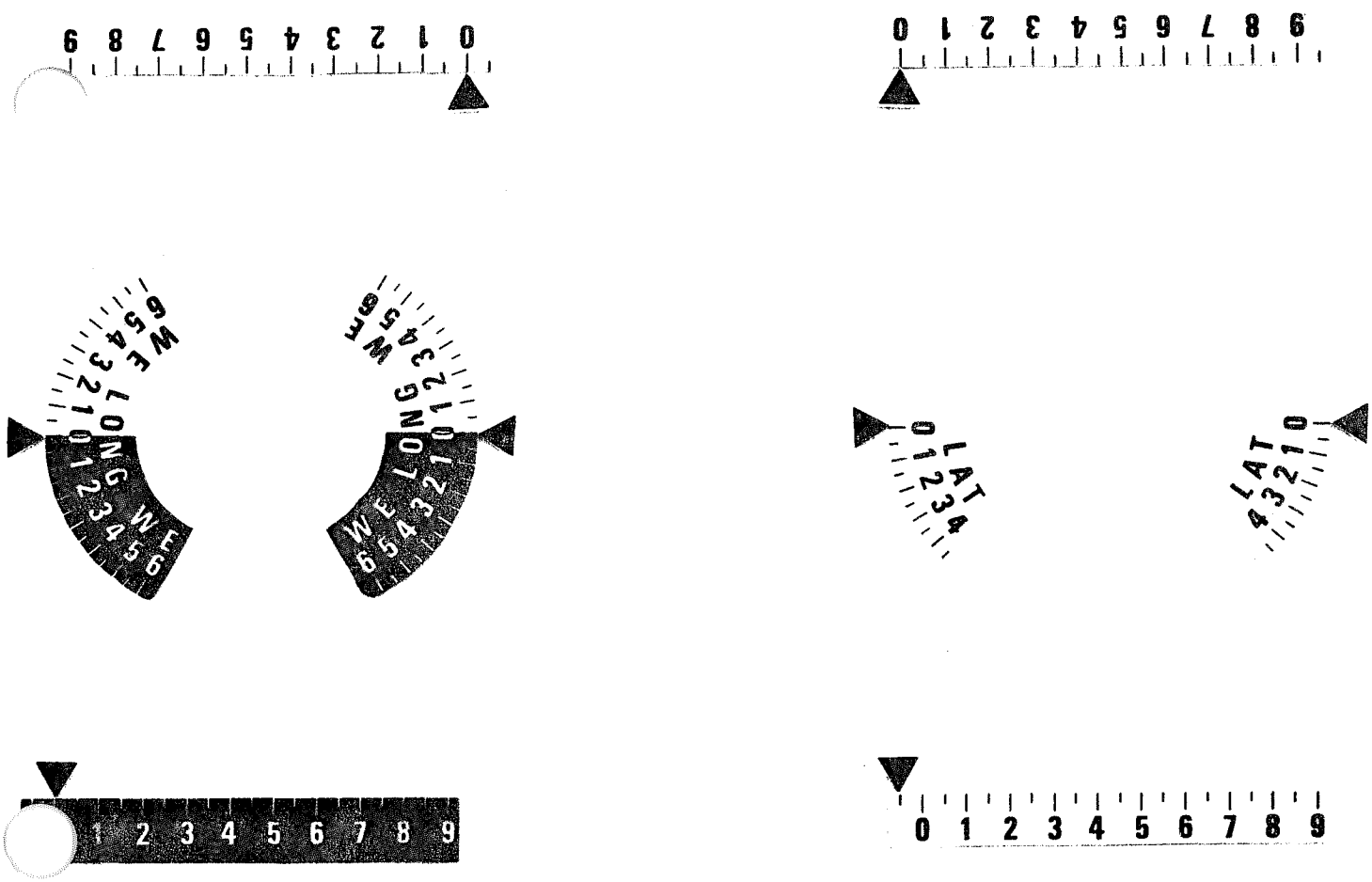
D. General.

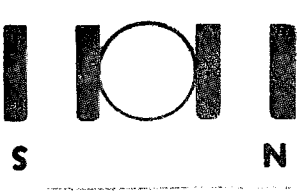
1. Some difficulties were encountered when working and moving around the Antenna Aiming Mechanism with the Antenna in place. Care must be taken to prevent the helmet or PLSS from coming in contact with the Antenna since equipment damage or degradation of aiming accuracy may result.

VI. CONCLUSIONS

Antenna Aiming Mechanism operation is acceptable from a crew standpoint and is well within the limits of human performance.

Further testing should be conducted, however, using an Antenna Aiming Mechanism which fully represents the final design. This evaluation should include Boydbolt release, removal from the LEAM Subpallet and foam removal with the Aiming Mechanism preset for the deployment site.





SHADOW ALIGN

Figure 1. Crew Engineering Antenna Aiming Mechanism Modifications.

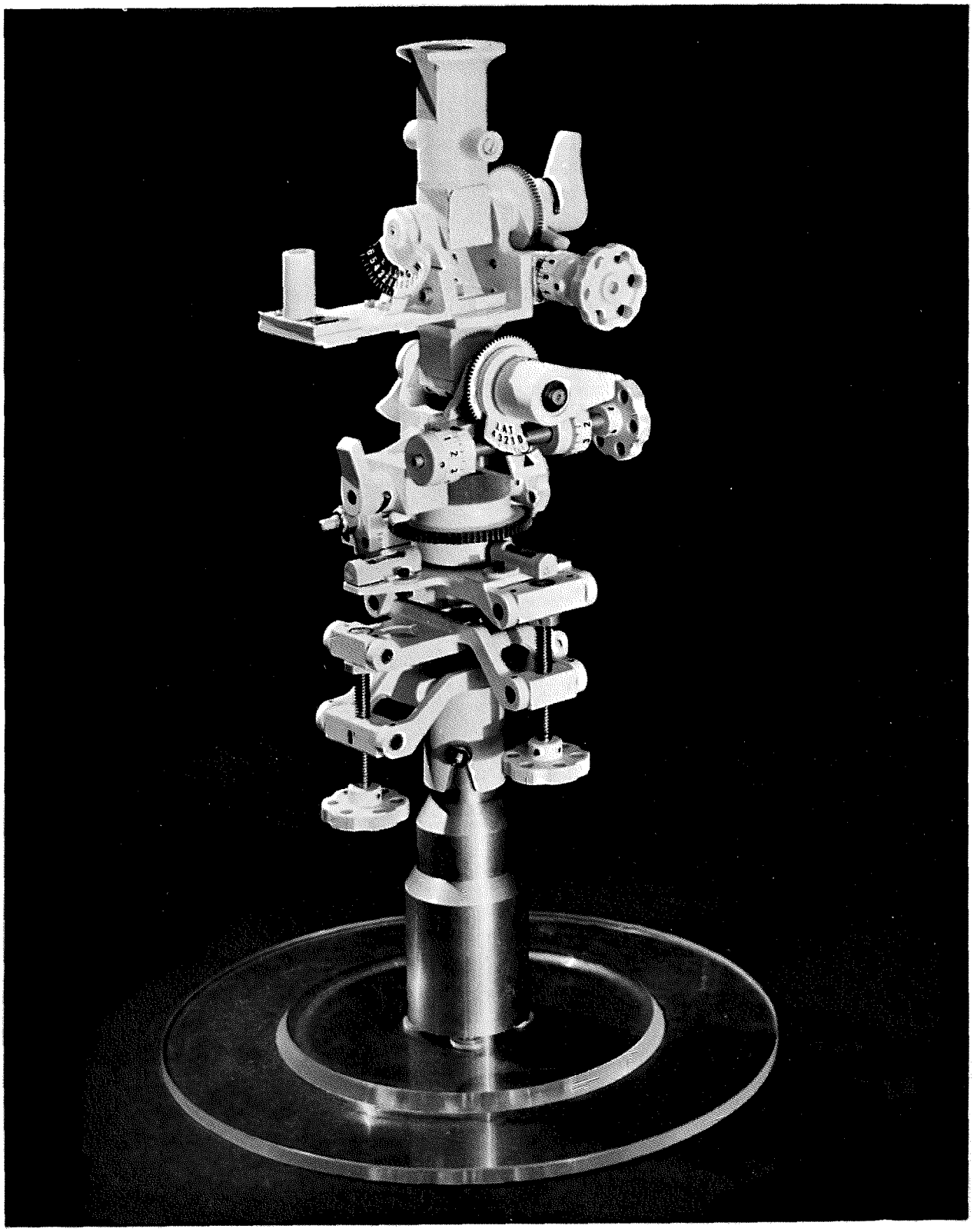


Figure 2. Antenna Aiming Mechanism - Outboard View (all settings zeroed).

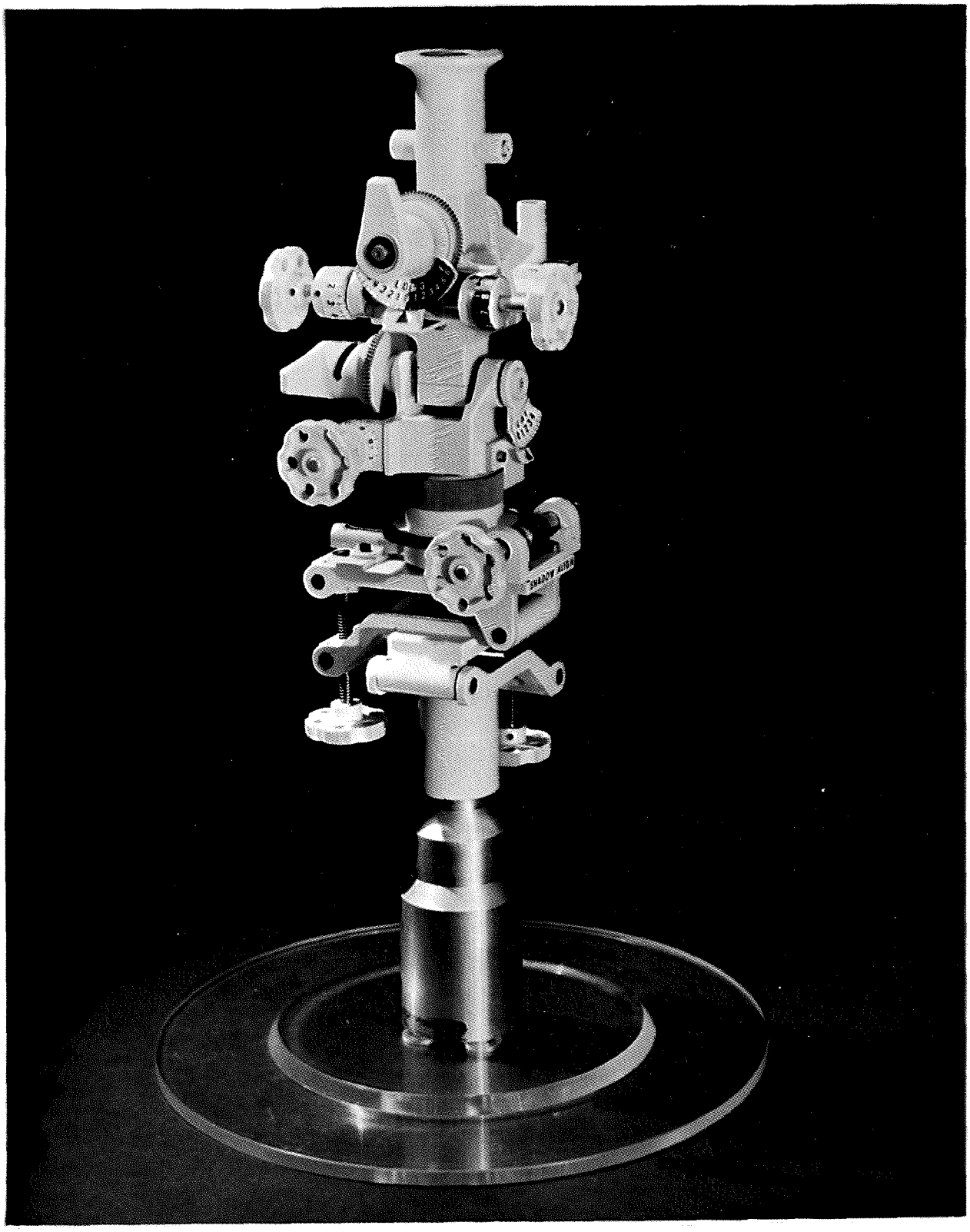


Figure 3. Antenna Aiming Mechanism - Inboard View (all settings zeroed).

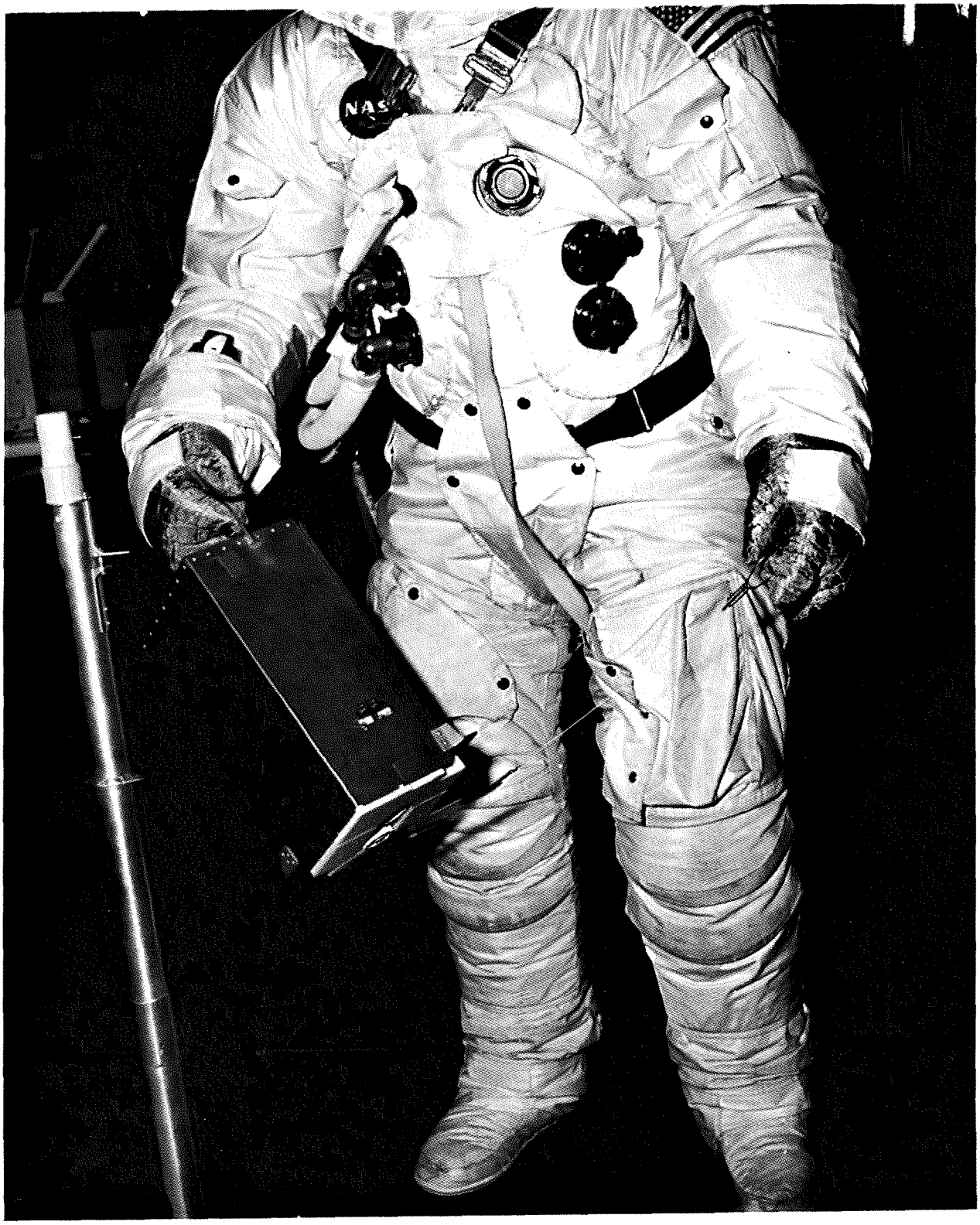


Figure 4. Antenna Aiming Mechanism Dust Cover Removal.

Figure 5. Antenna Aiming Mechanism Installation.

Figure 6. Antenna Aiming Mechanism Housing Pin Removal.

Figure 7. Antenna Aiming Mechanism Housing Removal.

Figure 8. Antenna Aiming Mechanism Foam Removal.

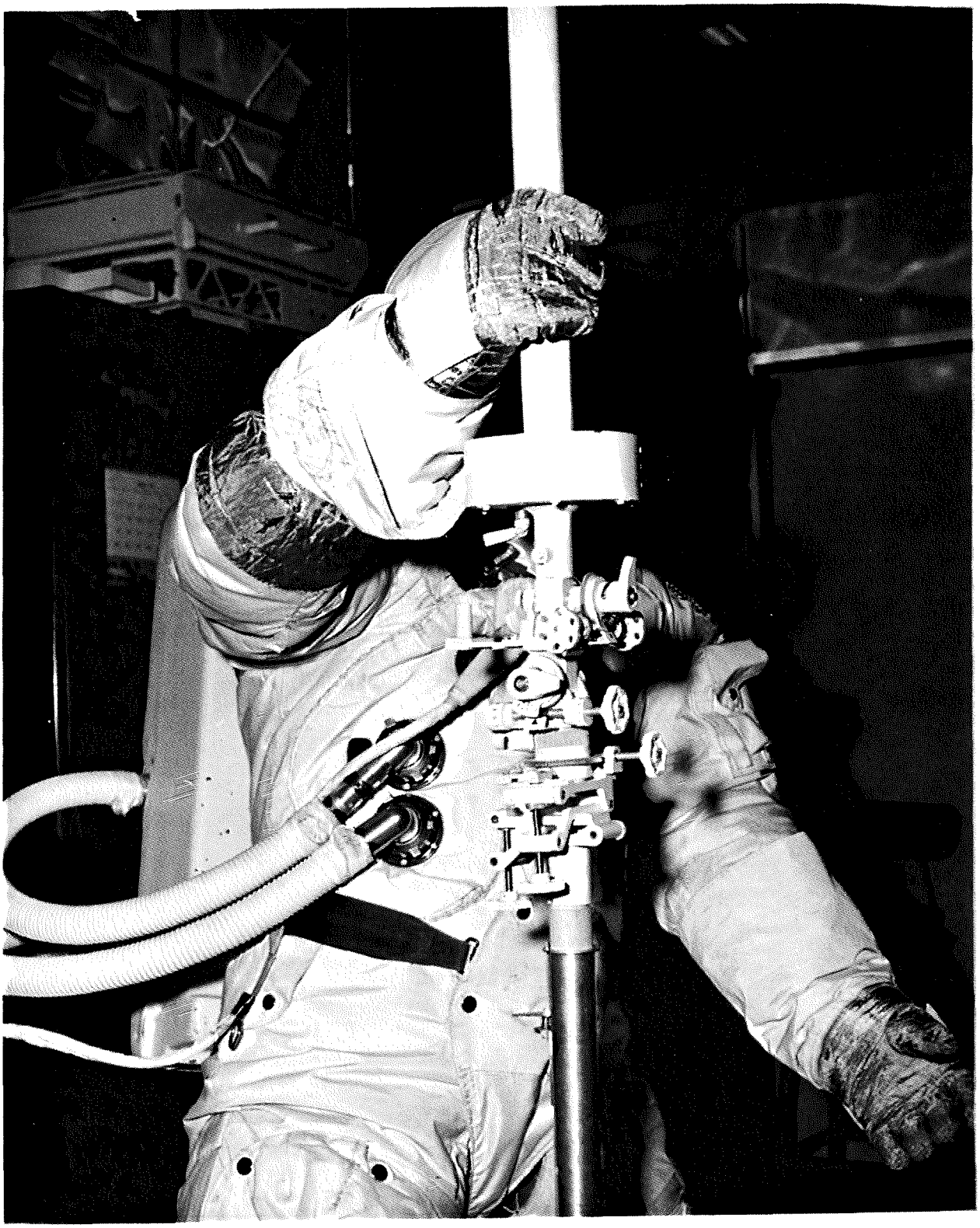


Figure 9. Antenna Installation.

Figure 10. Antenna Aiming Mechanism Longitude Operations (Primary Mode).

Figure 11. Antenna Aiming Mechanism Latitude Operations (Primary Mode).

Figure 12. Antenna Aiming Mechanism Leveling Operations.

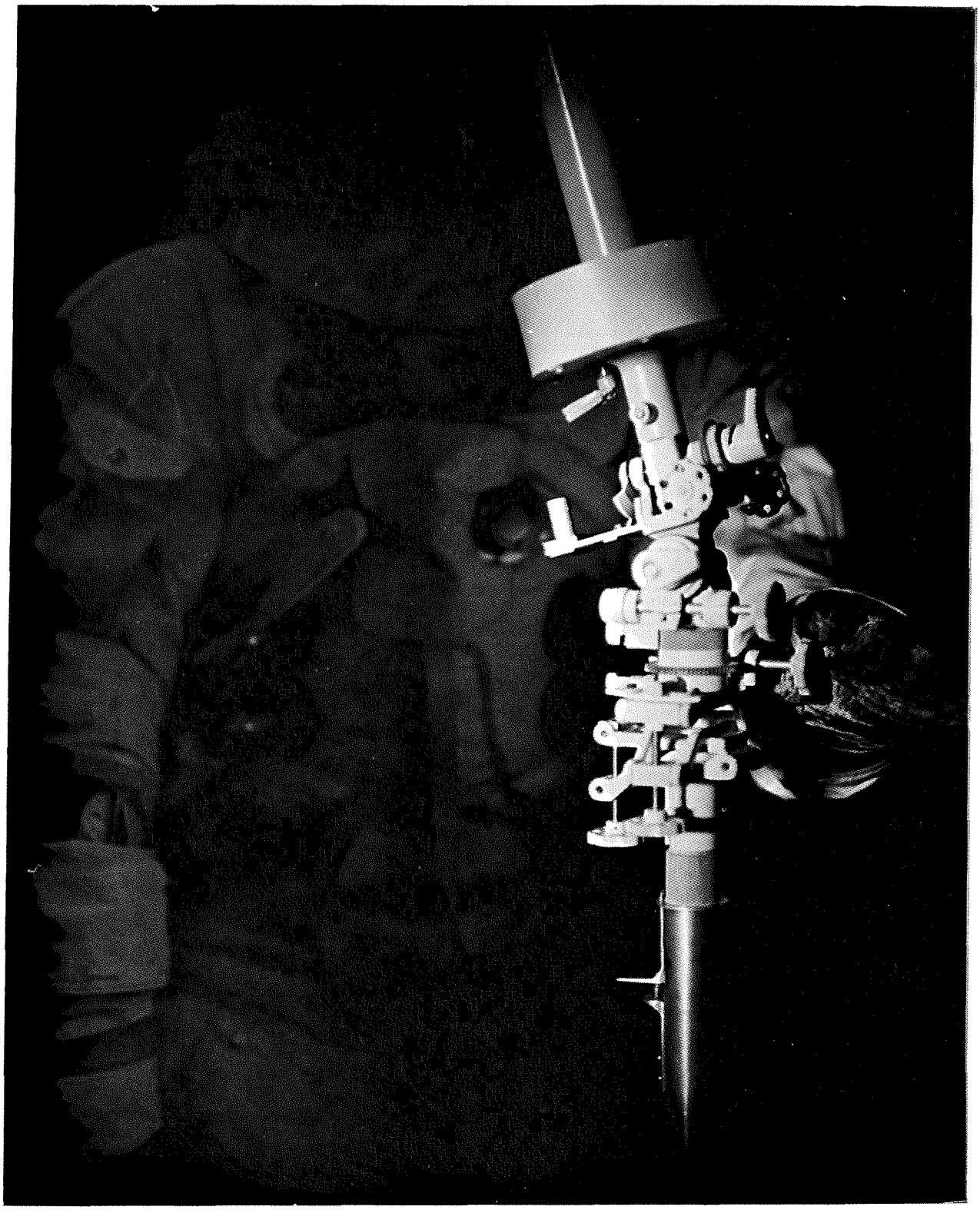


Figure 13. Antenna Aiming Mechanism Alignment Operations (Primary Mode).

Figure 14. Antenna Aiming Mechanism Setting Verification.

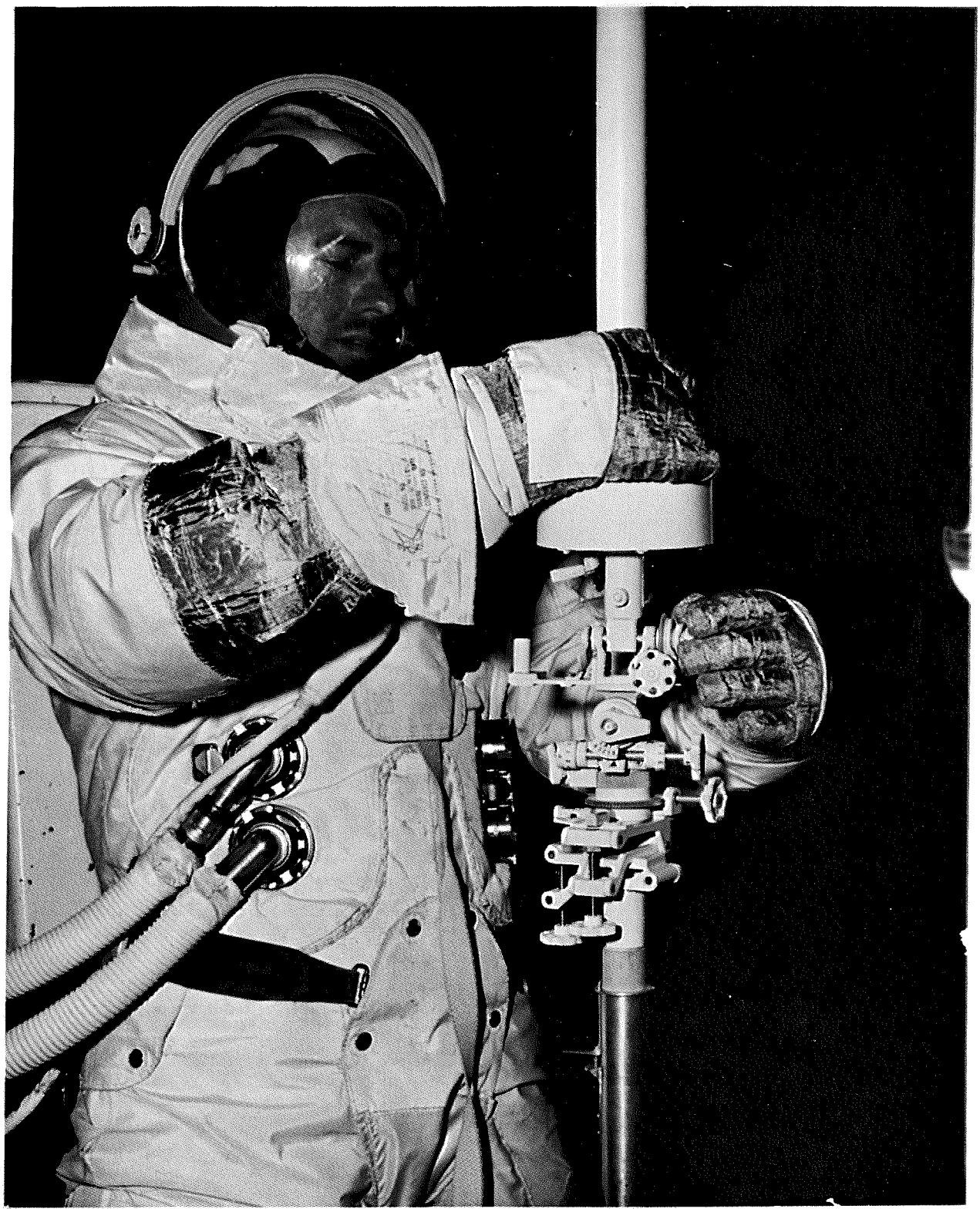


Figure 15. Antenna Aiming Mechanism Longitude Operations (Contingency Mode).

Figure 16. Antenna Aiming Mechanism Latitude Operations (Contingency Mode).

Figure 17. Antenna Aiming Mechanism Alignment Operations (Contingency Mode).