This is an unscheduled ATM dealing with the test and evaluation of the Heat Flow Experiment Probe Assembly conducted by two BxA subjects (working in shirt sleeves) at the Mission and Crew Engineering test facility on 1 August 1967.

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A. Test Objective

The purpose of this test was to determine the probability of the astronaut making contact with the Heat Flow Experiment probe assembly alignment springs. See Figure #1 for the location of these springs on the probe assembly and the alignment spring configuration. The test was structured to determine what the natural (unbiased) handling tendencies would be, with minimum training, during the HFE probe deployment, from removal of the probes from the probe package through insertion of the probes into the bore hole sheathing.

The following sections of this ATM describe the hardware, facilities, and test procedures. The results and the conclusions derived from the test are augmented by photographs.

B. Test Description

1. Hardware - ADL E-2 (Training Model) of the Heat Flow Probe Package with enclosed probe assemblies and emplacement tool; CU developmental model of the bore hole sheathing; and one A2L Apollo pressure suit glove.

2. Facilities - Shirt sleeve manipulation conducted on the BxA M & C Engineering simulated lunar surface, using the simulated three meter drill hole.

3. Procedures - In order to determine what the natural (unbiased) handling tendencies for the Heat Flow probe assemblies would be two subjects, who were familiar with Apollo pressure suit constraints on the astronaut but had never deployed the Heat Flow probes before, were selected and given the minimum amount of information that they would need to unpackage and deploy the probe assembly in the drill hole.

The deployment sequence started with the removal of the stowed probe assembly from the probe package. The packing pieces on either end of the folded probe assembly were then removed. The probes were unfolded, inserted into the bore hole sheathing, partially lowered down the drill hole, and the lower radiation shield was emplaced

at the top of the probe assembly. The expanded emplacement tool was then retrieved, placed over the cable, and slid to the top of the probe assembly. The probe assembly and the attached emplacement tool were then lowered to the bottom of the three meter sheathed bore hole. Finally, the emplacement tool was pulled out of the drill hole and detached from the cable. The above sequence was run through one time by each subject.

C. Results

Both subjects made contact with the probe alignment springs at different points in the deployment sequence. The first subject grasped the probes in the area of the alignment springs and/or slid his gloved hand along the edge of the springs when he removed the end pieces, when he unfolded the two halves of the probe assembly, when he inserted the probes into the hole sheathing, and as he lowered the probes into the sheathed hole. The second subject grasped the springs and/or slid his hand along the springs when he unfolded the probes, inserted the probes in the hole, as he started to lower the probes into the hole, and when he emplaced the radiation shield at the top of the probe assembly. Figures #2 through #5 depict the position of Subject No. 1's hand relative to the alignment springs, as described above, and Figures #6 through #8 show the position of the second subject's hand relative to the probe alignment springs.

D. Conclusions

1. Avoidance of contact with the springs is, at best, very difficult because of their location at the ends of the probe sections; the location of the packing pieces that hold the probes in their stowed position relative to the alignment springs and the probable point of holding the probe for initial engagement with the hole casing. If it is borne in mind that the astronaut minimum reach is 18 inches above the lunar surface, that the lower section of the probe is approximately 20 inches long from the bottom end to the second spring area, and that the two probe sections are interconnected by a flexible spring device, it is probable that in probe deployment the astronaut will have to grasp the probes at the area of the second set of springs to steady the lower probe section while making initial insertion of the probe into the hole and to continue to hold the probes in progressively higher positions until the emplacement tool can be engaged at the upper end for final emplacement. Both test subjects contacted the springs when handling the probes at the upper end.

2. The probes, including springs, are a flat black color for technical reasons. This color offers no visual cue as to spring location and makes the astronaut's need to avoid contact with the springs very difficult, since he must depend on a "knowledge" of the spring locations from training. Such positional cueing under unfamiliar and high stress conditions has been shown to be quite unreliable. Finally, if he makes contact with the springs, he will have no tactile "feel" that he has done so.

3. There seems to be an abrasion problem on the alignment springs, themselves, when the probes are inserted into the hole sheathing. It is understood that the probes will be inserted in casings several times prior to flight for testing and calibration purposes. When the springs were examined under a microscope (100X), following several insertions in the casing, the only abrasion that could be seen was of the paint on the springs. There was no evidence of burring or of the springs having been honed to a cutting edge.

4. More information is being gathered and additional testing will be performed at the earliest possible date.

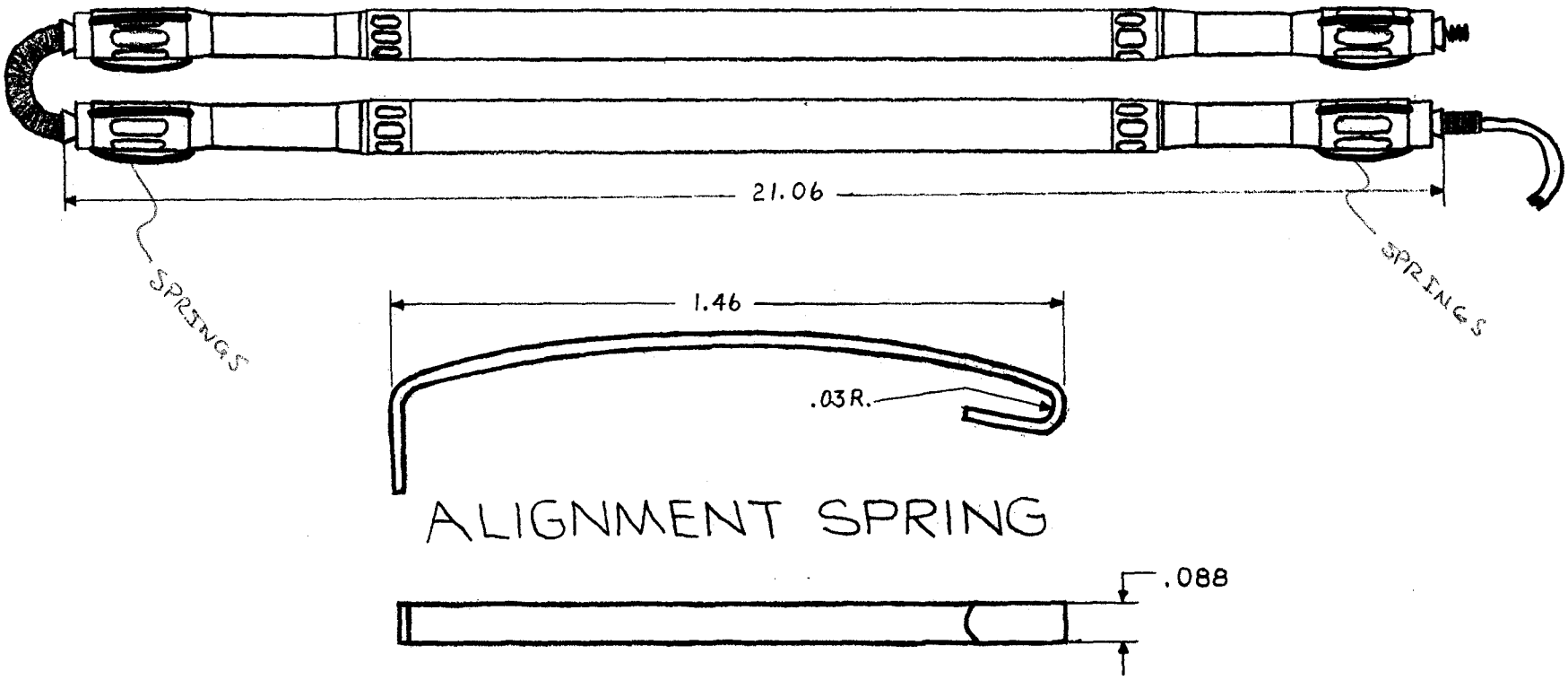

FIGURE #1

FIGURE #2 Subject No. 1 grasped the alignment springs when he removed the packing pieces prior to unfolding the probe assembly from the stowed configuration.

FIGURE #3 Subject No. 1 grasped and slid his glove along the alignment springs while unfolding the probe assembly.

FIGURE #4 Subject No. 1 grasped the alignment springs when he inserted the probe assembly into the simulated drill hole.

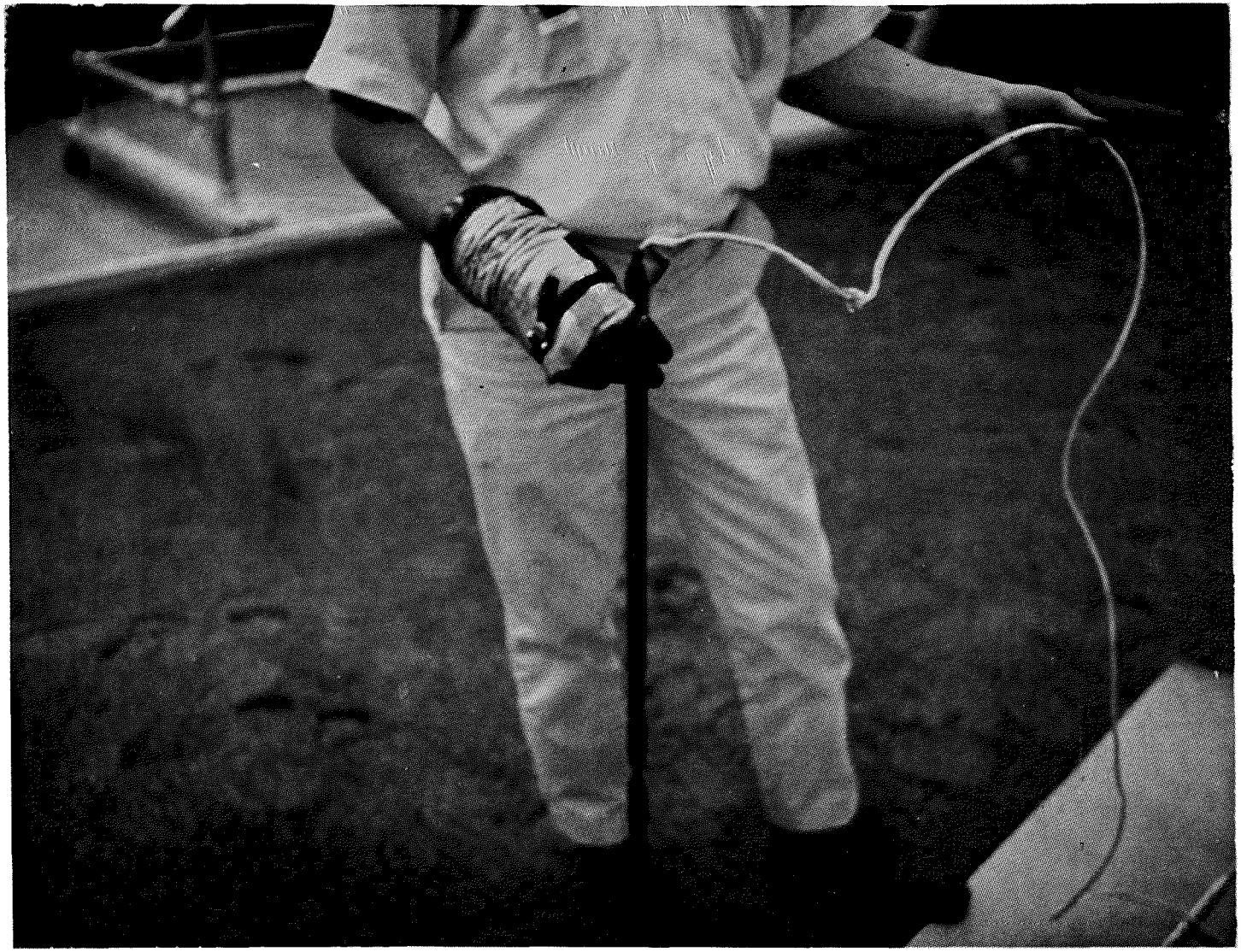

FIGURE #5 Subject No. 1 grasped and slid his glove along the alignment springs while lowering the probe assembly into the drill hole.

FIGURE #6 Subject No. 2 made contact with the alignment springs when he inserted the probe assembly into the drill hole.

FIGURE #7 Subject No. 2 grasped and slid his glove along the alignment springs while lowering the probe assembly into the drill hole.

FIGURE #8 Subject No. 2 slid his glove along the alignment springs while emplacing the radiation shield at the top of the probe assembly.