Bendix

Aerospace Systems Division

Final Report - ALSEP
Dust Protection Study

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This report summarizes the results of the Dust Protection Study authorized under CCP-251 to Contract NAS 9-5829.

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1.0 INTRODUCTION

The purpose of this study was to determine the modifications necessary to provide dust protection to the ALSEP systems to be flown on Apollo 14 and subsequent missions. Specifically, this includes all items that require dust protection on ALSEP flights 4, A2 and 5 for Subpackages I and II and the LRRR for Apollo 14, from installation into LM until experiment deployment on the lunar surface.

2.0 SUMMARY

Individual dust covers were considered for all experiments and other critical items on Flights 4, A2 and 5. These include the items tabulated below:

Subpack I

PSE Shroud
ASE Mortar Box
LSM EGFU (Electronic Gimbal Flip Unit)
CPLEE
SWE
PDM
An overall dust cover for Subpack I

Subpack II

SIDE
HFE Electronics
RTG Shorting Plug
RTG Top
UHT Socket - Top of RTG Cable Stowage

LRRR (Apollo 14 only)

A dust cover to protect the complete experiment and structure.

All dust covers will be made of clear Kapton film or Dacron Cloth varying in thickness from 1 to 5 mils. Where attachments are necessary, Velcro pads or draw strings have been used.

The recommended dust cover applications relative to design and deployment sequence are discussed in Section 3.0, Recommendations. These designs were selected as optimum from the collective viewpoint of dust protection provided, additional crew tasks and experiment stability during deployment.

A summary description of the ALSEP dust covers is shown in Table 2.1. Weight estimates are tabulated in Table 2.2. Detailed sketches are contained in Section 4.0.

The detailed study report is included in Section 4.0, Discussion. This study was based on the criteria that maximum protection be provided in terms of critical surface area exposed and time of deployment. The recommended dust cover designs were selected from this study by modifying the designs to meet the most practical deployment sequence relative to dust protection, crew tasks, and experiment stability.

TABLE 2.1

SUMMARY

ALSEP DUST COVERS

Item	Description	Comments
PSE	Thin (.0005) removable film covers top of shroud.	Protects thermal shroud during its deployment.
ASE	Four-sided 1 mil material wrap-around retained by folding legs.	Protects Mortar package through final deployment.
LSM	2 mil material integral with the PRA covers.	Protects EGFU on 4 sides and bottom up to final leveling.
CPLEE	Four-sided wrap-around of 1 mil material.	Protects major thermal surfaces.
SWE	1 mil and 5 mil materials. - Covers all but bottom of unit.	Protects major exposed surfaces.
PDM	5 mil Kapton panel attached to rear retainer.	Protects PDM during Subpack I leveling.
Sub-Pack I Cover	1 mil material cover contoured to fit with draw string releases.	Covers entire sub-pack and surrounds PSE.
SIDE	1 mil material form fitted to three sides and top. One attachment, deployed by SIDE legs.	Total access to all details prior to removal of cover.
HFE	Covers top & four sides with 1 mil material. Retained by sub-pallet brackets.	Protects all surfaces through final deployment of unit.

TABLE 2.1 (continued)

ALSEP DUST COVERS

Item	Description	Comments
Shorting Plug	2 mil material covers entire sub-assy. Retained and deployed by caplug.	Protects ammeter face and shorting button.
RTG Cover	Circular disc of 5 mil Kapton with retension fingers.	Prevents ingress of contaminants.
Tool Socket	Bonded Boydbolt cover & 1 mil Kapton disc.	Protects tool socket during immersions into lunar soil.
LRRR	1 mil material overall cover.	Protects entire package from contaminants.

TABLE 2.2

SUMMARY DUST COVER WEIGHT ESTIMATES

ALSEP Model	Estimated Weight (lb)
Flight 4	.66
PSE	.10
ASE	.02
CPLEE	.02
SIDE	.03
Subpack I	.40
Components	.09
Flight A2	.74
PSE	.10
SWE	.05
LSM	.07
SIDE	.03
Subpack I	.40
Components	.09
Flight 5	.71
PSE	.10
ASE	.02
LSM	.07
HFE	.03
Subpack I	.40
Components	.09
LRRR	.10

3.0 RECOMMENDATIONS

The dust covers discussed in Section 4.0 meet the design criteria that protection must be provided to each experiment against contamination from lunar soil (and other contaminants) throughout the entire ALSEP deployment sequence. Although technically this criteria is a very desirable design goal, it was found through examination of experiment stability and crew tasks that in most cases it is more practical to remove the dust covers while they are still supported by the UHT, rather than after the experiment had been oriented and leveled. This design constraint requires that minor modifications be made to the ASE mortar box and the SWE cover designs.

The recommended design concepts and deployment sequences described in the following pages, are based on the most practical deployment technique of each experiment for operational success.

These designs afford protection against contaminants to all critical surfaces within the constraints of experiment stability and crew tasks.

PSE

- Thin (0.5 mil) removable film.
- Stows internal to PSE on top of shroud.
- Removed after shroud deployment.

ASE Mortar Box

- Reference Figure 4.1
- Four Sided 1 mil wrap-around cover retained with velcro.
- Modified - small slit added to allow release over UHT.
- Removed prior to ASE antenna deployment, while UHT is still engaged.

LSM/EGFU

- Reference Figures 4.2, 4.3, & 4.4
- Five sided 2 mil cover integral with LSM/PRA covers.
- Removed with PRA covers.

CPLEE

- Reference Figures 4.5 & 4.6.
- Four-sided 1 mil wrap-around cover retained with velcro.
- Removed prior to experiment emplacement, while UHT is still engaged.

SWE

- Reference Figures 4.7 & 4.8.
- Covers all of experiment except bottom, and is retained by legs.
- Modified - slit added at corner adjacent to UHT socket to allow release over UHT.
- Removed prior to experiment emplacement, while UHT is still engaged.

PDM

- Reference Figure 4.9.
- Fitted 5 mil cover attached to rear curtain retainer.
- Removed with rear curtain retainer.

Subpack I

- Reference Figures 4.10 & 4.11.
- Contoured 1 mil cover retained with drawstrings.
- Removed during Subpack I emplacement.

SIDE

- Reference Figure 4.12.
- Covers three sides and top (1 mil) and retained by tie-string
- Removed prior to experiment emplacement, while UHT is still engaged.

HFE Electronics

- Reference Figure 4.13.
- Covers all except bottom (1 mil), and is retained by support brackets.
- Removed after final orientation and leveling.

RTG Shorting Plug

- Reference Figures 4.14 & 4.15.
- Covers entire assembly (2 mil) and is retained by caplug.
- Removed with caplug.

RTG Top

- Reference Figures 4.15 & 4.16.
- Circular 5 mil cap retained along cylindrical section.
- Removed prior to fuel transfer.

UHT Socket - RTG Cable Stowage

- Reference Figure 4.17.
- Bonded on Boydbolt cover (top) and 1 mil film (bottom).
- Pierced by UHT.

LRRR

- Reference Figures 4.18 and 4.19.
- Complete 1 mil cover retained by drawstring.
- Removed prior to LRRR array dust cover removal.

4.0 DISCUSSION

The following dust cover design concepts, as depicted by sketches and explanatory notes, have been conceived to meet the criteria that protection be provided to each experiment against contamination from lunar soil and deployment handling, throughout the entire deployment process.

Within this framework an effort has been made to free the individual cover from any physical attachment requiring separation forces which would tend to displace the experiment from its final leveled orientation. Where this has not been feasible, the dust cover has been designed to accommodate application of separation forces prior to final deployment, but the cover remains on the experiment. In all cases then, the last and final task of the astronaut is to lift off the dust cover.

Those experiment covers which have no positive attachment are positively retained in the pallet, sub-pallet and/or folding legs of the experiment, and will not encroach upon the I. C. D. envelope in either a static or dynamic condition.

Individual dust covers for all experiments on Flight 4, A2 & 5 were considered and are described from a conceptual point of view in this report.

These include, in order of Priority as set by the Flight 4 launch date, the PSE, ASE, CPLEE, SIDE, LSM, SWE and HFE. In addition to the experiment packages, protection is provided for the PDM located on the rear of Subpack I primary structure, the RTG shorting switch, top of the RTG, tool socket on the RTG cable stowage assembly, and an overall cover is provided for the subpack I, which conforms to the loaded subpack profile in all sections. This bag protects the SP I & PDM during unloading from LM through final orientation at the experiment site.

The LRRR has also been provided with additional dust protection that will cover the complete experiment and structure from time of installation on LM through transit to the deployment site on the lunar surface.

Where attachments have been found necessary, velcro pads have been used in most cases. A separate study of attachment methods which included "Safety" pin type (as in PSE), Velcro pads, draw strings, ties and pull pin, or cutting lanyard has shown that the velcro attachment is generally the most applicable for ALSEP. The subpack cover shown is the best choice of three separate concepts. The other concepts are a complete soft type contour cover and a rigid cover that uses the maximum ALSEP envelope. All the dust covers indicated in this study are made of clear Kapton or Dacron cloth .001 inch thick except as noted. For example, the separate protection provided for the PDM on Subpack I, will be of .005 inch thick Kapton.

A summary of the ALSEP items considered for dust protection on Flights 4, A2 & 5 is shown in Table 4.1. A brief description and comments on the dust protection item is included.

A weight summary is shown in Table 4.2. Weights are based on the design thickness of the dust protection material noted and the attachment hardware.

TABLE 4.1

ALSEP DUST COVERS

Item	Description	Comments
Subpack I		
PSE (all)	Thin (.0005) removal film covers top of shroud.	Protects thermal shroud during its deployment
ASE (Flts 4&5)	Four sided 1 mil material wrap-around retained by folding legs. Figure 4.1.	Protects mortar package through final deployment.
LSM (Flts A2 & 5)	2 mil material integral with the PRA covers. Figure 4.2.	Protects EGFU on 4 sides and bottom up to final leveling with no extra task.
CPLEE (Flt 4)	Four-sided wrap-around of 1 mil material & one velcro attachment. Figure 4.5.	Protects major thermal surfaces through final deployment.
SWE (Flt A2)	1 mil and 5 mil materials. Covers all but bottom of unit. Leg retention, no attachments. Figure 4.7.	Permits full deployment of unit, with minimal removal forces.
PDM (all)	5 mil Kapton panel attached to rear retainer (throw-away assy) Figure 4.9.	Protects PDM during leveling, after SP 1 dust cover is removed.
Sub-Pack I Cover (All)	1 mil material cover - contoured to fit with draw string releases. Figures 4.10 & 4.11.	Covers entire sub-pack and surrounds PSE - Leaves access to handling points & front of sunshield. Light weight, easily deployed.

Table 4.1 (continued)

ALSEP DUST COVERS

Item	Description	Comments
Subpack II		
SIDE (Flts 4, A2)	1 mil material form fitted to 3 sides & top. One attachment, deployed by SIDE legs. Figure 4.12.	Total access to all details for last minute removal of cover - minimal removal forces.
HFE (Flt 5)	Covers top & four sides with 1 mil material. Retained by sub-pallet brackets. Figure 4.13.	Protects all surfaces through final deployment of unit. Minimal removal forces.
Shorting Plug (All)	2 mil material covers entire sub-assy and is retained and deployed by caplug. Figure 4.14.	Protects ammeter face & shorting button.
RTG Cover (All)	Circular disc of 5 mil Kapton with retension fingers extending down the O.D. of the RTG. Figure 4.16.	Prevents ingress of contaminants prior to insertion of fuel capsule.
Tool Socket (All)	Bonded Boydbolt cover and 1 mil Kapton disc. Figure 4.17.	Pierced by UHT in use - protects tool socket during three immersions into lunar soil.
LRRR	1 mil material covers package. Retained by draw string. Figures 4.18 & 4.19.	Protects total package from contaminants.

TABLE 4.2

ALSEP DUST COVER WEIGHT ESTIMATES

(INCLUDES COVER HARDWARE)

Dust Covers		Estimated Weight (lb)
Experiments		
	PSE	.10
	ASE	.022
	LSM	.066
	SIDE	.028
	CPLEE	.018
	SWE	.050
	HFE	.026
	LRRR	.10
Subpack 1 (typical)		.40
PDM		.08
RTG Shorting Plug		.003
RTG		.010
UHT Socket		negl.
Flight 4		.66*
Flight A2		.74*
Flight 5		.71*

*Total rounded weight, excluding LRRR.

4.1 Subpack I

The items on Subpack I that require dust protection are:

PSE Shroud
ASE Mortar Box
LSM EGFU (Electronic Gimbal Flip Unit)
CPLEE
SWE
PDM

In addition to the above items, an overall dust protection cover is required for the Subpack I sunshield, experiments and PDM. Detailed information, conceptual sketches, and photos of available mock-ups are covered in Section 1.

4.1.1 PSE Shroud

Externally, the PSE package has not been considered for additional dust protection, since this experiment is intrinsically protected by virtue of its functional design. However, dust protection has been provided internally for the shroud in the form of a thin annular layer (1 mil or less) of clear Kapton or Dacron that rests loosely on the top layer of the shroud. This cover will be removed after the initial deployment of the shroud, by means of a loop that can be engaged with the UHT. The annular cover has a diametrical separation to allow for easy removal. Subsequent minor smoothing out of the shroud may be required after the cover is pulled aside.

4.1.2 ASE

It was observed early in this study that the only ASE item that really needs additional dust protection (over that provided by the subpack I cover) is the mortar box .

The protection for the ASE mortar box must be compromised in terms of total area coverage to provide access to all details required for use during the full deployment procedure. Since the thermal characteristics are not as critical for this unit as for others, this coverage is well optimized.

The dust cover concept as shown in Figure 4.1 is a wrap around design with clearance holes for the eight (8) interface and attach points, and for the UHT socket. It also provides for clearance with the bubble level and for flag deployment. The dust cover is retained by the folding legs of the unit & one velcro pad, and is deployed by a single circular motion of the pull ring. It is recommended that the velcro connection be broken prior to final leveling.

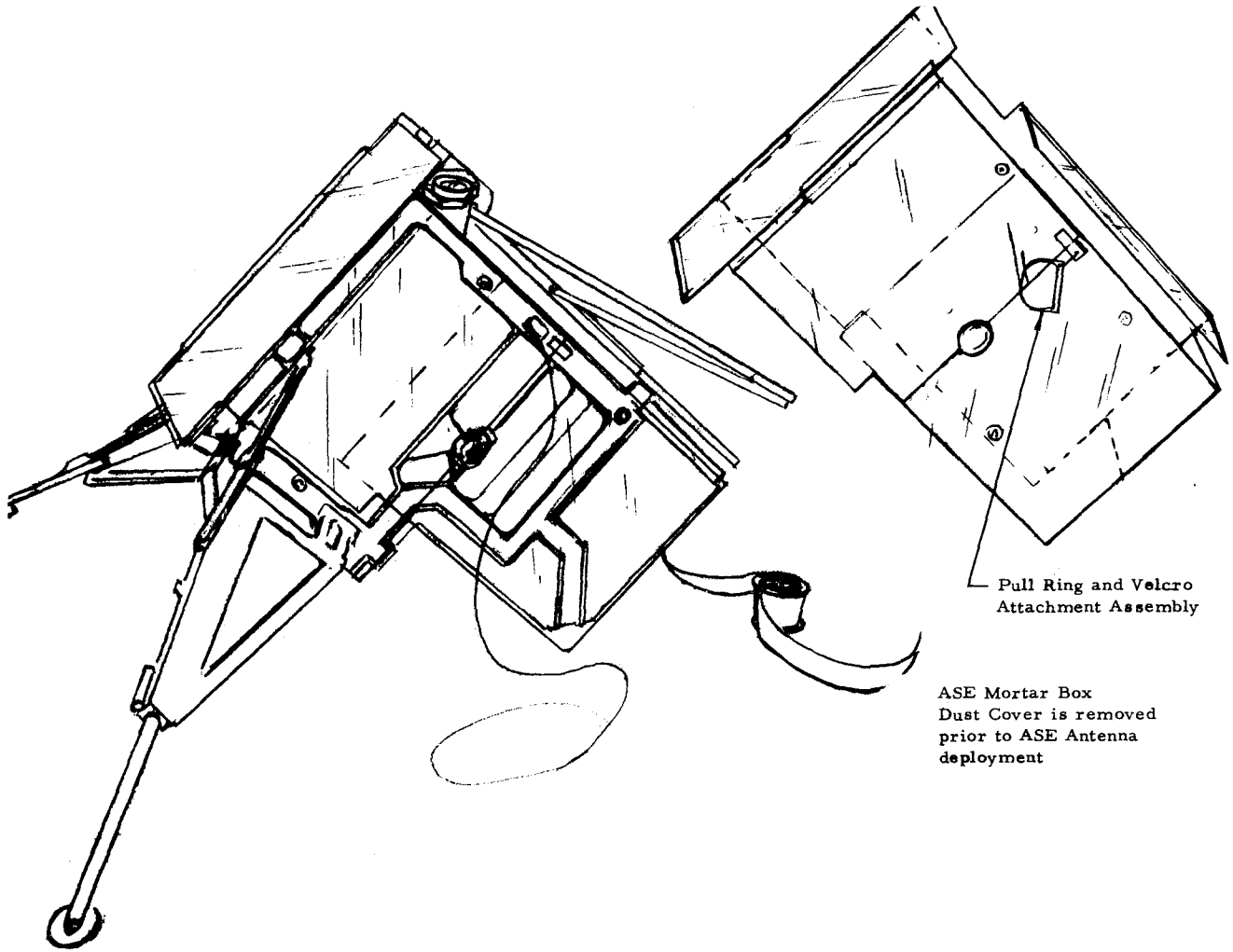

Figure 4.1 Proposed Dust Cover ASE Mortar Box

4.1.3 LSM

The LSM has already been provided with dust covers for the sensor heads and the surfaces containing the PRA. Since it was established that the extension booms do not require additional dust protection over that provided by the stowed ALSEP dust cover (Subpack I), the only LSM item that was considered in this study for dust protection is the EGFU (Electronic Gimbal Flip Unit).

The dust protection for this unit is essentially an extension of the PRA Dust Cover Extant. As indicated in the Figure 4.2, a five-sided; overlapping cover is bonded to the existing PRA cover & stowed under the PRA attach-release mechanism.

Protection is thus provided for the bottom and four sides of the unit untilfinal deployment, just prior to leveling. The material thickness used for a mock-up (Figures 4.3 & 4.4) was .005 inch Kapton. However, the use of thinner materials will be investigated during the final design.

Removal of this dust protection cover is accomplished in the normal sequence of astronaut tasks when the PRA cover is removed.

Removal of the dust cover at an earlier point in the deployment sequence can be accommodated by adding a slit in the cover that "captures" the UHT.

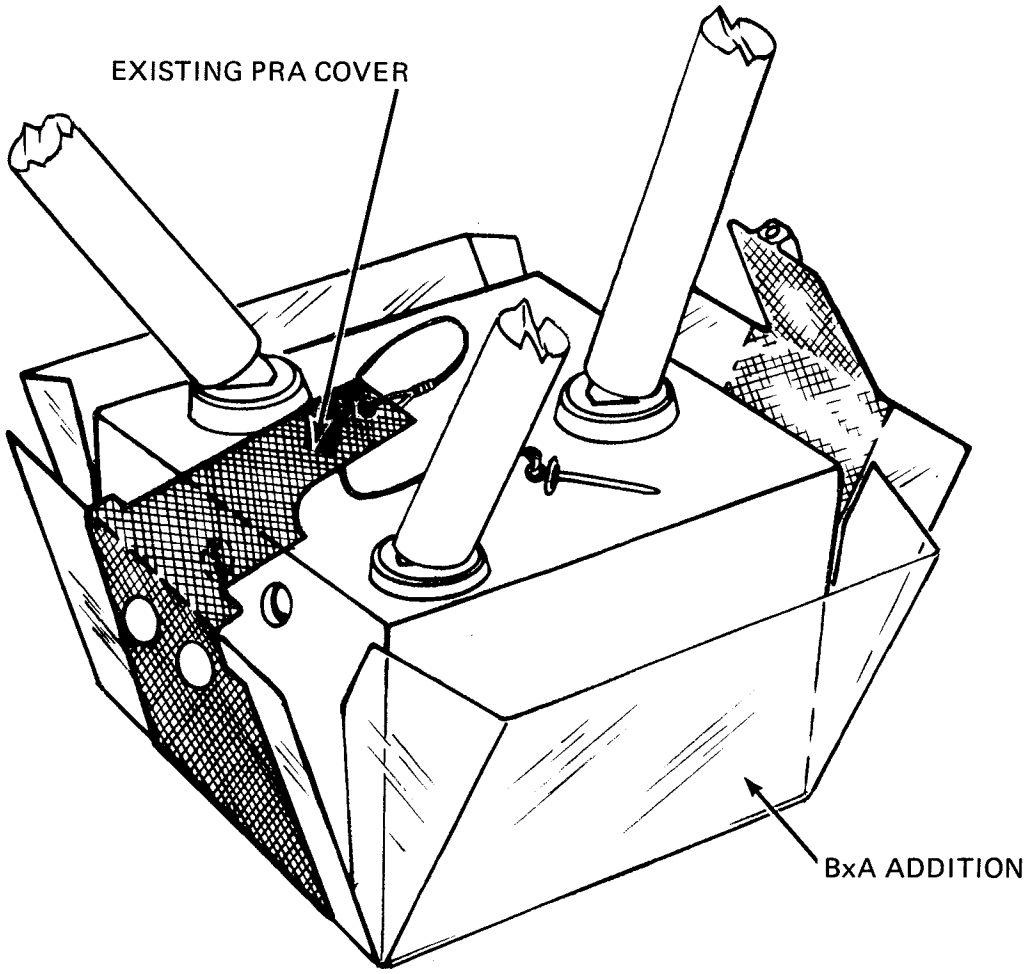

Figure 4.2 Proposed LSM/EGFU Dust Cover

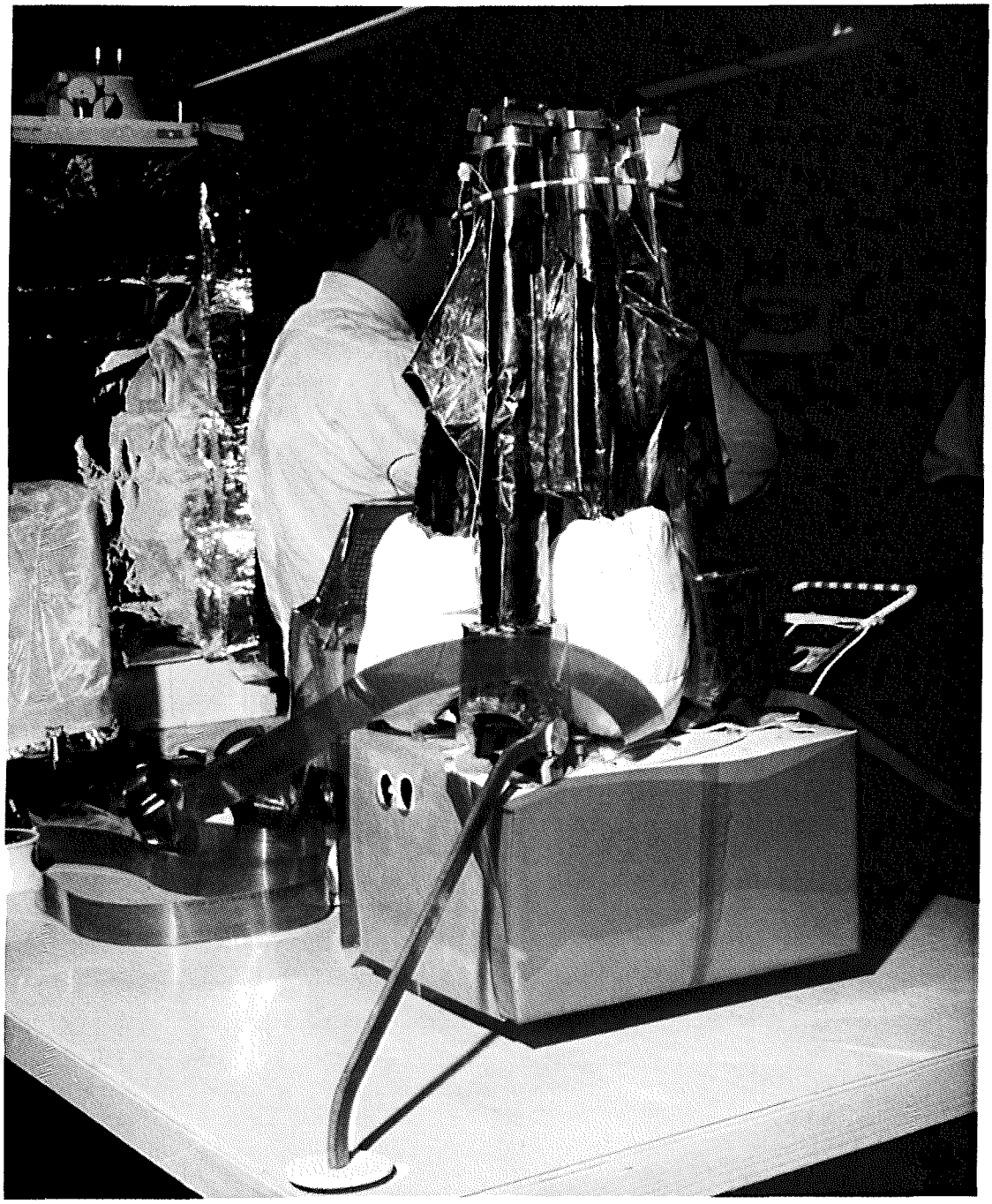

Figure 4.3. LSM/EGFU Dust Cover Mockup (Stowed)

Figure 4.4. LSM/EGFU Dust Cover Mock-Up (Deployed)

4.1.4 CPLEE

A wrap-around concept shown in Figure 4.5 covers thermal surfaces and leaves access to the UHT socket, cable reel, and leveling bubble. The attachment takes place over the unused leg-deployment lug which the overlapping portions of the dust cover are cut to clear. The pull ring is permanently attached to one velcro pad on the overlapping end, which mates with a pad attached to the underlying material.

When the unit is reversed on the UHT from the inverted stowed position, this may be detached, but the cover is left hanging loosely on the experiment until it is fully deployed. The cover may then be removed by the UHT handle without disturbing the unit.

The mockup (Figure 4.6) used for the preliminary demonstration was made of .005 inch thick Kapton. Usage of thinner material will be investigated for the final design.

Removal of this cover prior to complete deployment can be accomplished with no change in the design concept.

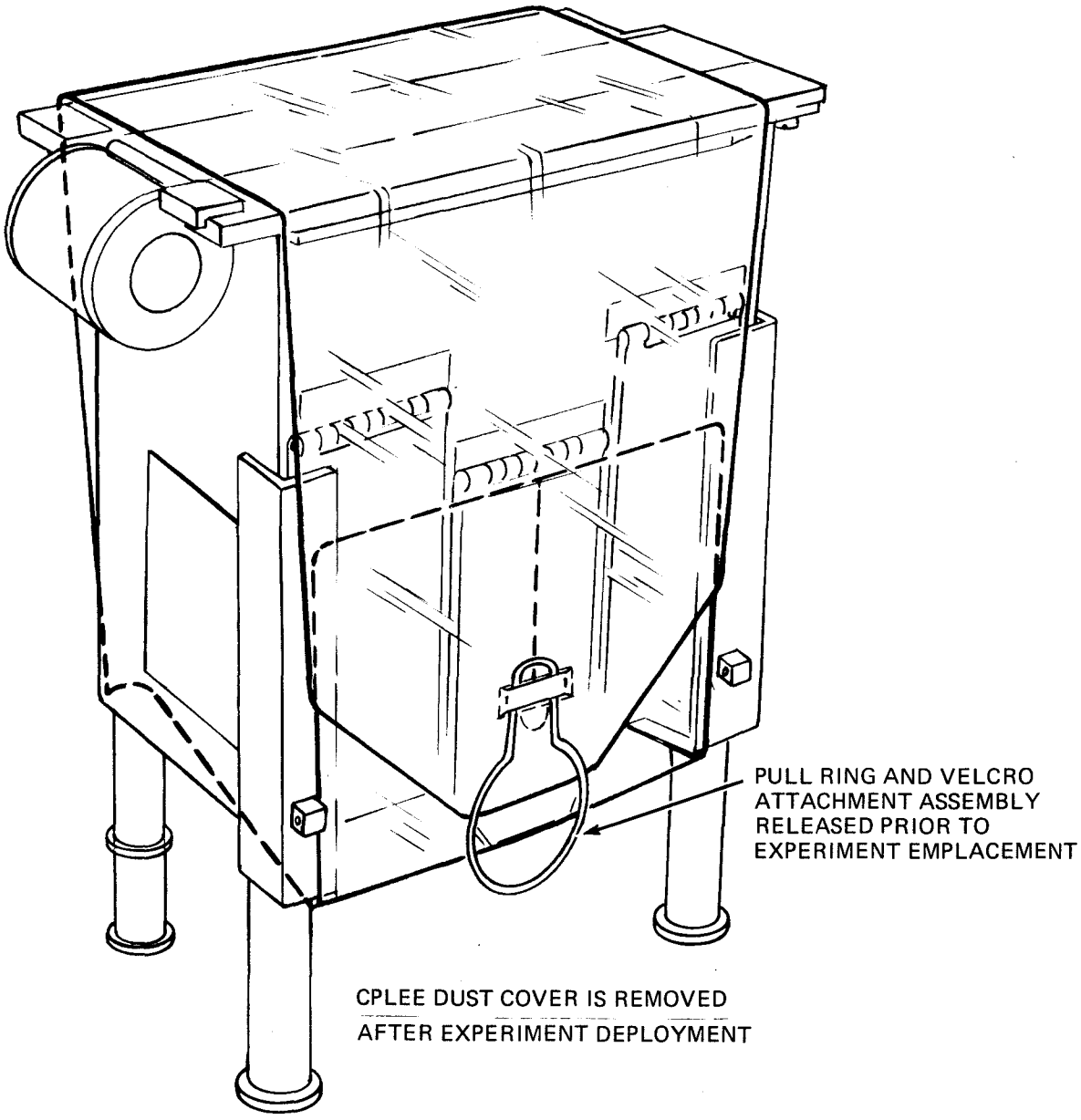

Figure 4.5 CPLEE - Wrap-around Dust Cover

Figure 4.6. CPLEE Dust Cover Mock-up

4.1.5 SWE

In providing a dust cover for the SWE, the ideal of maximum protection up to final deployment can be attained. Figure 4.7 illustrates that all surfaces can be covered without interfering with stowage, uncaging, handling or deployment.

This dust cover may remain on the unit until final deployment, in spite of the light weight of the unit, since it has no attachments. The cover is retained by the leg structures on either side of the SWE unit where the skirts of the cover are .001 inch thick, offering little resistance to removal. The truncated cone and its base are of .005 inch thick material. The assembly is stiff enough to avoid contact with the unit in this area. The slit in the side skirts accommodates stowage, and also deployment of the sunshield when it is uncaged by the extending legs. The 'D'-ring is stowed horizontally on the top of the cone with sufficient overhang to permit deployment. The cover is removed vertically by means of the UHT handle.

Removal of the cover prior to final deployment can be accomplished by adding another slit along the corner of the skirt, adjacent to the UHT socket. This will permit the cover to pass freely over the UHT.

A mock-up of the SWE dust cover is shown in Figure 4.8 (photo).

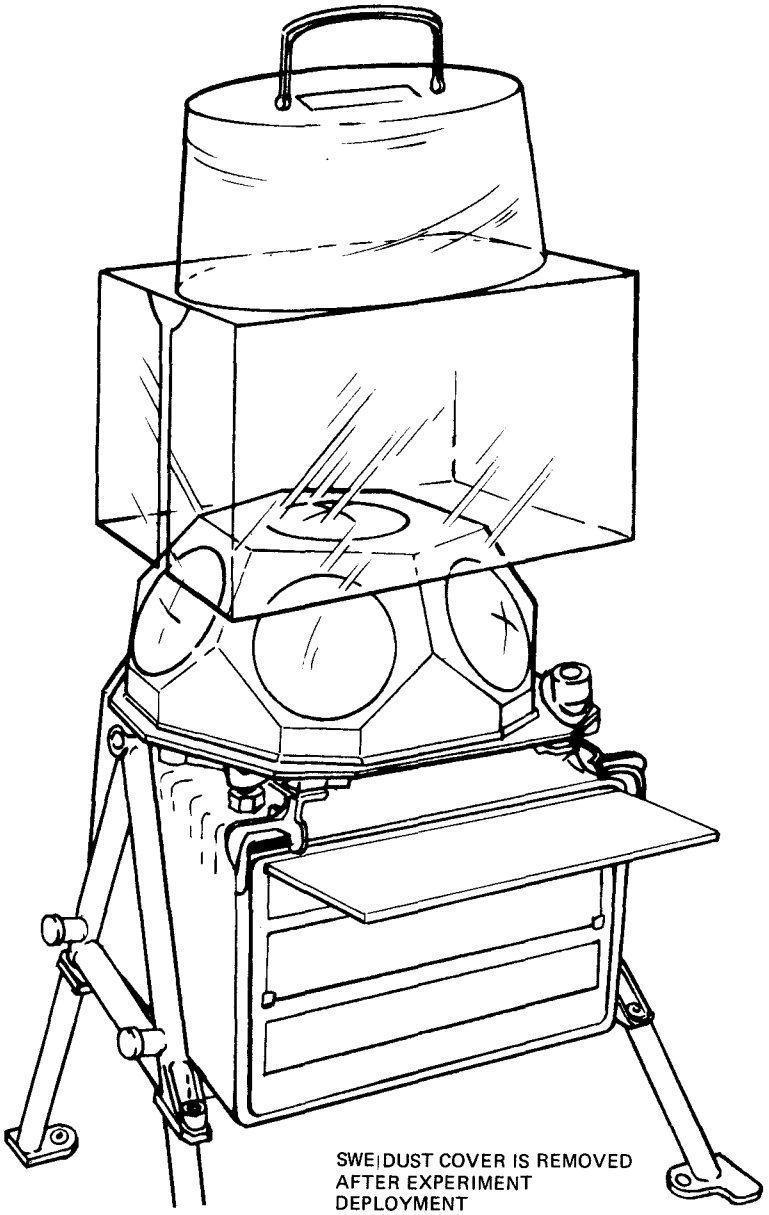

Figure 4.7 SWE Dust Cover

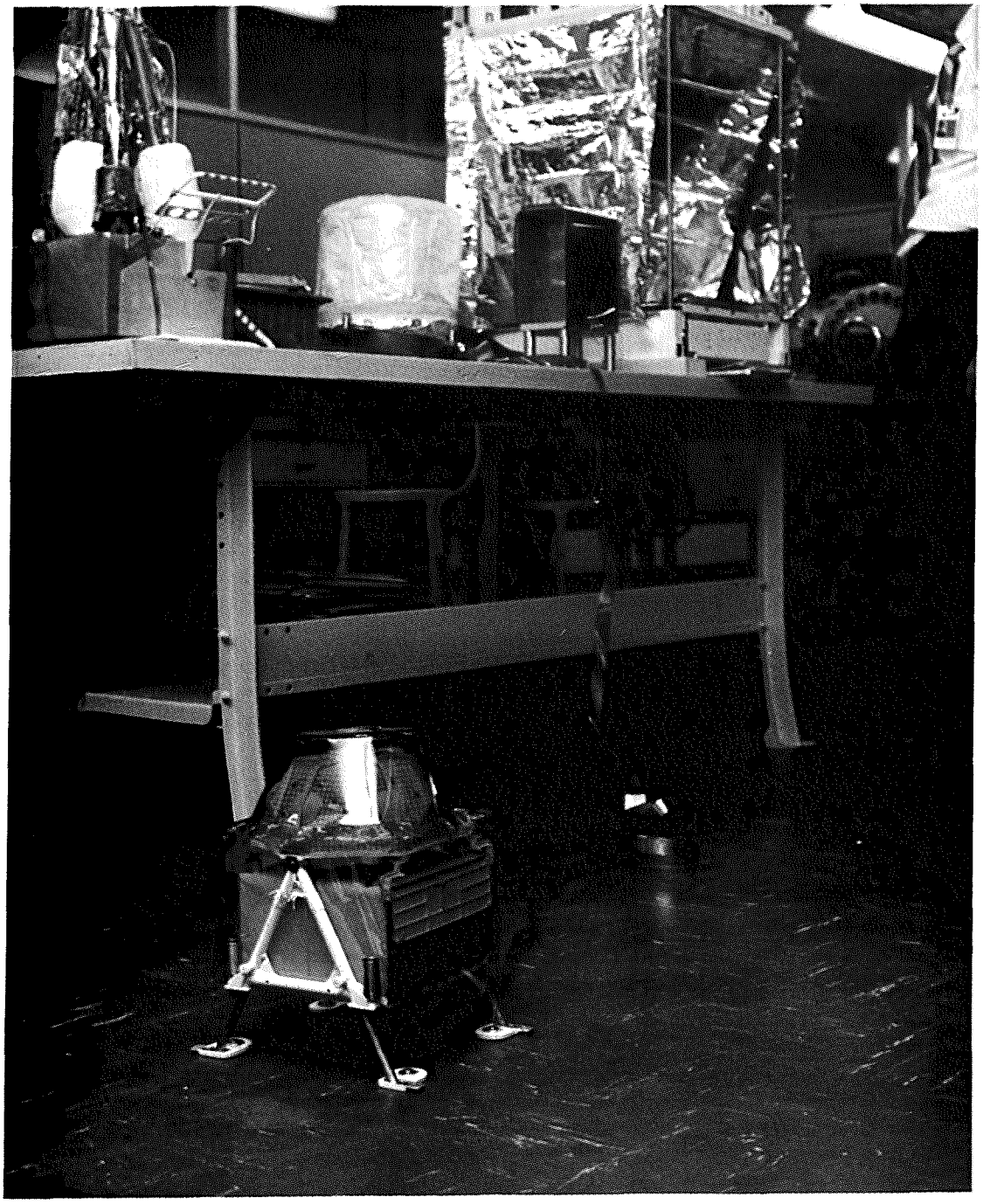

Figure 4.8 SWE Dust Cover Mock-Up

4.1.6 PDM Cover

In examining the dust protection needs of the PDM, it was found that this unit is immersed in the lunar soil at both the LM and ALSEP experiment deployment sites. In addition, dust is forced into the region of the PDM during the leveling and orientation phase of the subpack. For this reason, dust protection for the PDM is provided throughout the leveled orientation phase of Subpack I by means of a special individual cover in addition to the dust protection flap provided on the subpack I dust cover.

This PDM dust cover is shown in Figure 4.9. It is made of .005 inch thick clear Kapton formed to fit closely around the PDM on five sides. Attachment to Subpack I will be by means of the rear curtain retainer as illustrated (typically) in Figure 4.9. In the case where a rear curtain assembly is not used on Subpack I, an additional light weight device resembling the curtain retainer outline will be designed to support the dust cover.

Removal of the dust cover will occur simultaneously with the normal astronaut rear curtain retainer removal tasks.

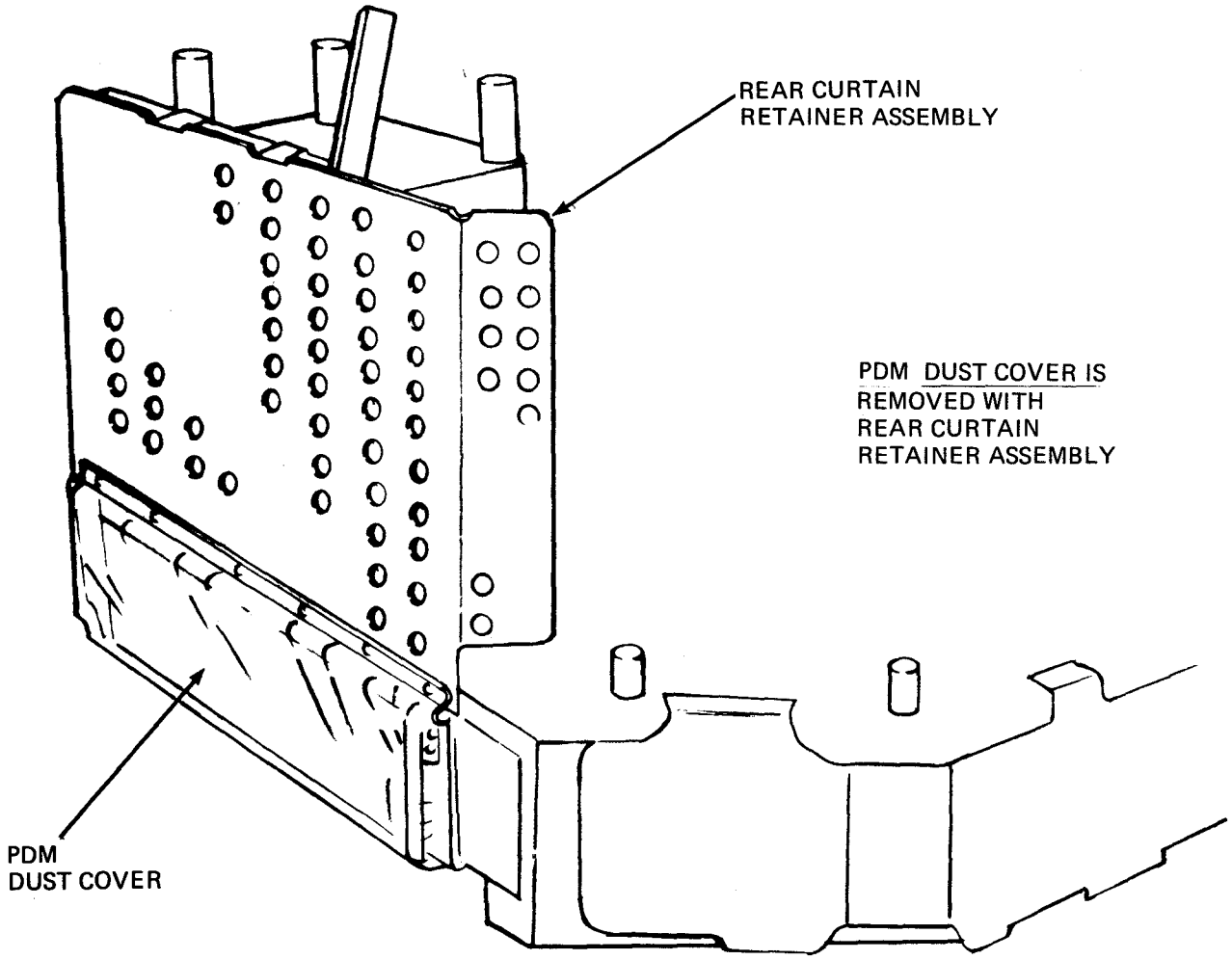

Figure 4.9 Primary PDM Cover (Typical)

4.1.7 Subpack I Cover

A dust cover for Subpack I is considered necessary to protect the subpack items above the primary structure that cannot be covered by other means. This cover would protect these items, and afford secondary protection to more critical items already covered, from contaminants during the period from installation into LM (and perhaps during prior storage) until deployment of the Subpack at the ALSEP site. Specific items that would benefit from this protection are the ASE Thumper, unprotected portions of the ASE Mortar Box and the CPLEE, open areas of the sunshield, the Boydbolt guide cup covers, the level and sun dial, and the PDM.

The concept indicated in the Figures 4.10 and 4.11 sketches was derived to meet the following criteria:

Additional protection desirable for experiments and sunshield assembly items.

All but the primary structure be protected.

Additional protection to the PDM be provided, accommodating that provided separately.

Contour of the subpack and experiments, be adhered to as closely as practical.

Deployment of this overall cover be made as simple as possible - preferably one continuous pull to remove.

Figure 4.10 shows the dust covers as installed in Subpack I. Figure 4.11 illustrates the cover alone, with the stowage and release devices.

One of the features of this design is the utilization of the existing cover on the PSE as part of the overall subpack cover, thru the use of a hole with a drawstring surrounding the PSE at the level indicated. This drawstring is then made to be an integral part of the bag removal mechanism. The basic retension and release system is a drawstring about the entire sunshield structure. The front panel of the bag is open, at the lower level, to avoid fowling or damage to the flat cables in that region.

The material to be used for this cover, as indicated in the opening remarks of this report, is .001 to .002 inch thick clear Kapton or Dacron cloth. The Kapton will be joined by Kapton tape, and the cloth by sewing.

Removal of the subpack cover will begin by releasing the pull pin located under the boom retainer bracket. This must be done while the subpack is still positioned with the handle upright. A clockwise and upward lifting motion using the UHT handle engaged in the pull ring (retained in left draw-string bracket) will remove the subpack cover after the subpack has been rotated to the normal horizontal position.

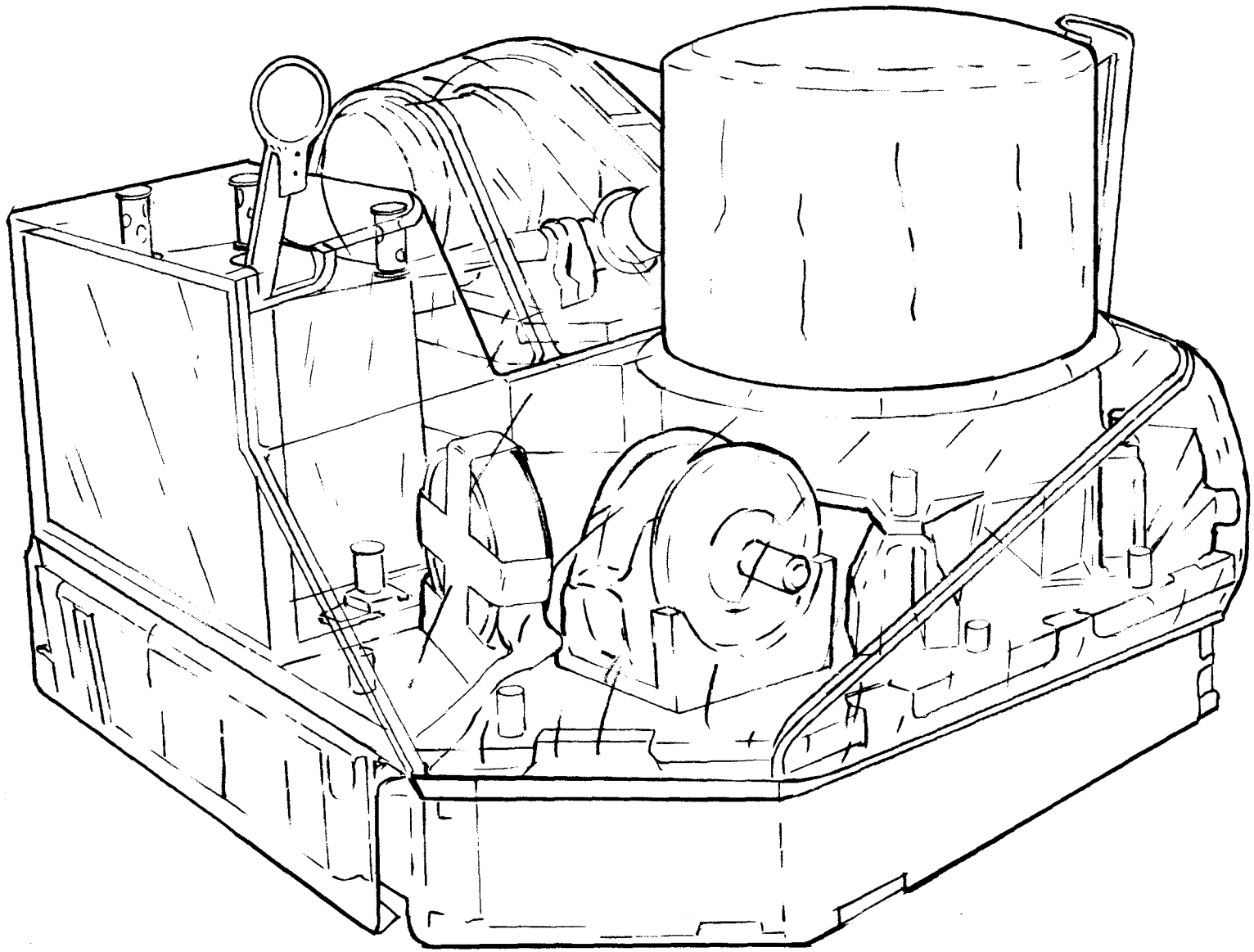

Figure 4.10. Subpack I - Proposed Dust Cover Envelope

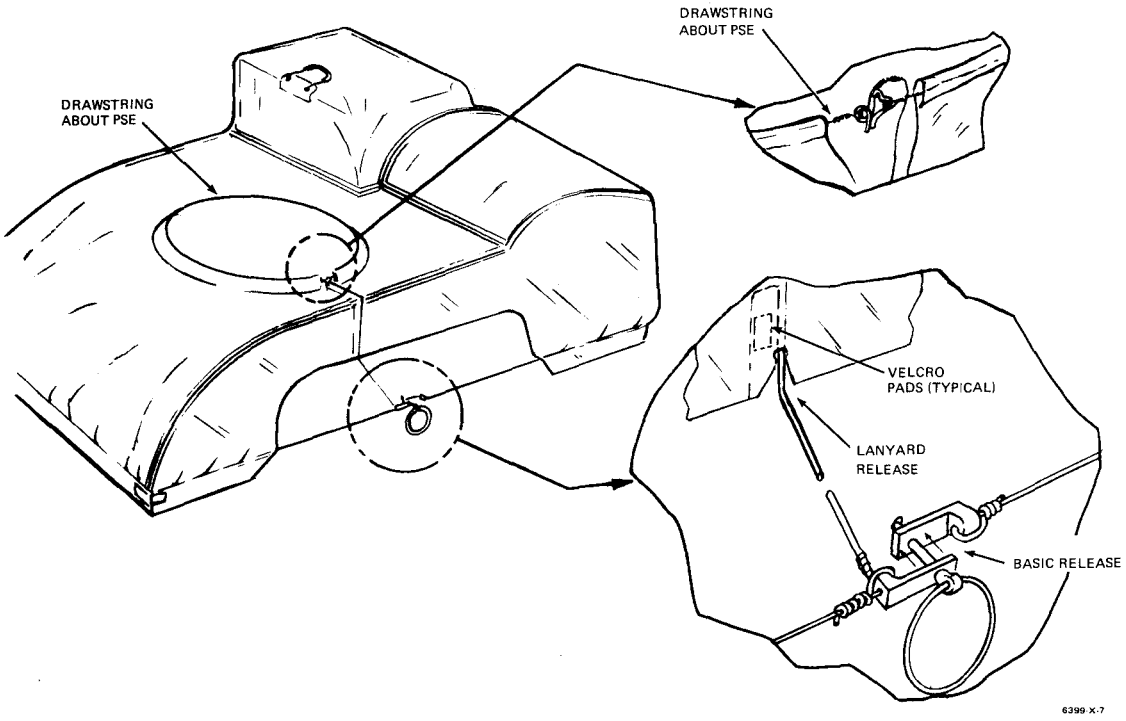

Figure 4.11. Subpack I - Dust Cover Deployment Scheme

4.2 Subpack II

The items on Subpack II that require dust protection are:

SIDE
HFE Electronics
RTG Shorting Switch
RTG Top
UHT Socket - Top of RTG Cable Stowage.

Detailed information, conceptual sketches and photos of available mock-ups are covered in Section 4.2.

4.2.1 SIDE

The protection configuration best suited to the SIDE for equatorial site deployment is a form-fitting cover which pulls down over the unit and ties across the bottom in one location. (Ref. Figure 4.12).

One end is left entirely open to provide access to the UHT socket, bubble level, screen deployment, CCIG deployment, and flat cable. The automatic dust shield deployment safety pin release mechanism is accessable through (i) a small slit in one side, and (ii) the provision to mount the pull ring outside the dust cover.

Since the leg deployment mechanism is confined to the bottom of the unit, the cover does not interfere with this function. Advantage is taken of the leg deployment configuration, to provide a means of breaking the tie across the bottom of the unit. This tie constrains the sides of the cover at the open, or loose end, and may be broken without introducing extra tasks by either of two general methods:

rotational spring-loaded deployment of the central leg,

leg-deployment lanyard linkage.

This overall design permits the use of a close fitting cover which provides access to all boydbolts in the stowage mode, and permits all deployment tasks to be performed prior to its removal.

The double lanyard pull ring enhances removal of the cover and avoids the necessity to anchor the pull ring in storage, as it assumes a position at rest which will always permit gloved access.

As indicated in Figure 4.12, a slit is required at one side to permit angular displacement of the leg for deployment at off-equatorial sites. The cover is identical in all other respects.

No modification of this cover is required to accommodate removal prior to final deployment of the SIDE.

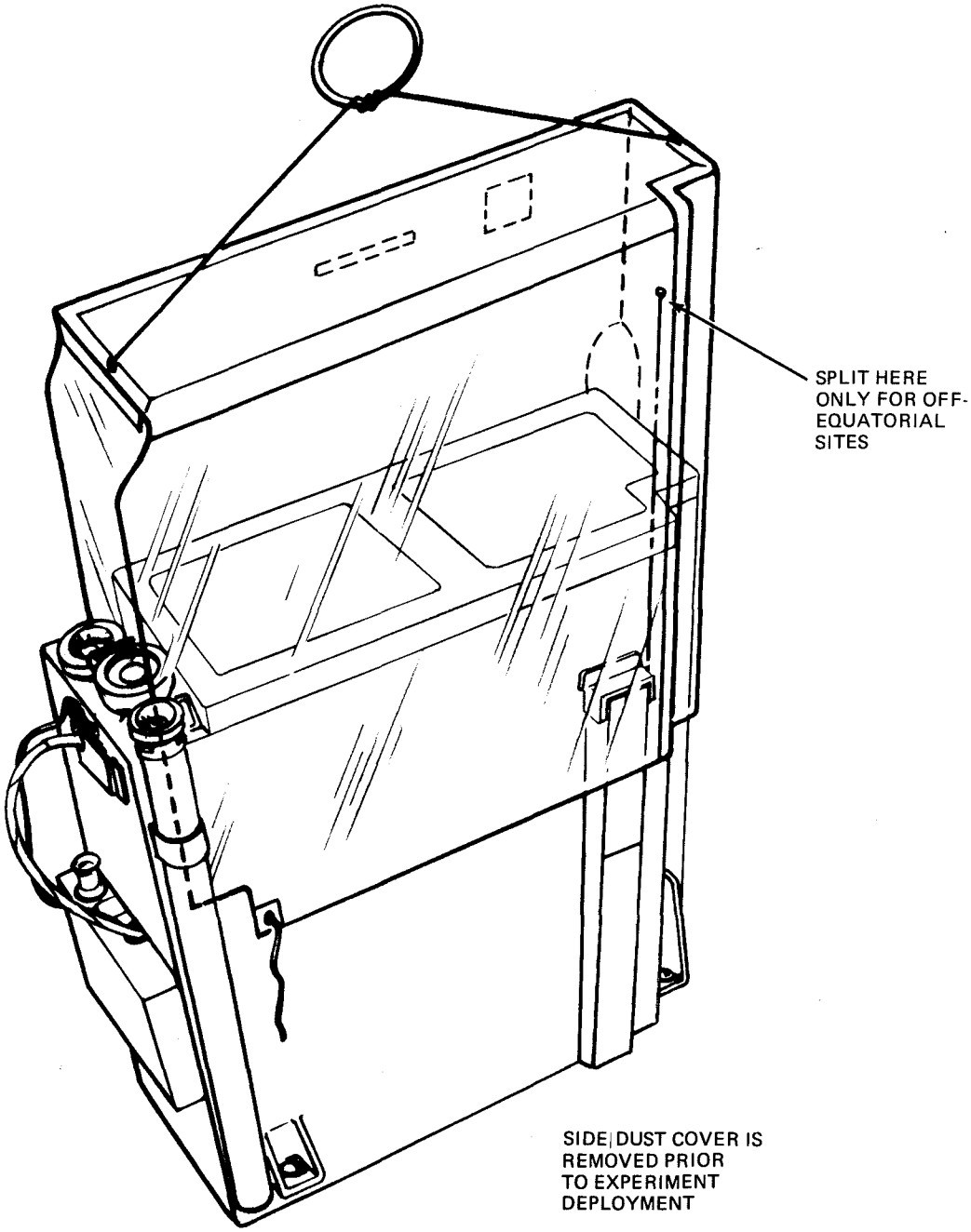

Figure 4.12. SIDE Dust Protection Enclosure

4.2.2 HFE

Dust protection is only required for the Heat Flow Experiment electronics package, since all other package components in the HFE are discarded after use by the astronauts.

The dust bag (see Figure 4.13) is made of .001 inch thick clear Kapton or Dacron cloth with a top and four sides. Clearance notches, side slits and holes are provided to clear the stowage brackets, the cables and astronaut mate connector, and the leveling and aligning devices.

The cover is retained on the subpallet by tucking the edges of the clearance notches under the webs of the subpallet unit stowage brackets.

Removal of the dust bag is accomplished by lifting vertically on the D-ring with the UHT handle after leveled orientation has been completed. Removal of the dust bag at an earlier point in the deployment sequence can be accomplished by a slight modification to provide removal capability with the UHT engaged.

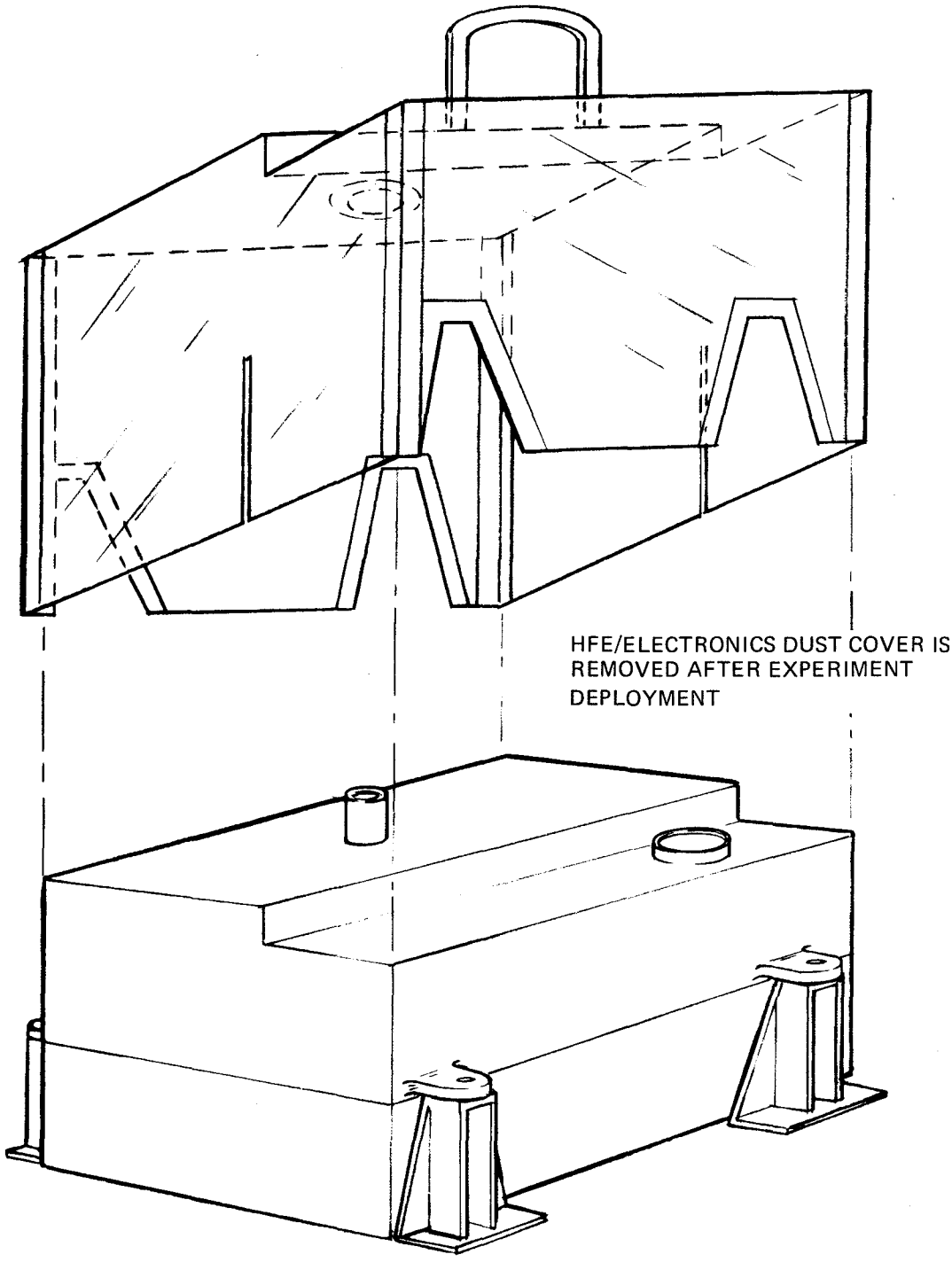

Figure 4.13 HFE Electronics Dust Cover

4.2.3 RTG Shorting Plug

The RTG shorting plug requires dust protection for the shorting switch and dial indicator. A .001 inch thick clear Kapton bag or Dacron cloth made integral with the cover for the connector (Figure 4.14) will provide this protection. The dust protection bag will be removed simultaneously with the connector cover as a scheduled astronaut task just prior to mating with Subpack I.

A mockup of this dust protection cover is shown in Figure 4-15 (photo).

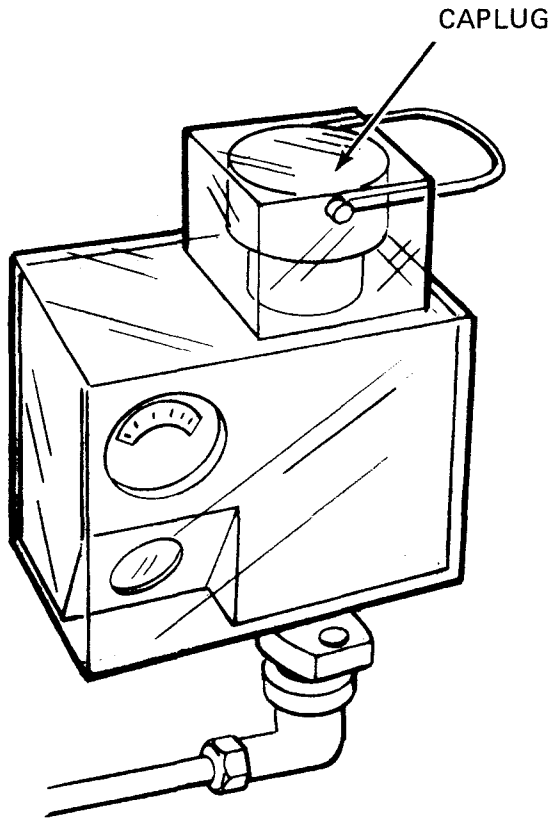

Figure 4.14 RTG Shorting Plug Dust Cover

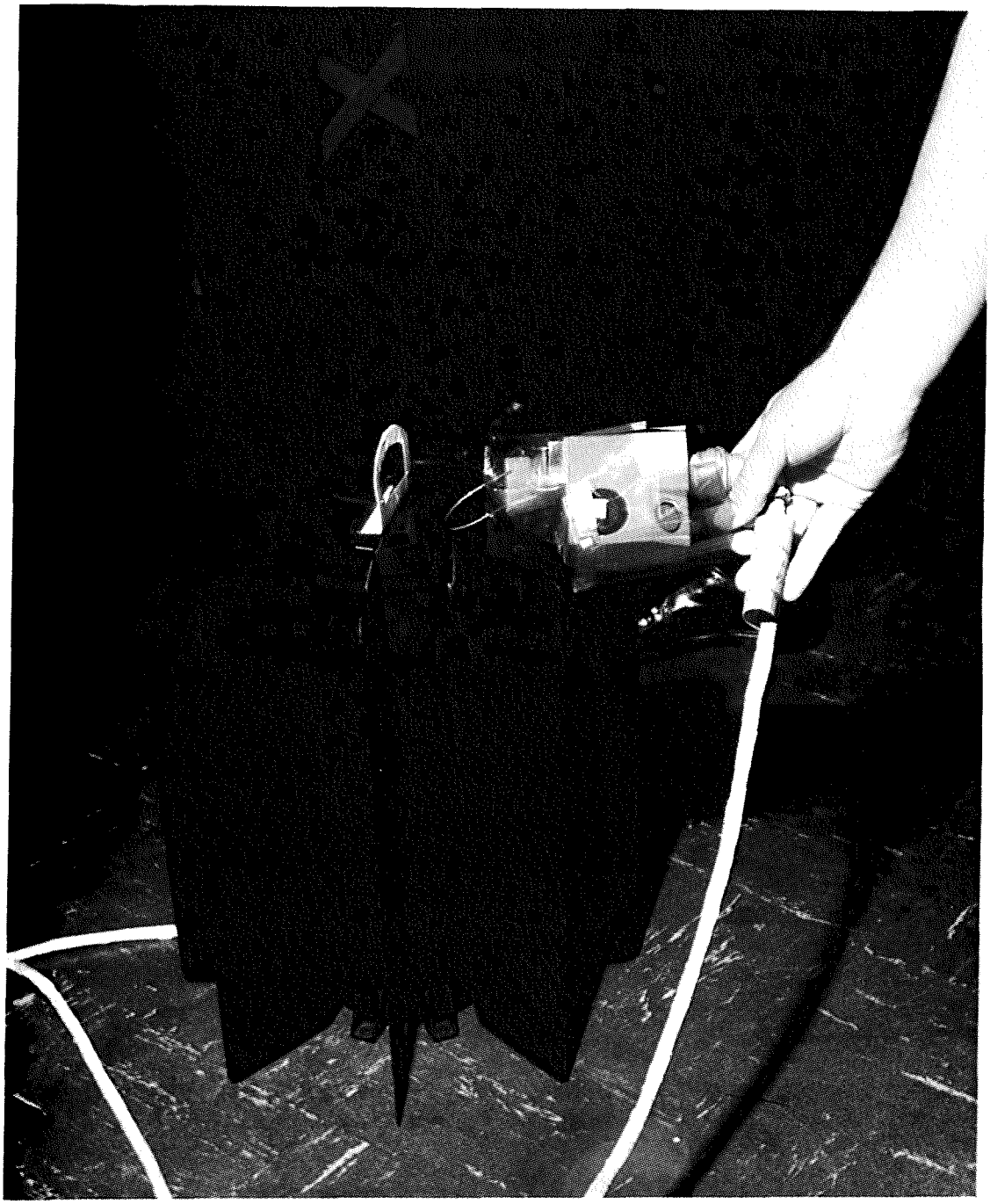

Figure 4.15. RTG Shorting Plug and RTG Top Dust Cover Mock-Ups.

4.2.4 RTG Top Cover

The RTG Central section requires dust protection to eliminate any possibility of contamination in the open chamber. A cover made of clear .005 inch thick Kapton covers the RTG top as shown in Figure 4.16. Fingers on the sides between the fins will hold the cap. A spring loaded D-ring will be used for removal prior to opening the RTG for fuel capsule insertion.

A mockup of this dust cover is shown in Figure 4.15 (photo).

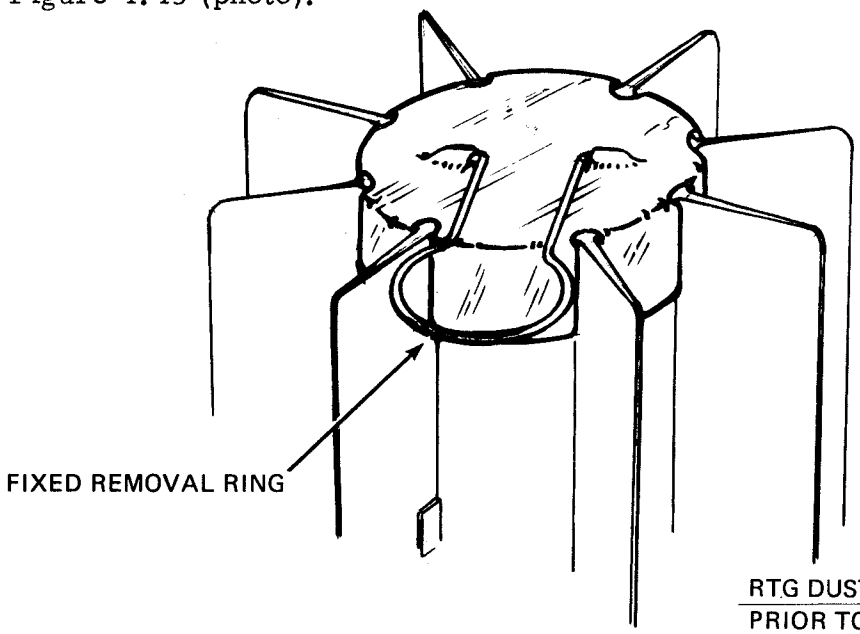

Figure 4.16. RTG Top Dust Cover

4.2.5 UHT Socket - Top of RTG Cable Stowage Assembly

The UHT socket on the RTG cable stowage assembly requires dust protection since it is immersed in the lunar dust at both the LM and ALSEP deployment sites. The simplest way to protect the socket as shown in Figure 4.17 is with the typical Boydbolt cover material on the top and the bottom with .001 inch thick clear Kapton. Both materials will be bonded on the socket.

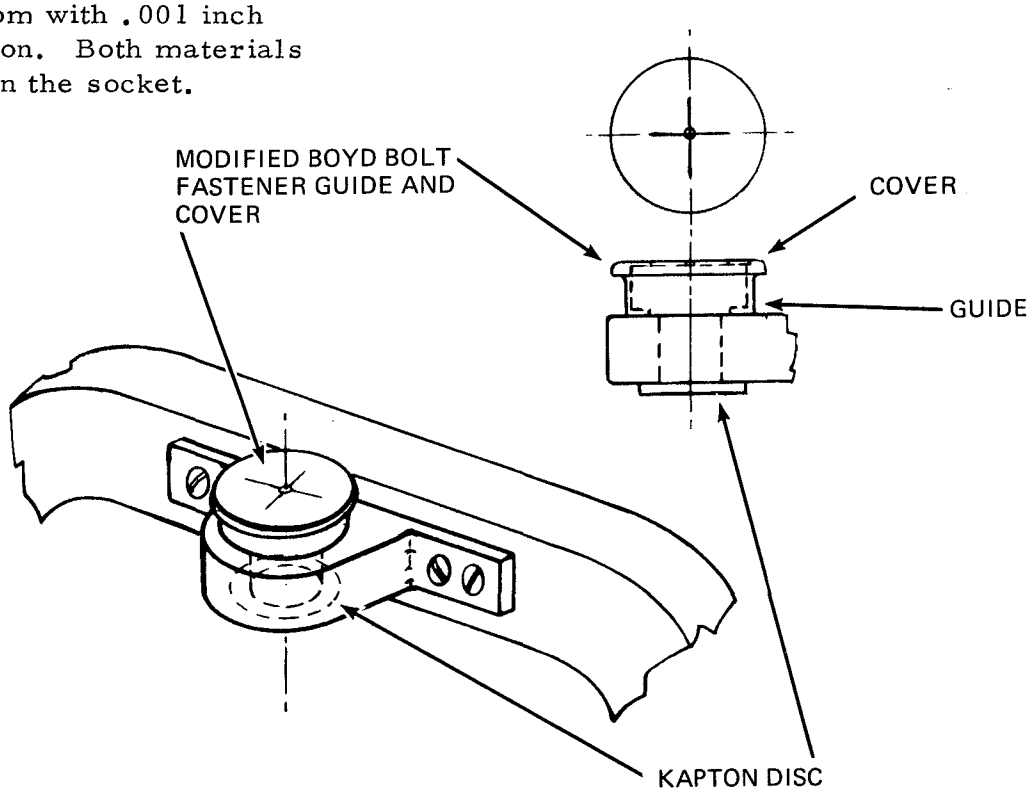

Figure 4.17. UHT Socket Dust Cover

4.3 LRRR

The design concept shown in Figures 4.18 and 4.19 is directed toward complete coverage of the package with provision for final deployment prior to removal of the array dust cover.

A single wrap of .001 inch thick Kapton or Dacron cloth envelopes the experiment as a whole, and a system of overlapping flaps (Fig. 4.19) ties all four sides together by a removable drawstring on the bottom of the package. One of these flaps is readily deployable by the action of the experiment leg as it rotates outward and locks for experiment deploying. This may take place without releasing the dust cover drawstring.

The interface pickup points and the steady-rest structure are circumvented by the dust cover, at the corners, and the carry-handle is constructed by the system although for convenience, the release ring is stowed close to the handle.

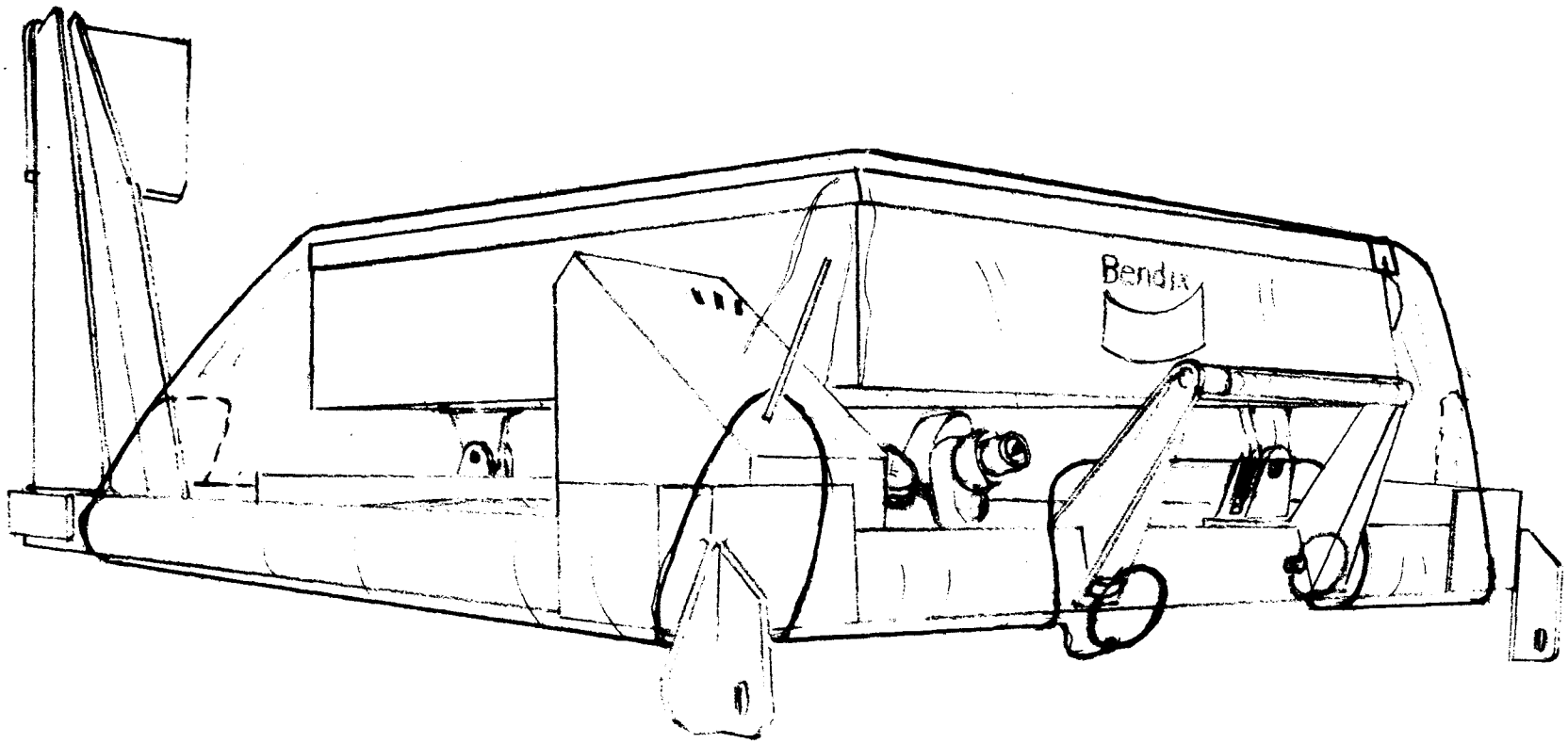

Figure 4.18. LRRR Dust Cover - General Coverage

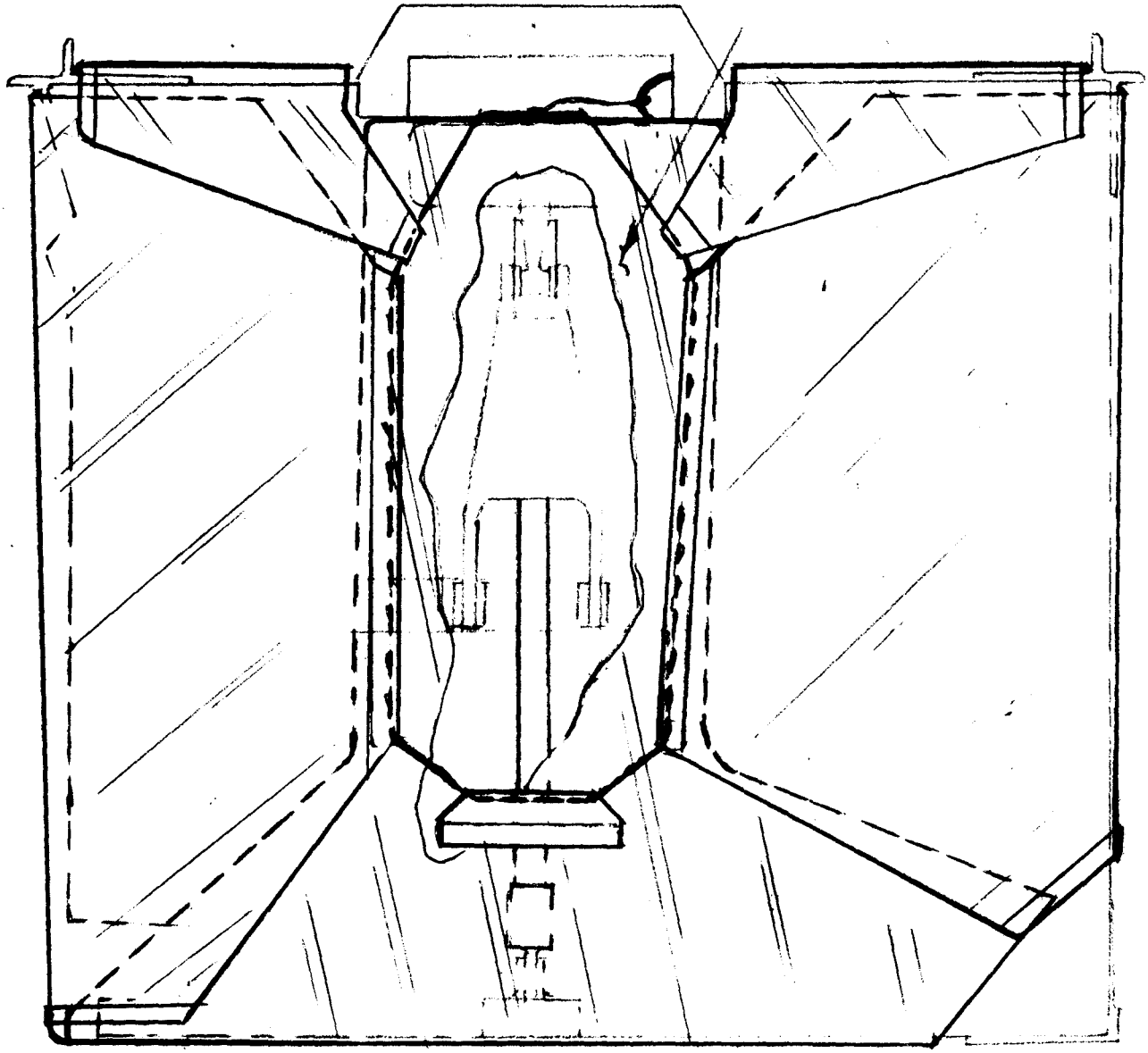

Figure 4. 19. LRRR Dust Cover Attachment Concept (Bottom View)