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SKYLAB EXPERIENCE BULLETIN NO. 9

FOOT RESTRAINT SYSTEMS

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National Aeronautics and Space Administration

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FOOT RESTRAINT SYSTEMS

December 1974

MAN-MACHINE ENGINEERING DATA APPLICATIONS OF SKYLAB EXPERIMENTS M487/M516

BULLETIN NO. 9

FOOT RESTRAINT SYSTEMS

This document is the ninth in a series of releases which are intended to make available to NASA and contractor personnel those results from the Skylab Man-Machine Engineering Experiments which have design and requirements relevance to current projects and programs. This method of data distribution has been instituted as a convenient way to provide early access to Skylab experience.

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FOOT RESTRAINT SYSTEMS

INTRODUCTION

This document is the second of the four-document series on personnel restraints identified in Skylab Experience Bulletin #7. The various types of foot restraints developed and flown on Skylab are the subject of this bulletin.

SUMMARY

The triangle grid and triangle shoes flown aboard Skylab proved to be an extremely good foot restraint system. The crewmen's comments indicated a desire to have that type of positive, passive restraint in those locations in the spacecraft where triangle grid did not exist. All required locations for foot restraints cannot be totally predetermined.

Flexible toe straps were unacceptable as general foot restraints because they required the crewmen to concentrate on remaining restrained.

In general, several foot restraint requirements evolved from the Skylab experience:

A. The foot restraint must be passive and not require the user to concentrate on remaining restrained.

B. The foot restraint must be positive and firmly hold the user in the desired position.

C. The foot restraint must be capable of being engaged and disengaged easily and quickly.

D. The foot restraint must permit the user to change his position during use in order to allow full advantage to be taken of the zero-g envelope of operations.

E. The same type of foot restraint must be utilized over the entire vehicle. Mixing foot restraint types creates problems for the users.

F. A portable form of the restraint should be available for installation at various temporary work sites within the spacecraft.

PRE-SKYLAB EXPERIENCE

The Mercury program had no need for foot restraints. The spacecraft was too small to move around in and there was no EVA program.

The Gemini program did have a requirement for EVA foot restraints which will be discussed in a subsequent bulletin. However, this initial venture into foot restraint design developed the primary design criteria inherent for any zero-g foot restraints, namely that the feet must be restrained in six degrees of motion and no mechanically active devices should be used to restrain the feet.

These criteria were carried over into the Apollo program. Again, no IVA foot restraints were necessary but foot restraints were required in support of the Apollo 9 EVA and the trans-earth EVA's of Apollo's 15, 16, and 17.

Strips of velcro pile material on the floor of the LM were provided to interface with velcro hook pad on the crewmen's boots. However, it was discovered that it took more force to engage the hook and pile material than to disengage it, so the velcro was discounted as a restraining force. It was left in the spacecraft to provide a needed friction surface for the crewmen to work against when restrained.

SKYLAB DESIGN

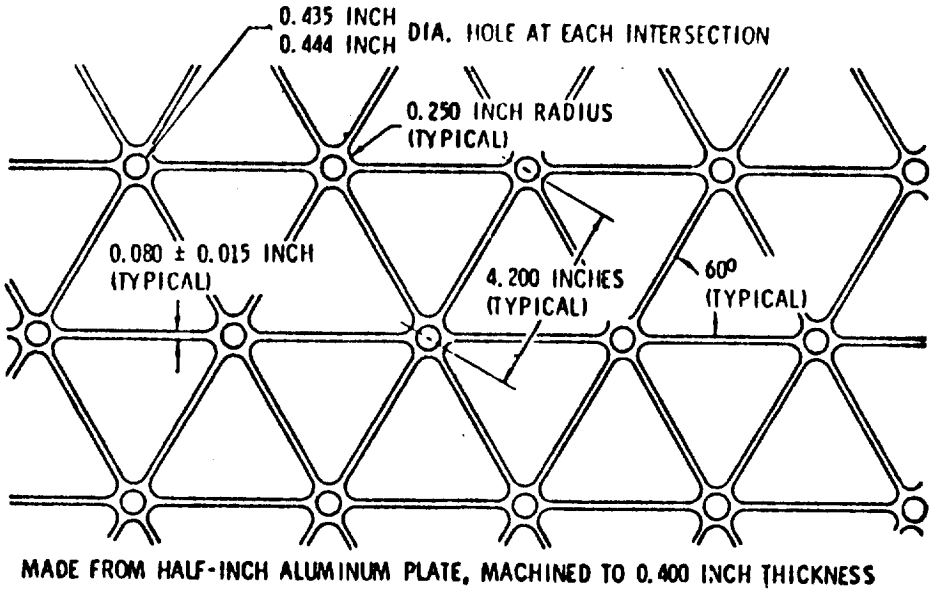
Several types of IVA foot restraints were developed and deployed aboard Skylab.

Triangle Grid

Floor and ceiling grid was installed on the experiment deck and on the floor of the forward compartment of the workshop. This served as both a handhold and as a locking surface for the triangle shoe. The grid, illustrated in figure 1, consisted of equilateral triangle cutouts machined from aluminum plate. The grid concept originated with the original "wet" workshop requirement to allow liquid hydrogen drainage through the preinstalled floors and walls during the launch and boost phases of the mission. The round holes at each triangle apex were added later to provide equipment tie-down points.

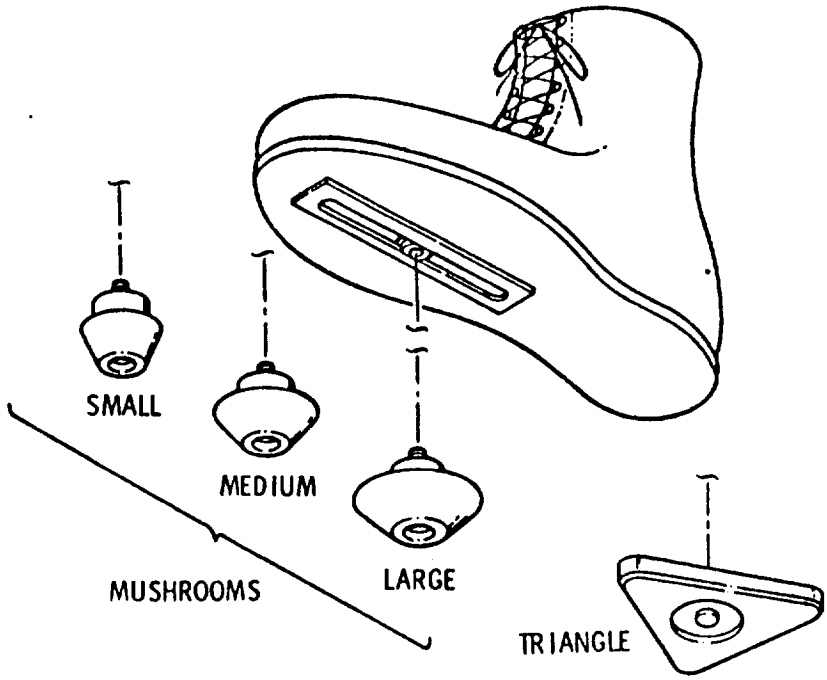
Portable Foot Restraint Assembly (Triangle Shoes)

One pair of custom-fitted triangle shoes was provided for each crewman to enable them to lock their feet into the floor and ceiling grid, the water tank foot restraint platforms, the ATM and M512 foot restraint platforms, the food table foot restraints, and the egometer foot pedals. A triangular cleat with an integral engage/disengage mechanism was fitted to the sole of each shoe. The cleat was designed to be inserted into the triangular cutouts in the open grid or into the cleat receptacles on the platform foot restraints and foot table foot restraints. Once the triangular cleat was inserted into the cutout, it was engaged by rotating the shoe slightly and was disengaged by a reverse rotation. In the case of failure, the cleat was removable from the shoe through use of three screws accessed from inside the shoe.



Triangle Grid

Figure 1



Conical and Triangular Cleats

Figure 2

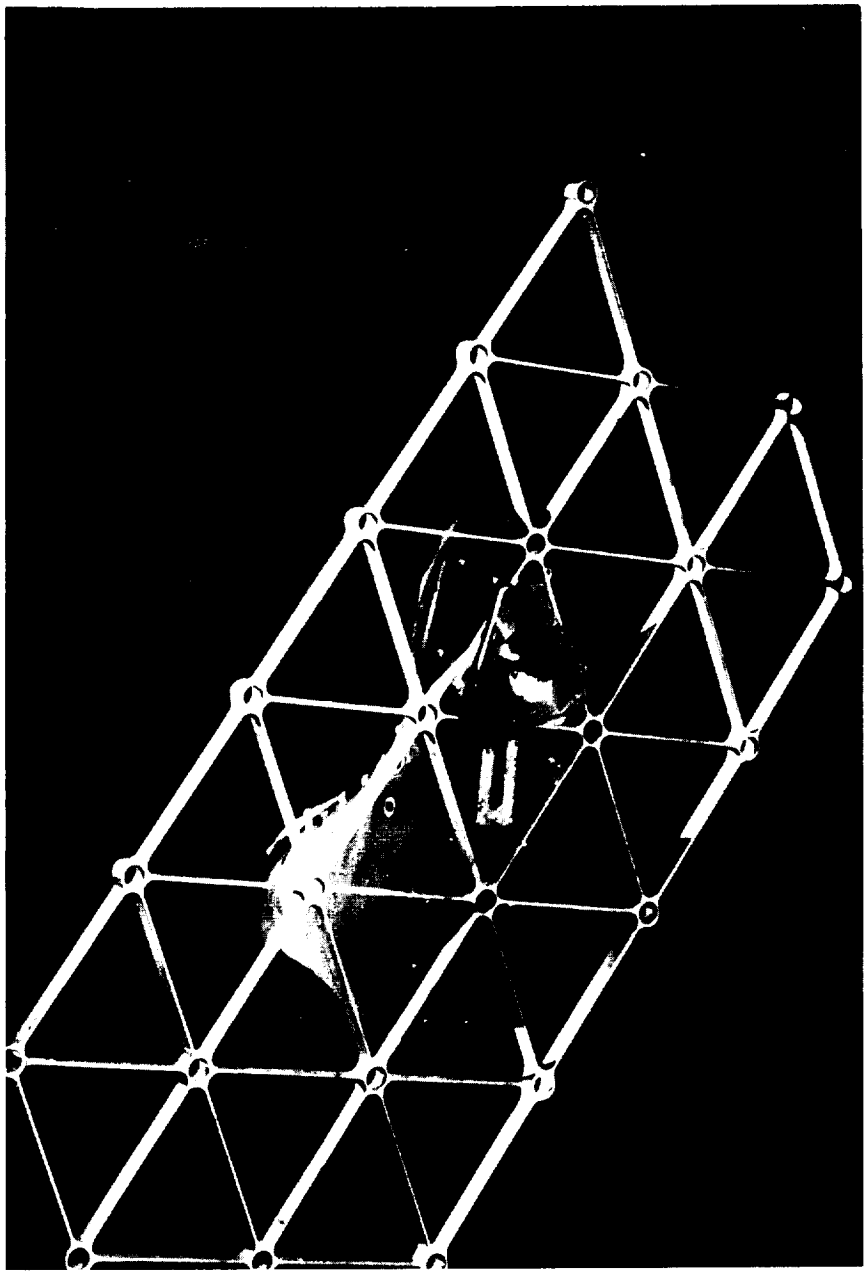
In addition to the triangular cleats, three sizes of conical (mushroom) cleats were also provided. These could replace the triangular cleats at the individual crewman's discretion. Figure 2 shows the conical and triangular cleat configurations, and figure 3 shows a triangle shoe with a triangular cleat engaged in the grid.

Platform Foot Restraints

Three platforms containing either the triangle grid or a modified type of grid for use with the triangle shoes were installed in various locations aboard the Skylab to provide foot restraints in heavy work areas. Figure 4 shows the location and make-up of these restraints.

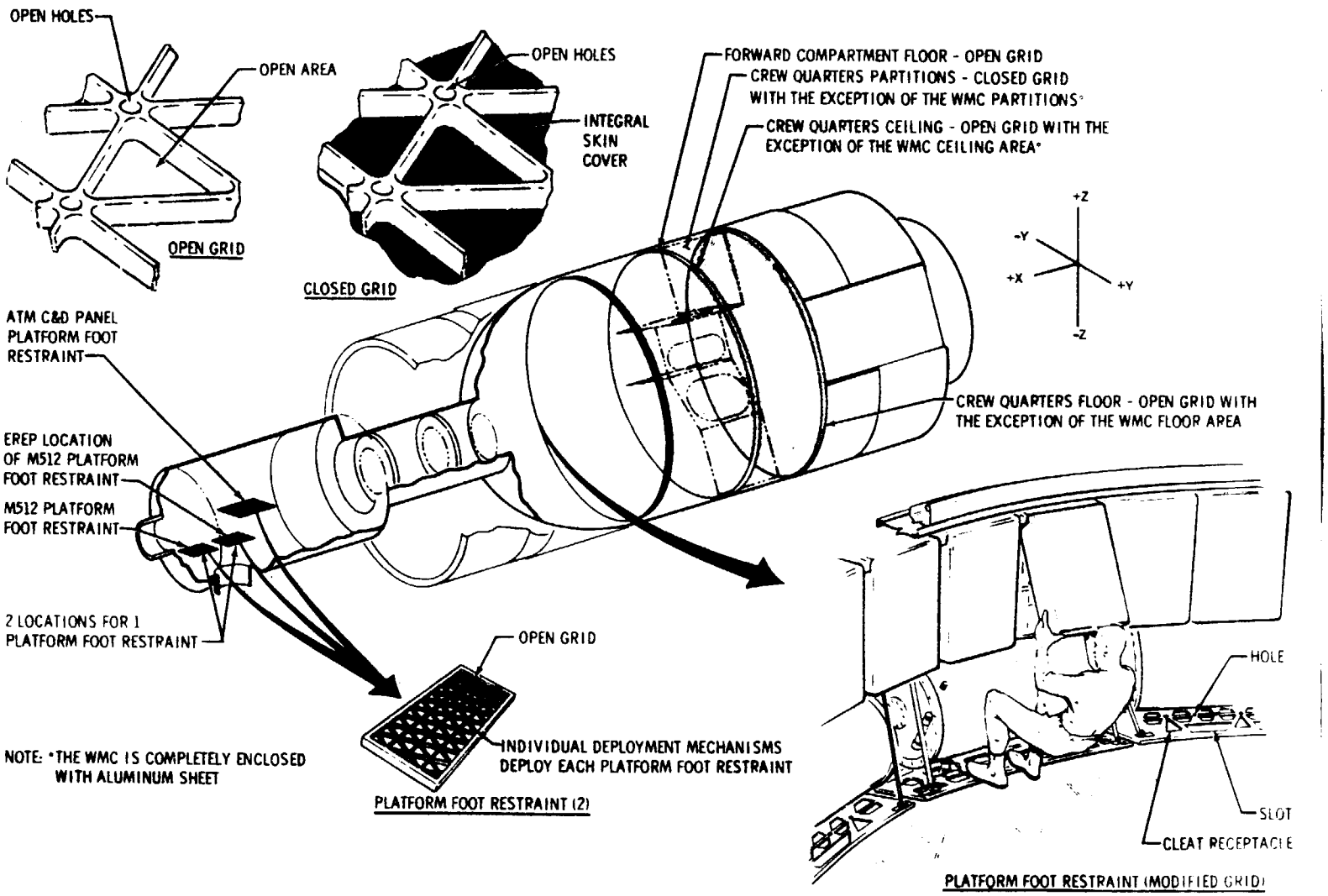
The water tank ring platform was composed of sections of a modified grid section mounted rigidly on the periphery of the forward dome just below the water tank. Each platform section contained triangle cleat receptacles as well as open slots for handholds. The platform was intended to provide restraint and stabilization for the crewmen while they were working at the dome storage lockers and while conducting operational procedures and maintenance on the water tanks.

The M512/EREP foot restraint platform was a portable triangular grid platform 83 cm. (32.4 in.) X 45 cm. (17.5 in.), used to restrain a crewman working at either the M512/M479 work station or the Earth Resources Experiment Package (EREP) work station in the MDA. It was installed parallel to the X-axis in the EREP location. Figure 4 shows the two locations of the M512/EREP platform.



Triangle Shoe Engaged into the Triangle Grid

Figure 3



Platform Foot Restraints

Figure 4

The ATM Foot Restraint Platform was intended to provide a crew restraint for operations at the ATM Control and Display console. Composed of triangle grid, it was approximately 50 centimeters (20 inches) wide and the same length as the ATM C and D console. As shown on Figure 5, it was vertically adjustable in 15 centimeter (6 inch) increments relative to the control console.

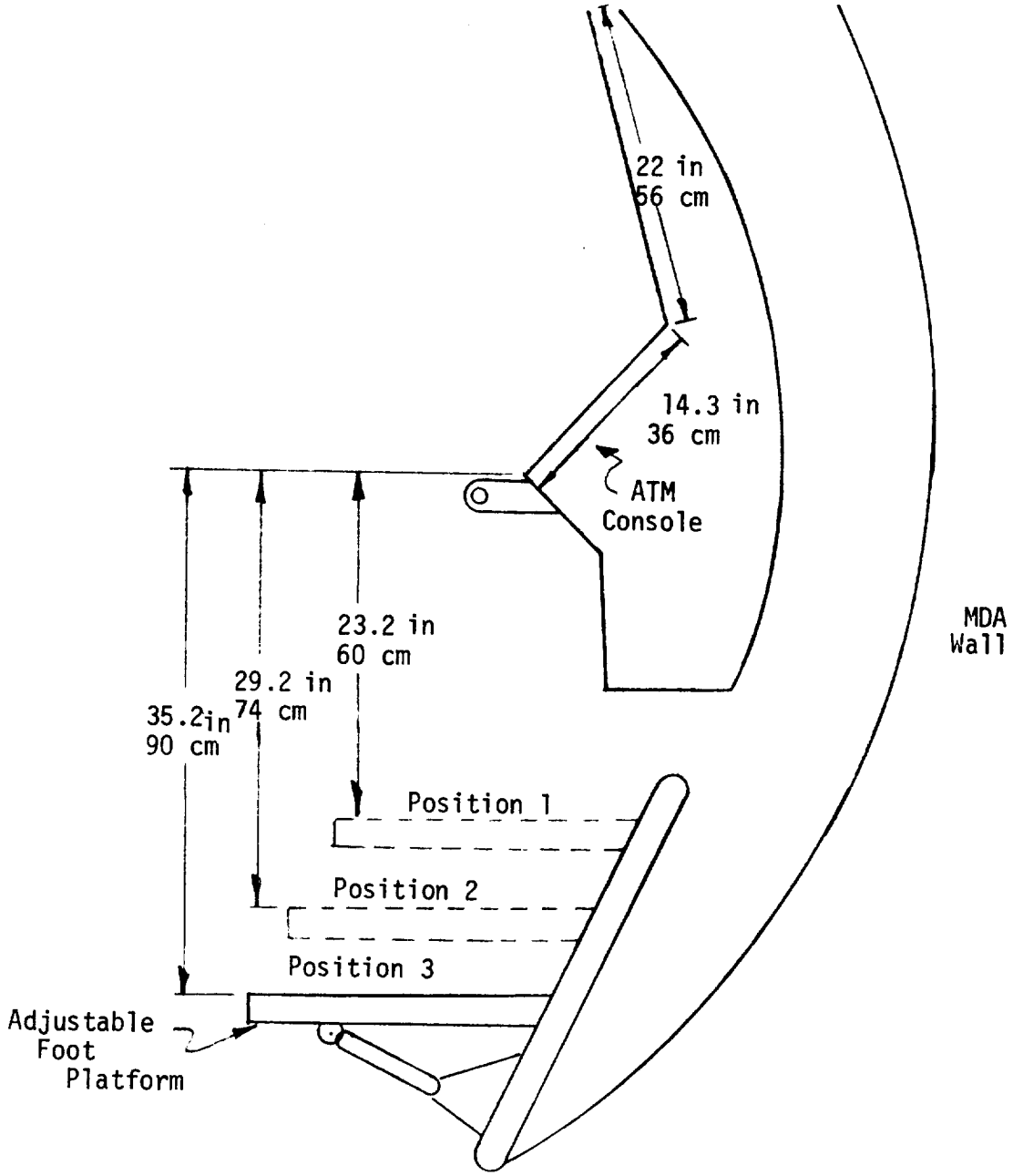
The platform was useable with either the triangle shoes or the ATM chair, a whole body restraint mechanism which will be treated in a subsequent bulletin.

Light Duty Foot Restraints

The Waste Management Compartment (WMC) was fitted with two pairs of light duty foot restraints to enable the crewmen (while barefooted, stocking-footed, or wearing soft boots) to use the urine collector and the handwasher, and to perform various hygiene and maintenance tasks with both hands free. These restraints, shown on figure 6, were installed on the floor in front of the fecal urine collector and the handwashing unit. Each of the restraints was fitted with a velcro lined strap to provide an adjustment to the individual crewman's foot envelope.

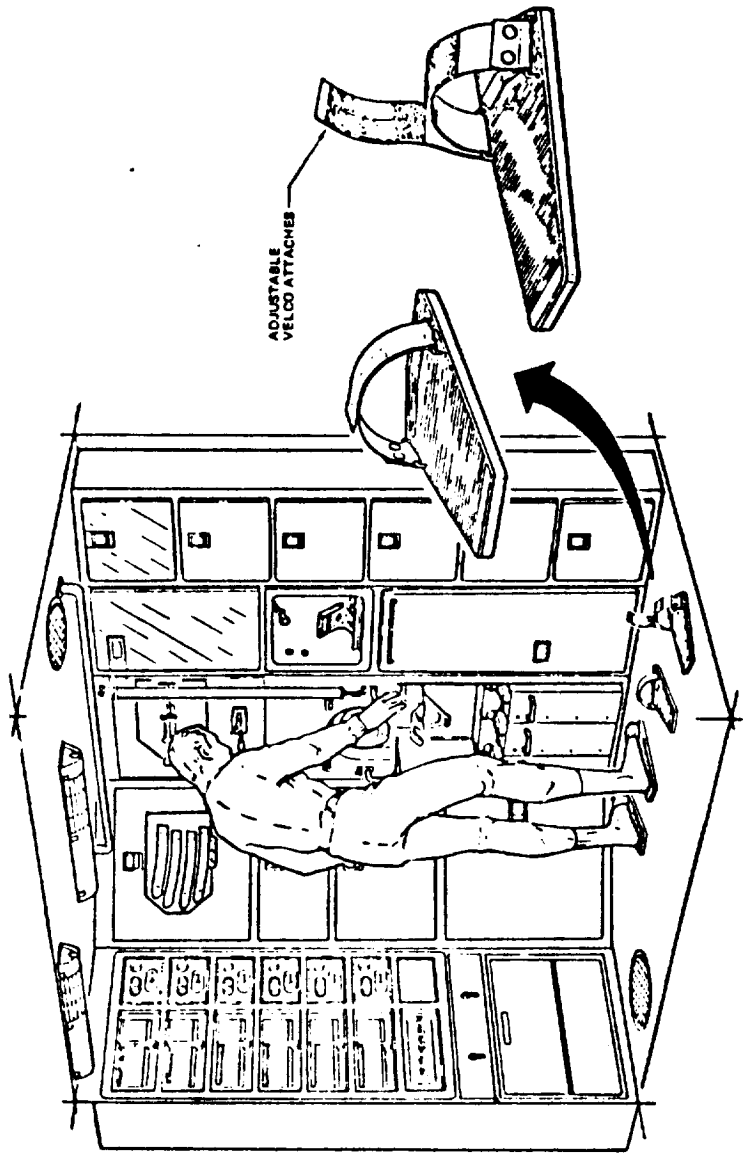
Wardroom Table Foot Restraints

Each of the three food table eating stations were provided with a platform containing two sets of foot restraints; a pair of toe straps and a pair of triangle cutouts.



ATM Panel Foot Platform

Figure 5



Light Duty Foot Restraints
Figure 6

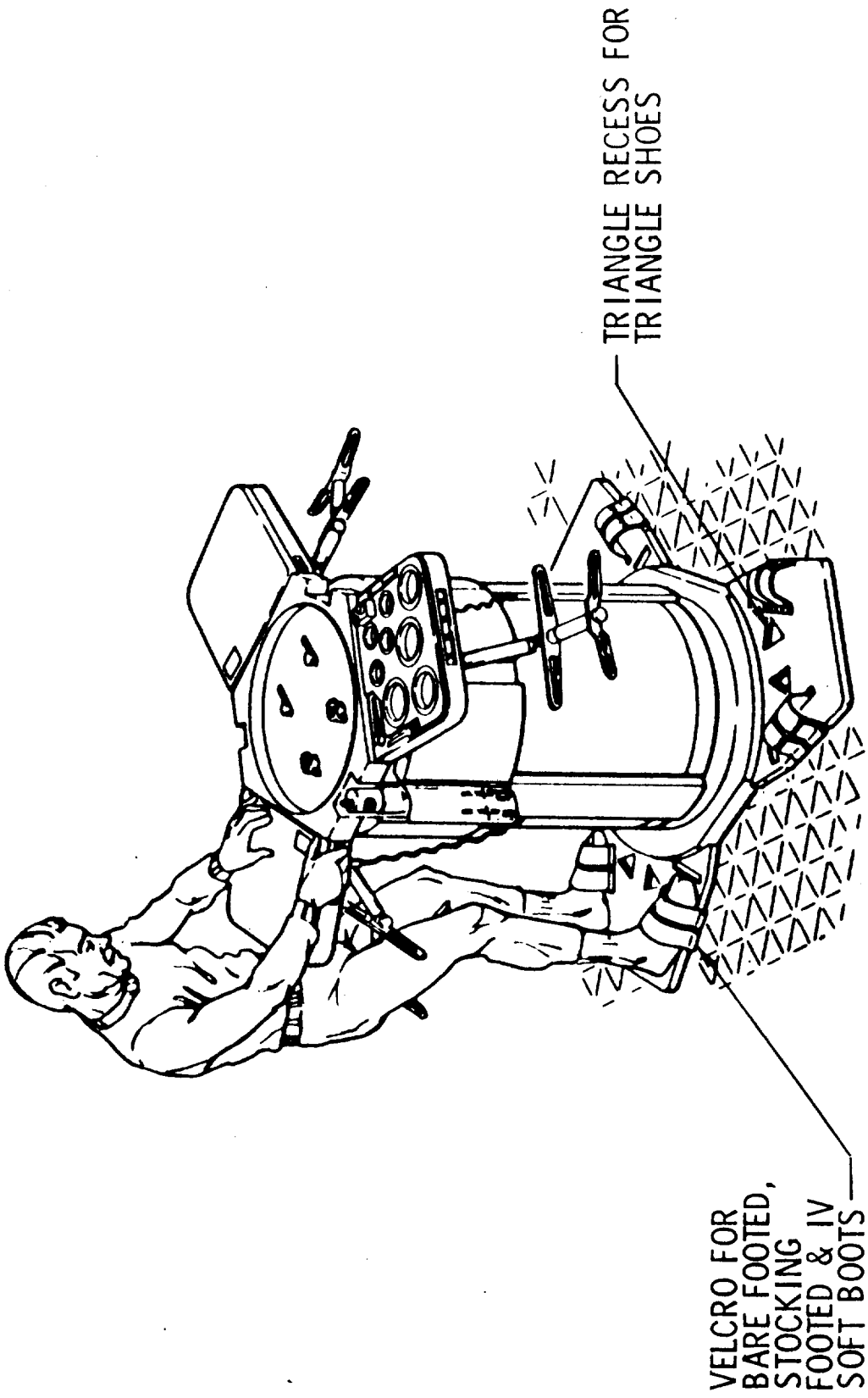
The toe straps were velcro-lined, adjustable straps very similar to the light duty foot restraints in the WMC. Like the light duty foot restraints, they were to be used barefooted, stocking-footed, or with the soft boots provided for the crewmen. In addition, at the toe end of each foot restraint strap, a toe slot was provided in the floor-mounted foot restraint base to permit the crewman to insert the forward end of his foot for added stability.

The triangular cutouts were holes in the platform to be used with the triangle shoes.

Figure 7 shows the food table foot restraint system.

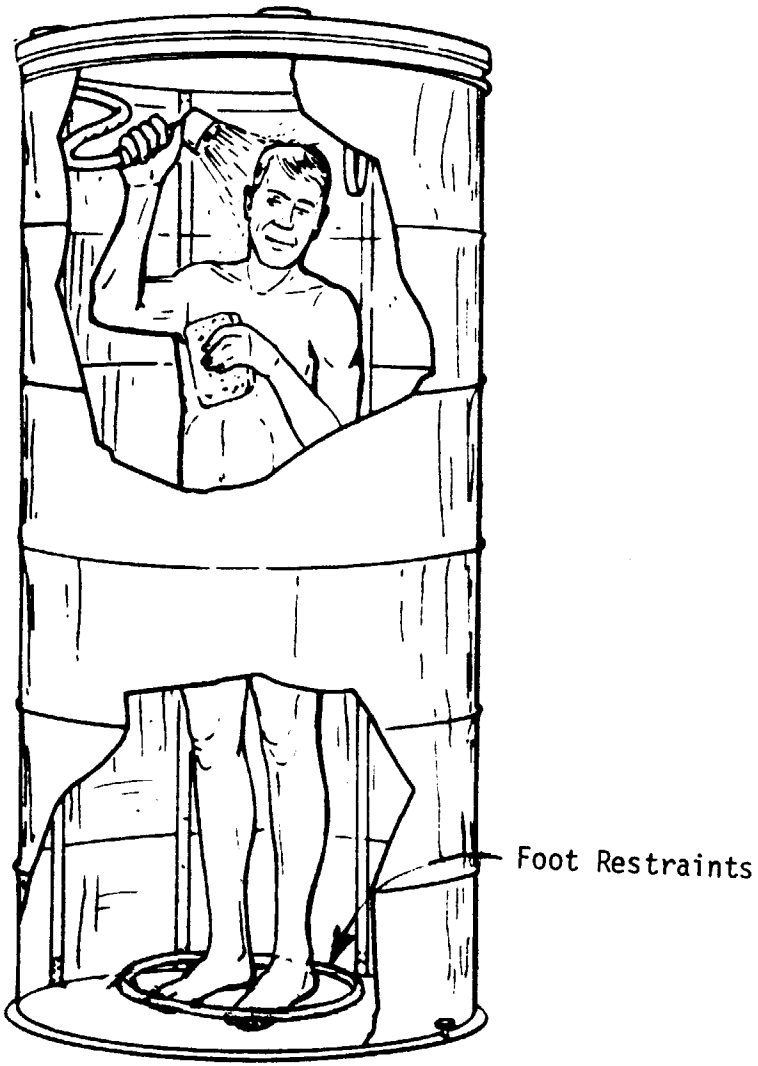
Portable PGA Foot Restraints

Three portable pressure garment assembly (PGA) foot restraints were provided in the workshop for pressure-suited activities. Primarily, the restraint was to provide a drying station for the PGA (after EVA use), restrain a pressure suited crewman near the M509 astronaut maneuvering unit, and to provide general restraint for pressure suit donning and doffing in the forward compartment. It was portable to permit relocation within the OWS during all the pressure-suited activities. The PGA foot restraint shown on figure 8 accepted and restrained the PGA boots through use of a toe-bar and a heel fitting. Heel clips, an integral part of the PGA boots, engaged under the foot restraint heel fittings to provide rigid PGA boot restraint.

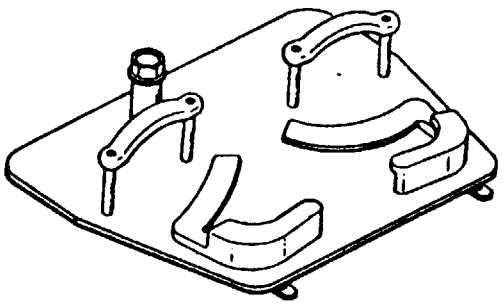


Food Table Foot Restraints

Figure 7



Whole Body Shower Unit



PGA Foot Restraints

Figure 8

Shower Foot Restraint

The shower foot restraint was permanently installed on the floor of the shower. It was doughnut shaped and was to provide restraint for the crewman while he was taking a shower. This restraint is illustrated in figure 8.

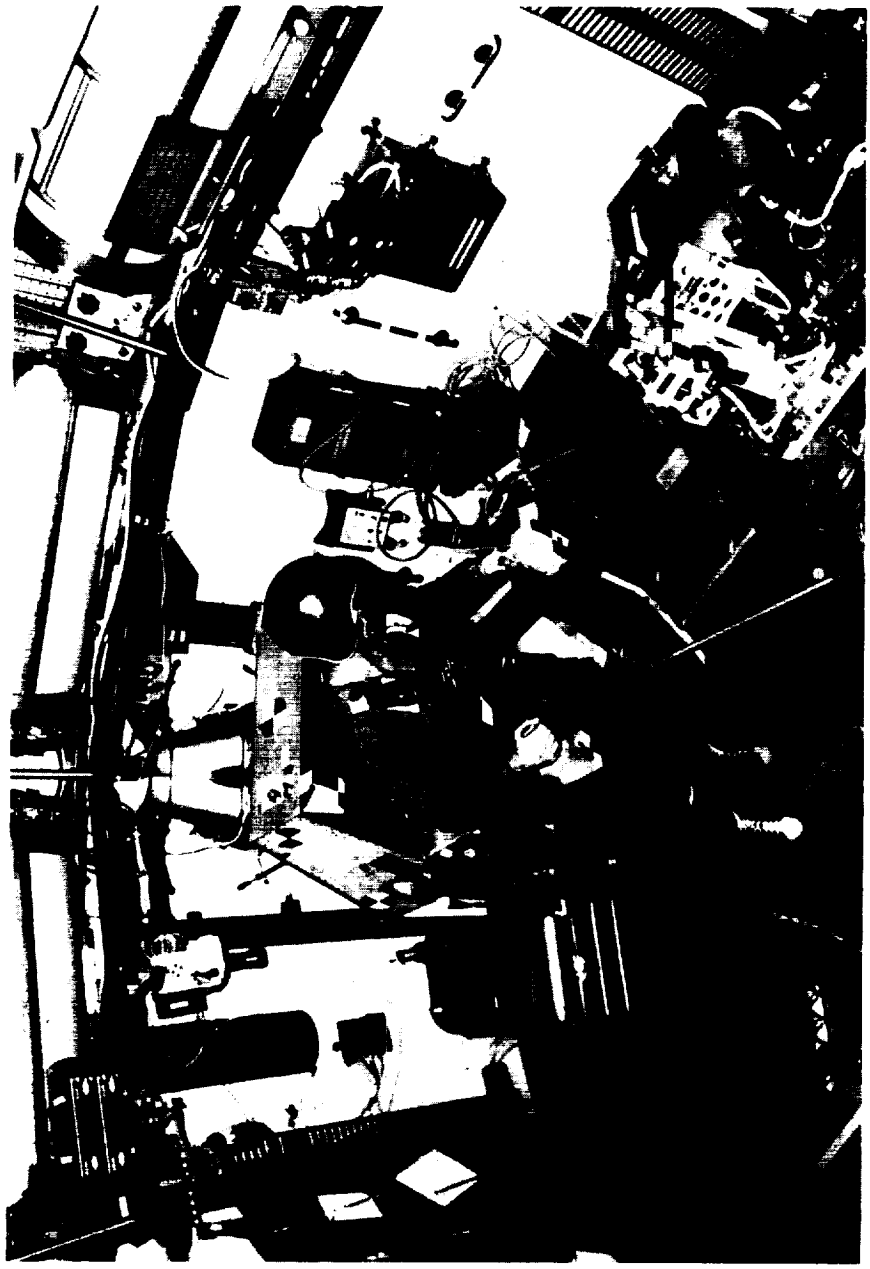
SKYLAB EXPERIENCE

The various foot restraints on Skylab have been analyzed utilizing the air-to-ground transcripts, crew debriefings, and inflight movies.

Triangle Grid

The triangle grid utilized on Skylab as an internal structural element proved to be an extremely good restraint system. The triangle shoes worked very well with it, it was convenient for hand holds and it provided perforations to use with temporary equipment restraints. The flexibility thus attained was widely acclaimed by the crewmen.

The only problem the crewmen had with the grid was the shortage of triangle cutouts. Several comments were made concerning the amount of equipment installed on the grid and the number of holes made unuseable by the supporting structure beneath the grid. Figure 9 illustrates a section of the cluttered triangle grid flooring in the forward compartment. The following references contain crew comments concerning the triangle grid.



Forward Compartment Flooring

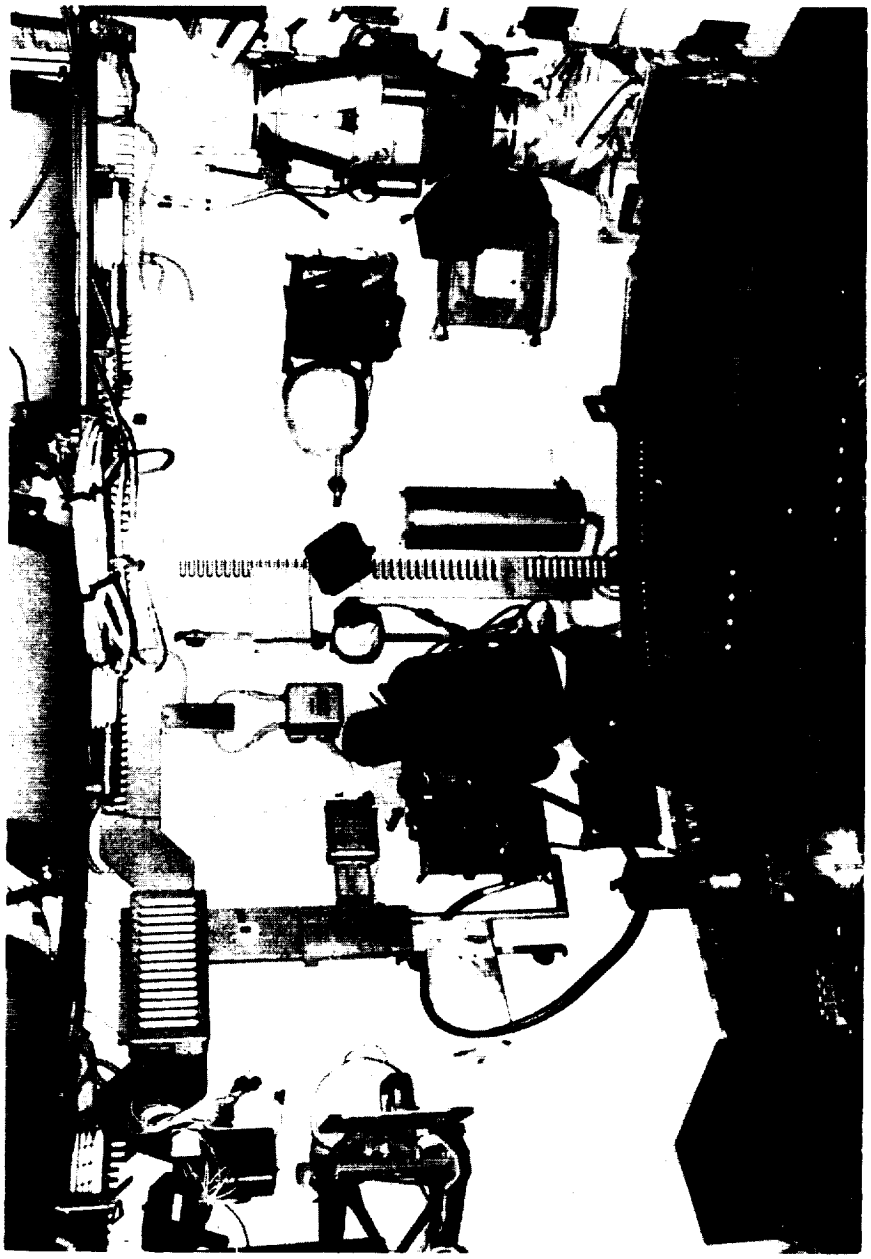
Figure 9

Reference	Appendix Page Number
2	3
3	6
4	12
5	17
8	22
9	24
10	28
12	42
13	44
14	46
15	47
20	61
22	70
24	76
25	78
29	86
30	92
37	108
38	116

Triangle Shoes

The triangle shoes were the primary means of foot restraint aboard Skylab. They provided the crewmen with adequate restraint to perform nearly all of their assigned tasks. The crew rating comments ranged from "adequate" to "excellent". The majority of the crewmen indicated that "they were the very best" restraint onboard.

The triangle cleats on the shoes provided the crewmen with a positive restraint that, once the user was locked into the grid, was completely passive. The user did not have concern himself with remaining restrained, but was able to concentrate on the task at hand. This appears to be the main reason that the triangle shoes were so widely acclaimed. Figure 10 shows a crewman using the triangle grid and shoes on the floor of the forward compartment.



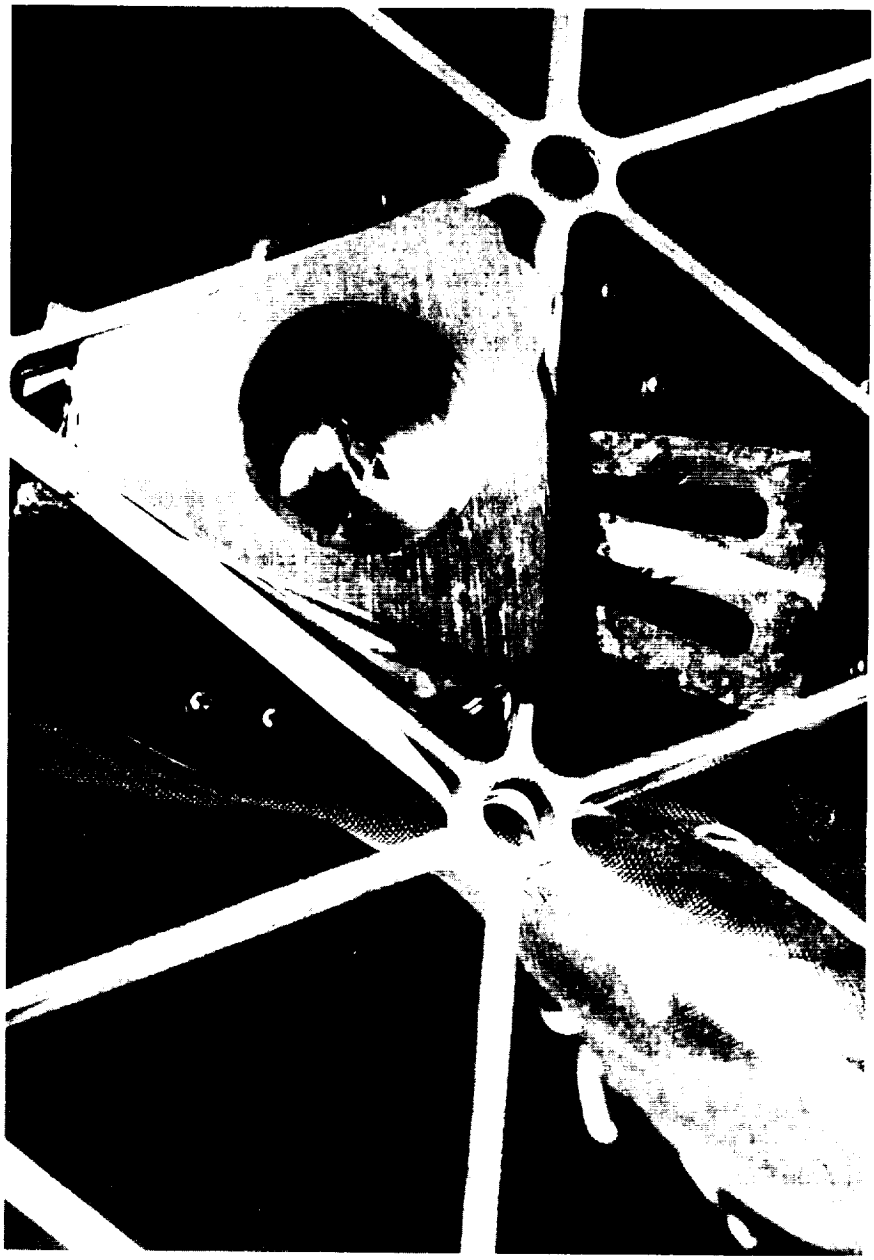
Using Triangle Shoes
Figure 10

However, the crewmen were not totally happy with the triangle shoes. For operation, the triangle cleat had to be inserted into the grid and the foot rotated to latch it. Figure 11 shows a composite picture of the triangle shoe with the cleat in both the latched and unlatched position. The cleat had to be aligned properly with the triangle hole in the grid to permit proper insertion before latching. This was time consuming. Also, at times, the triangular cleat latching mechanism would malfunction and the clearing procedure was again time consuming.

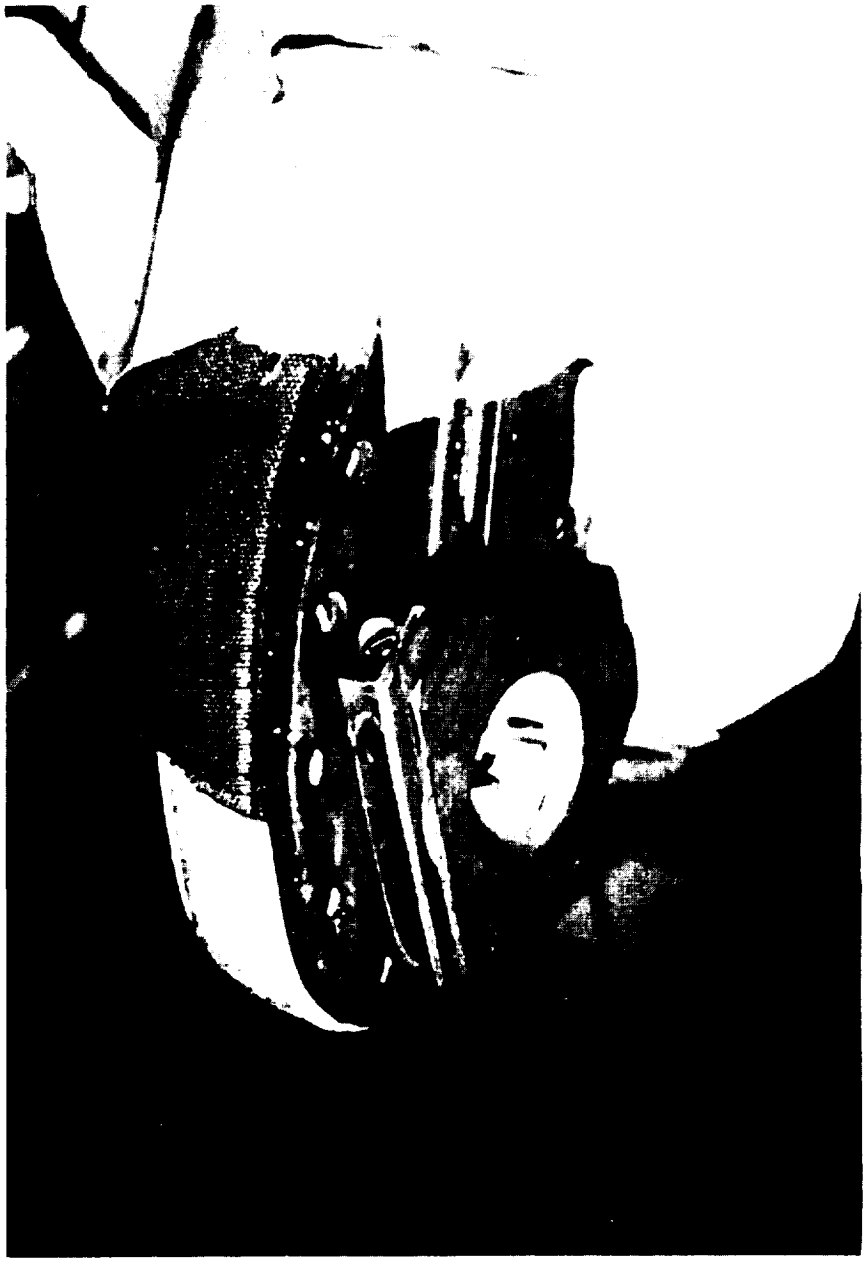
Several of the crewmen did not like the high top shoes or the laces. It took too long to remove the shoes or to change them. However, there were conflicting desires in this area. The crewmen disliked the inconvenience caused by the high tops and laces, but when they had a task that required more than the usual amount of force, they were confident that the high-topped shoes would hold them.

There were a few comments about the massiveness of the triangles on the feet. One of the crewmen said they felt like combat boots. Also, the shoes received excessive wear and tear (ref. Skylab Experience Bulletin No. 6). Figure 12 shows one of the triangle shoes with a protective toe cap installed. The gray tape shown was used to repair a fracture in the metal slide mechanism which allowed repositioning of the triangle in the fore-aft direction.

The conical cleats provided for the crewmen to use instead of the triangles were not a complete success. The crew comments indicate that only one crewman used them to any extent and he used a cone on one shoe and a triangle



Triangle Shoe Operation
Figure 11



Triangle Shoe Repair

Figure 12

on the other. In operation, the conical cleats were much easier to engage into the grid than were the triangles. However, they required the user to keep a constant pressure against the grid in order to keep them from inadvertently disengaging. This was unsatisfactory.

In summary, the triangle shoes with the triangle grid provided the crewmen with the most useful foot restraint on the Skylab. Probably, this was due to the system being a positive and passive restraint. This permitted the user to lock himself into position and address the task at hand, without being concerned about remaining in position.

The following references contain comments pertaining to the triangle grid, triangle shoes, and conical cleats.

Reference	Appendix Page Number
2	3
3	6
4	12
5	17
6	20
8	22
9	24
10	28
11	36
12	42
13	44
14	46
15	47
16	51
17	55
19	59
20	61
22	70
24	76
25	78
26	82
29	86
30	92

Reference	Appendix Page Number
34	102
35	103
36	105
37	108
38	116

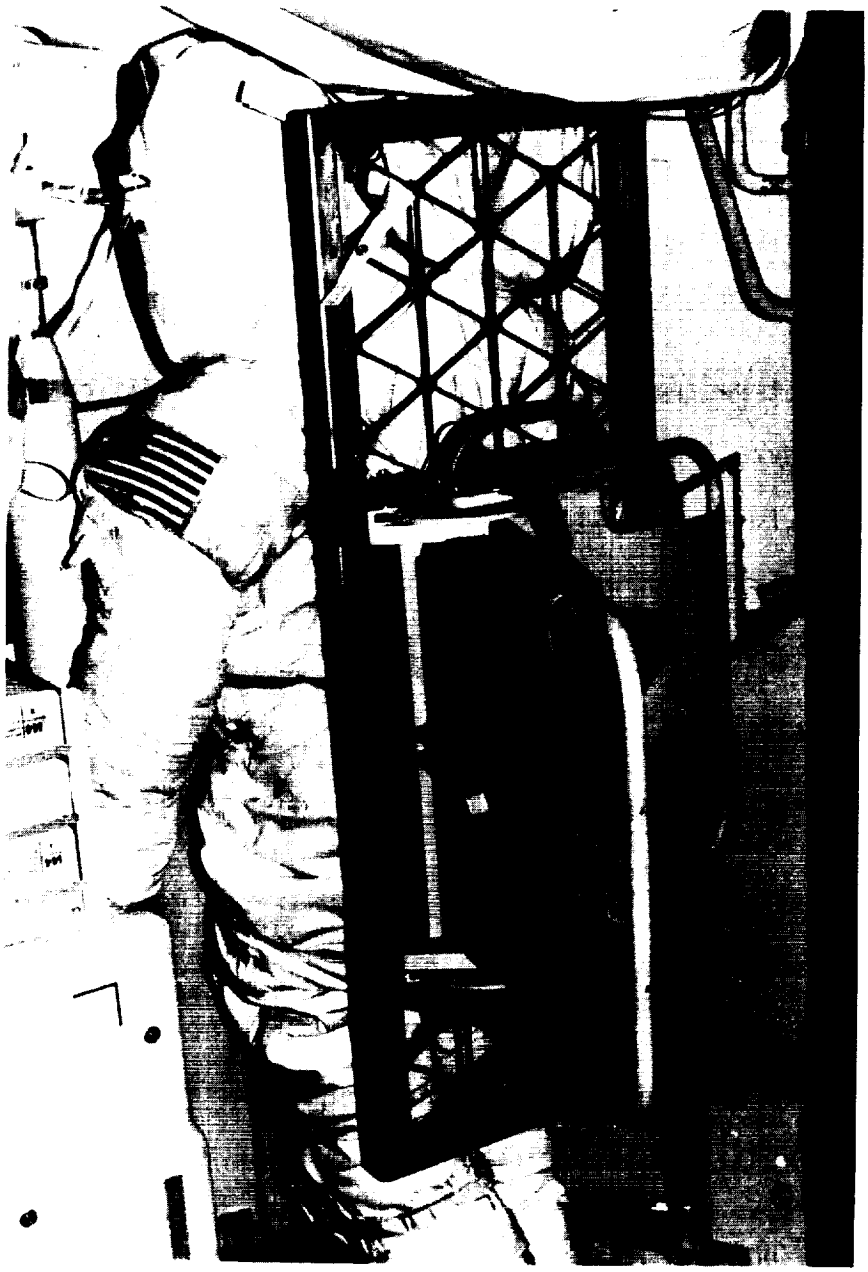
Platform Foot Restraints

The platform foot restraints were triangle grid or a modified form of triangle grid installed at specific locations in the OWS and the MDA. The three locations for the platforms were at the Apollo Telescope Mount (ATM) panel, the M512/EREP platform, both in the MDA and the water tank ring platform in the forward compartment of the OWS.

The ATM foot platform was used two ways. It was used as a support for the ATM chair for the SL-2 mission as well as for foot restraints. Figure 13 illustrates this configuration.

The SL-3 and 4 crews found that foot restraints were adequate to support them while operating the ATM control panel and did not use the ATM chair. The platform foot restraints served the purpose quite well. Figure 14 shows the foot restraint platform and its relationship to the ATM panel.

One problem was noted. The foot restraint platform was adjustable in height to a certain extent but it was determined that it would not go low enough. The crewmen had to maintain a crouched position at the panel that was fatiguing. However, this was due to the relationship of the panel to the foot restraints, not the foot restraints themselves. Figure 15 shows



ATM Platform Foot Restraint

Figure 13

ATM Platform and ATM Panel

Figure 14

a crewman holding himself in the crouched position necessary for operating the ATM panel in contrast to the more relaxed position shown in figure 14. This position was strenuous to maintain for long periods of time.

The following references contain the crew comments concerning the ATM platform foot restraints.

Reference	Appendix Page Number
3	6
4	12
8	22
13	44
15	47
16	51
17	55
22	70
29	86
30	92
32	100
37	108
38	116

The M-512 foot restraint platform in the MDA was used in two locations. It could be deployed from the M-512 experiment station to the EREP C and D panel to provide foot restraint in each location.

The crew comments ranging from "extremely handy" to "excellent" indicate that it worked quite well for the EREP C and D panel. However, it was apparently not located properly for the M-512 experiment work. The SL-4 crew commented that it held them in an incorrect body position. The SL-4 commander used it by inserting only one foot in the grid and "hanging off the end" to complete his task. As a foot restraint, it worked well, its only problem was location.

ATM Panel Working Position

Figure 15

Figure 16 shows the foot platform installed in the MDA

The following references address the M-516/EREP deployable foot restraint platform.

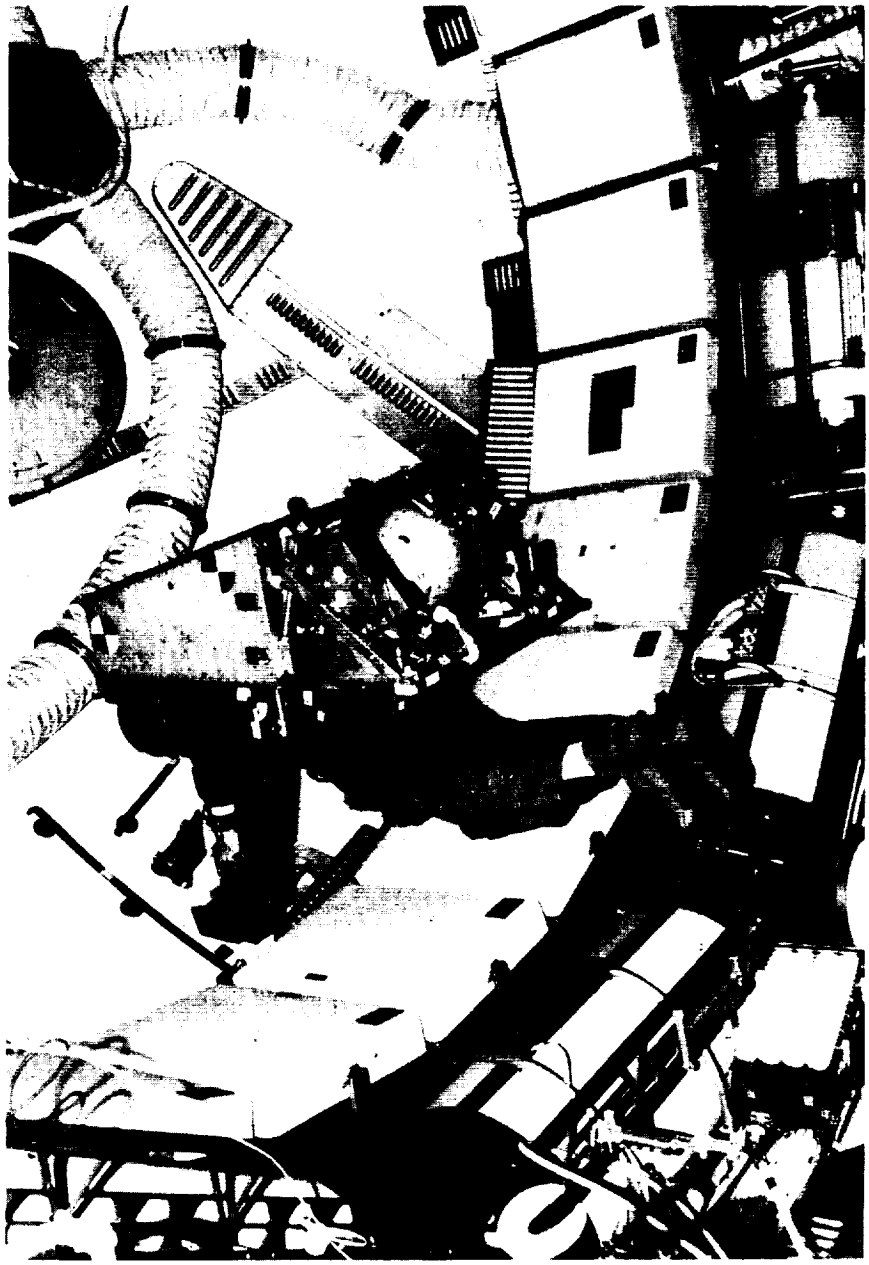
Reference	Appendix Page Number
4	12
8	22
17	55
22	70
30	92
32	100
37	108
38	116

The water tank ring platform was a structure with handholds and triangle cutouts located in the OWS forward compartment, beneath the ring of water tanks around the periphery of the compartment. Figure 17 shows a portion of the ring as does Figure 9. In general, the crewmen found it an extremely useful restraint for working at the dome lockers. One crewman commented that it was handy, but not required, but the rest of them indicated that it was necessary. It was utilized in the usual fashion, one or both feet hooked into it, but it also served as an object to grip with the knees for some tasks.

One crewman commented that the triangles held his toes in such a position that it was very easy for his feet to come out. He had to consciously hold his legs in the right posture to remain restrained. No other crewman mentioned having this problem.

M512/EREP Foot Restraint Platform

Figure 16



Water Tank Ring Platform

Figure 17

The location of the water tank ring platform was not optimum for working on the water tanks. The crewman had to assume a full crouch position if he wanted to work on the water tanks while restrained by the platform. However, this was a function of the location and not of the foot restraint platform.

One crewman apparently had some difficulty working at the dome lockers. His comment indicated that items located high in the dome lockers were nearly out of reach and items located in the locker lids were difficult to get at. In general, though, the water tank ring platform was assessed by the crewmen to be very useful.

The following references contain comments referring to the water tank ring platform.

Reference	Appendix Page Number
2	3
3	6
4	12
5	17
13	44
14	46
16	51
22	70
25	78
29	86
30	92
33	101
38	116

Light Duty Foot Restraints in WMC

There were two pairs of foot straps installed in the Waste Management Compartment. One set was on the floor in front of the waste collection unit and the other was on the floor in front of the hand washer unit. The SL-2 crewmen found that the straps were too stiff to adjust with the velcro adjustment patches. Also, the velcro wouldn't hold well when they tried to jam their triangle shoes under the straps. The straps were located in the right place, and the crewmen commented that they needed them, but they couldn't be used. It was felt that a different, softer material would solve the problem.

A new set of straps was sent up with the SL-3 crew. The crew installed them and the first comments indicated that they were working rather well. Soon, however, the restraints were being described as "poor" to "unacceptable." The new straps were useable for bare feet, but were not functional with the triangle shoes. One of the crewmen commented that even when you got your shoe under the straps, you really had to concentrate on keeping it in or it would slip out. The final concensus among the SL-3 crews was that the straps were not good restraints but it wasn't worth while trying to apply a simple fix for SL-4. A complete redesign would have been necessary.

The SL-4 crew had many vociferous comments concerning the WMC foot restraints, all of them derogatory. They felt that the straps in the WMC were the worst foot restraints in the entire vehicle. As with the other crews, the SL-4 crew thought that the location was good, and the cloth straps worked well enough when the user was barefooted, but were completely unacceptable for use with the triangle shoes.

The reasons for the controversy about the strap restraints become obvious when the crew comments are analyzed. The straps were supposed to be used by barefooted or IVA booted crewmen, and not with the triangle shoes. The triangle shoes were too large to fit under the straps. After the straps were modified, the triangle shoes could be slipped under them, but the metal-to-metal contact between the triangle cleats and the floor of the WMC was lacking in friction and permitted the shoe to slide out easily. Thus, using the straps incorrectly caused most of the problem. However, the straps, even when used correctly, were not completely passive restraints.

An additional problem with the WMC light duty foot restraints in front of the urine collector was that of interference. The cloth straps provided were high enough above the floor to catch two of the urine separator drawers when the drawers were opened. This added to the disenchantment with the straps.

The following references contain comments relative to the Waste Management Compartment light duty foot restraints.

Reference	Appendix Page Number
1	1
3	6
4	12
5	17
6	20
7	21
8	22
10	28
11	36
15	47
16	51
17	55

Reference	Appendix Page Number
18	57
20	61
21	68
24	76
25	78
29	86
30	92
37	108
38	116

Wardroom Table Foot Restraints

The wardroom table foot restraints were mounted on a plate installed on the triangle grid at the base of the wardroom table. There was a pair of foot straps similar to those in the WMC at each eating location as well as two triangular cutouts in the plate for the triangle shoes.

The SL-2 crewmen found that the foot straps were unuseable with the triangle shoes because the material was too stiff to permit a user to put his foot or shoe under it. The triangular cutouts were useable with triangle shoes or the conical cleats, but were not too satisfactory.

New foot straps were sent up with the SL-3 crew similar to those installed in the WMC. The first reports were that the foot restraints seemed good. Soon, however, comments similar to those describing the WMC foot restraints were received. The toe-strap type of restraint was not useable with the triangle shoes. One of the crewmen used them when he was barefooted but no one else indicated that they could use them at all. The triangular cutouts were used with the triangle shoes on occasion. A problem with one of the triangular cutouts arose, however. The SL-3 SPT reported that one

of the cutouts at his eating station would not reclock his triangle cleat when he disengaged it. He would then have to reclock the cleat by hand in order to use it elsewhere. This became quite a nuisance.

The SL-4 crew had the same problem. The toe straps wouldn't fit the triangle shoes and the triangular cutouts were causing the same triangle cleat reclocking problem experienced by the SL-3 crew. After 16 days in orbit, the SL-4 crew asked for and received permission to remove the foot restraint plates from the triangle grid at the base of the food table. They removed the plates and began to use the newly exposed triangle grid for restraint. The crew comments indicate that this solved the foot restraint problem at the wardroom table. Figure 18 shows the wardroom table with the foot restraint panels removed.

The transcript comments indicate the crewmen preferred a standard foot restraint that was useable at all locations in the vehicle. However, they also enjoyed a restraint that could be used with bare or stocking feet at certain locations. This would permit eating or personal hygiene functions without having to put on foot restraint shoes. The SL-4 SPT recommended a portable foot restraint that could be used for bare feet to be installed when and where the user desired.

The following references contain crew comments relative to the wardroom table foot restraints.

Wardroom Table Without Foot Restraint Plates

Figure 18

Reference	Appendix Page Number
2	3
3	6
4	12
5	17
9	24
16	51
17	55
18	57
20	61
22	70
23	75
24	76
25	78
27	84
28	85
30	92
21	99
37	108
38	116

Portable PGA Foot Restraints

Although originally designed for pressure-suited EVA use, the portable Pressure Garment Assembly foot restraints were installed inside the workshop for use as a doffing and donning station for the EVA pressure suits, and as a tie-down station for drying the pressure suits after EVA. They were deemed excellent for these tasks. They were also at several EVA work sites outside the spacecraft and were termed indispensable for this use.

One crewman commented that the astropin method of restraining the restraint was very poor. The location of the tie-down was apparently correct, but the crewmen didn't like the astropin. To quote the SL-3 commander, "It's too difficult to operate and understand and there is just no desire on the part of the crewmember to fool with it all the time."

The PGA foot restraint was a somewhat specialized foot restraint in that it could only be used with the boots on the pressure suit, but it was an extremely good restraint for that purpose. As with the triangle shoes, it was a passive, positive restraint.

The following references contain comments relative to the PGA foot restraint.

Reference	Appendix Page Number
2	3
8	22
14	46
15	47
16	51
29	86
30	92

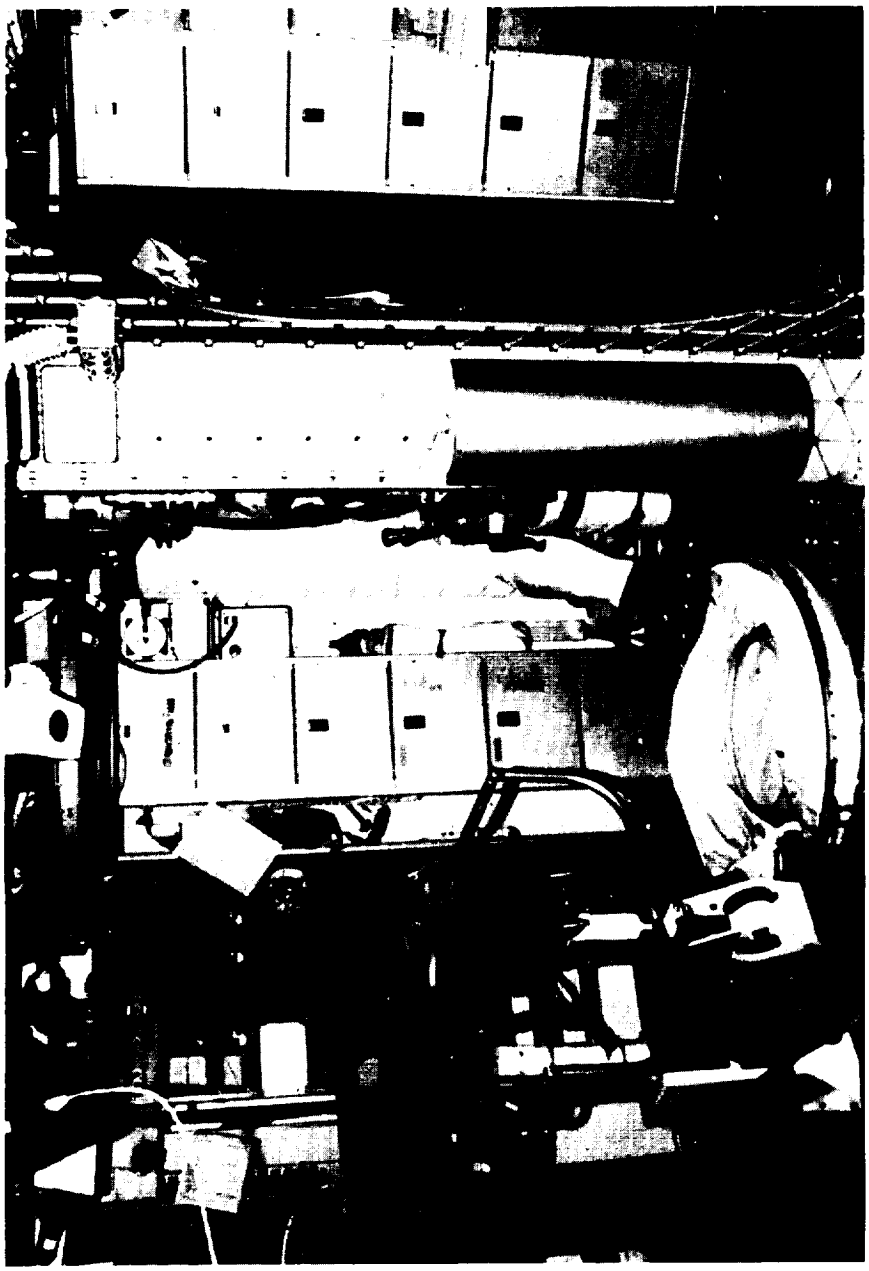
Shower Foot Restraint

The shower foot restraint appears to have performed its task satisfactorily. There were only two crew comments concerning it during the entire program.

The SL-4 crew thought that it worked quite well for shower use, but it could have been a bit softer. The SL-3 crew thought it was great for shower use, but it would not have been too good for use elsewhere. It was not a passive restraint. Figure 19 shows the shower unit and its foot restraint installed on the experiment deck.

The following references pertain to the shower foot restraint.

Reference	Appendix Page Number
22	70
38	116



Shower Foot Restraint

Figure 19

CONCLUSIONS AND RECOMMENDATIONS

1. The triangle grid proved to be excellent as a base for the IVA restraint system. It functioned well with the triangle shoes, provided readily available hand holds and provided easily accessed perforations for equipment restraint systems. The only difficulty the crewmen had with the grid was the lack of it in areas where it was either not installed, covered with equipment, or made unuseable by the supporting beams and intercostal beams.

2. The triangle shoes were an excellent personnel restraint system. Once engaged into the triangle grid, they provided the crewmen with a positive, passive restraint. The crewmen felt that the triangle cleats took too long to align with and insert into the grid. This was probably due to the close tolerance between the cleats and the grid. Another problem with the triangle shoes was the basket-ball shoe type laces. They just took too long to put on and take off.

3. The platform restraints, established for use with the triangle shoes, generally functioned quite well for personnel foot restraints. The only problems noted were due to location of the platforms. The ATM platform was too high for comfortable extended use at the panel, even when adjusted to its lowest position. The M-512 platform was not in an optimum position for use with the M-512 experiment.

4. The Waste Management Compartment foot restraints were highly controversial. The straps, when used as designed (bare feet, stocking feet, or IVA boots), were reasonably successful, but did not provide a passive restraint. They required the user to concentrate on keeping his feet in them. They were not useable with the triangle shoes.

5. The wardroom table had two types of restraints at each eating station. A pair of flexible straps similar to those in the WMC were installed for barefooted use and a pair of triangular cutouts were in the foot restraint plate for use with the triangle shoes. The crewmen did not use the straps to any extent because they wore their triangle shoes nearly all of the time. Only one man used them to any extent. The triangular cutouts caused the triangle cleats to malfunction and become quite a nuisance.

   The SL-4 crew finally removed the foot restraint plate to expose the triangle grid and had much better results with their triangle shoes.

6. The Pressure Garment Assembly (PGA) foot restraint functioned very well with the pressure suit boots. The crews indicated that they were indispensable for pressure suited use.

7. The shower foot restraint apparently functioned quite well. The crews were able to concentrate on keeping their feet restrained and had few problems.

8. Several general foot restraint requirements have evolved from the Skylab experience:

   A. Only one type of foot restraint should be utilized throughout the vehicle as a main restraint. Mixing types of foot restraints creates problems for the users.

   B. The foot restraint utilized must be passive, positive, and readily used.

   C. A restraint for use with bare or stocking feet could be utilized as a portable unit, if it is compact and easily installed in a new location.

RAW DATA APPENDIX

Reference	Source	Page
23	SL-4 Dump Tape 332-08	75
24	SL-4 Dump Tape 332-11	76
25	SL-4 Dump Tape 333-02	78
26	SL-4 Dump Tape 333-09	82
27	SL-4 Dump Tape 336-06	84
28	SL-4 TAG Tape 337-10	85
29	SL-4 Dump Tape 338-02	86
30	SL-4 Dump Tape 344-06	92
31	SL-4 Dump Tape 347-08	99
32	SL-4 Dump Tape 356-06	100
33	SL-4 Dump Tape 025-02	101
34	SL-4 Dump Tape 031-09	102
35	SL-4 Dump Tape 032-01	103
36	SL-4 Earth Resources Experiment Debriefing JSC-08813	105
37	SL-4 Technical Debriefing, JSC-08809	108
38	SL-4 Systems Debriefing, JSC-08833	116

Final
TAG Tape 148-08
Time: 13:53:22 to 14:24:04
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Reference 1

CDR Hank, unfortunately I got every message but 313 and 314. And - I've got 315 - 413, 414-B - 411-A. Send me 314 again, and then I think we'll be all right.

CC Okay. Would you like to have accounting of what you should have up there?

14 00 57 CDR No, don't confuse me. I'm confused enough now. (Laughter) Starting tonight, we've got to get organized on that. These message numbers don't make sense to me, anyhow. And I always sit here and scratch stuff in one spot.

CC Okay. We're - we're looking at that too, Pete. We think there's got to be a better way here. We're - we're also concerned that we don't have a way to check to make sure the messages are getting up. We send them, and we're not sure you're getting them all, and especially since you've been having a few problems with the teleprinter.

14 01 33 CC We will send you 314 again.

CDR Okay.

14 01 51 CDR Yes. It's taking us awhile to get the hang of things. I'd say, this morning with the M110 and everything, it probably took us 45 minutes to an hour longer. But we're finding out things that are costing us time. Number 1, Rusty loses his bet to me. The water system does, in fact, have gas in it. And if you go to 7-1/2 ounces of water in a coffee thing and it won't handle it, you've got to let air out and mess around with it. So food handling, I think, it is taking us a little longer than normal right now than on the ground, and I don't think that's to be unexpected. I think we're getting a little bit better hang on it, as we get better organized. We all had to refresh our memories today as we went through all the waste management stuff exchanging filters, I mean changing urine bags and so forth. So, I think we've got some learning curves to go yet, here in zero-g. There are places that not having restraint is kind of bothering us a little bit. As an example, we're all using triangle shoes and it doesn't work too well with those straps in the waste management

		compartment. Your feet don't tend to stay under the straps, and we can't fasten the straps. They're too stiff to make the Velcro work on them. So you're going to work off the wall or the ceiling. Just a little areas like that. As a rule, moving the big stuff and everything is sup ... just - not like ...
14 03 58	CC	Pete, we lost the last part of that transmission. We handed over sites right in the middle of it.
	CDR	Okay. Where was I?
	CC	Well, we got to the part where you said you were having trouble with the shoes in the WMC.
	CDR	Yes. You can't use those foot restraints in the waste management compartment when you have triangle shoes on. The material's so stiff that even if you hook them over to make them big enough to put your feet in, the Velcro won't stay stuck and you just - you'd have to apply pressure to hold a little friction in there. They just - They won't hold, so you slip out of them. So we're ricocheting off the walls in there. We'll probably work something out here a little bit later. I would say that big boxes - all that big gear. It's no problem at all to handle any of that. As a matter of fact, most of the food boxes were done - one man. So big stuff actually went quicker than expected. It's just a lot of this little stuff getting anchored, doing it, collecting it, and figuring out where to go next. And I think we'll pick up as we go along here.
14 05 10	CC	Roger. That was a good rundown, Pete.
	CC	SPT, what are you doing for it - -
14 05 19	CDR	We've done a lot of other things that are not reflected in the workload, I'm sure. If you can imagine, it's always been said on every flight, you really generate a lot of trash. And that command module was a sight to behold. Now, Joe spent the better part of a couple of hours yesterday just cleaning the command module up. And it still needs some more, you know, just

Reference 2
Final
Dump Tape 151-09
Time: 18:33:24 to 20:04:08
Page 1 of 5

18 33 24 SPT Contamination observation on window - STS window 4. The window itself is clean. However, it has several linty particles on the outside. These come from the fact that on all STS windows, which I neglected to mention before, this is one of the most noticeable looking into the Sun, is that as you open and close the window cover, it rubs over that silver foil insulation and frays it. And the backing material appears to be some kind of cloth, and that causes linting.

19 13 14 PLT Hello, B channel. This is the PLT with the M487-3 Alfa. Going to page 3-3 on restraints and mobility aids. The fireman's pole we have not used yet because we have not needed it. The OWS dome and wall handrails have, on occasion, been of some use primarily for stability. They are not used for transiting the dome or forward areas. We do that by point-to-point translations free floating. Same thing with the STS handrails and the MDA. We've generally found that you just move about this vehicle by, as I say, just pushing off and translating from point to point. You use these handrails, but you use whatever is available; a surface - The mol sieve surface, the back of the ATM chair; whatever you need just to give yourself a little tweaks to keep yourself trimmed up. The handrails are not needed for translation. Handholds and handrails are needed for stability. And on occasion, for example, yesterday when I vacuum cleaned the plenum inlet screen at the top of the dome, I found the ducts themselves very handy for footholds. I'd wrap my legs around them and use that to stablize myself while I was vacuuming the screen. The triangular shoes in the grid have come in very handy. The mode we've gotten into usually, most of the time, is you only hook in one shoe. Consequently, we've been trying off and on, we'll comment on it later, on two triangles as opposed to one triangle and one mushroom.

19 15 03 PLT The water tank foot platform has been used on occasion when working in a dome locker. I think it's been necessary and useful. Again, the usual use for myself has been to hook one foot in one of the triangular cutouts.

19 15 21 PLT The ATM foot platform has been used so far only to hold the captain's chair. We have been using the captain's chair almost exclusively at the ATM.

The portable foot restraint platform in the MDA: the CDR used it yesterday for an EREP run, and it appeared to work quite well. He said he was quite happy with it. The portable PGA foot restraints we have not used. Portable handholds: the only place we've really used them is in the vicinity of the bicycle ergometer, and we - were attempting to figure out how in heaven's name we can really ride that bicycle and get some work done in a fairly reasonable manner. Portable equipment restraints: you could never have too many of those, ... tethers, bungees, universal mounts. The one thing that you're always looking for in a vehicle and we never - there are never too many straps or Velcro - correction: not straps, snaps - never too many snaps or Velcro patches in the vehicle itself. The ATM seat/backrest restraint has been used. It's got the airline pipe belt on it, which is a necessity. Velcro just doesn't do the job in zero g for a belt. You look at the belt on the M131 chair, and it is practically negative, useless. The conical shoe cleats, we are still evaluating. They come in handy at times in that they are quick and easy to use relative to the triangles; however, the one drawback to them is that occasionally they get caught in the grid when you don't want them to. Let's see now. Waste management: I, as a new boy, and hearing horror stories from the old heads, have been ... deliriously surprised with the operation of the waste management equipment, the fecal collection and the urine collection both. The air stream on the fecal collection unit works quite well. You must - I have found personally that you must use the belt, and I must use the handhold and pull myself down on the seat to make sure you get a good seal. The better the seal you got around the lid of the seat, the better the equipment seems to work. The urine collection equipment: once we found out that it didn't work right unless you had a fecal bag in, otherwise you don't get enough suction to the urine receiver, works quite well. It is - it stays surprisingly clean, and after some 4 days of use, the urine receiver and hose has no odor, which I was concerned about prior to launch.

19 19 37 PLT

Okay. Pressing on to page 3-4, food management. The wardroom table is, as far as an eating station, is very nice. Just like training. The thigh restraints I use two ways: either as designed or I also hook

my knees over the innermost of the two crossmembers. I find that I personally don't use the footstraps at all. I just hook my knees over the thigh restraints and, with light pressure on the toes against the table pedestal, maintain myself in position there. So that covers the first three, I guess. The food reconstitution dispenser is - is good. Let me look at your definitions.

19 23 20 PLT

Okay, tape recorder. I find that for I don't know how long I've been holding the record switch up on this COMM box instead of the intercom box. Hopefully, (cough) I got the run down on work restraints. I got page 3-3 on there. I'll do page 3-4 over again. The wardroom table is convenient. It's - we've been using it just as we have in training. The thigh restraints I use two ways. One is to put my legs in in the ... method. The other is I hook my knees over the innermost of the two crossmembers and with light toe pressure against the work table pedestal, I maintain position that way. The foot restraint - for either the straps or the triangle fittings I haven't been using at all. Food reconstitution dispenser: those water dispensers need some kind of handhold in their vicinity.

19 24 16 PLT

It's fairly difficult to press down on it, especially a juice bag, which is filling and unpleating it's accordian style at the same time. I think we need some sort of small fingerhold not a handhold, right around those water dispensers. The water gun works, as I suppose you know, it's easy to use. It takes about three shots of water before you get chilled water, but that's all right. The food tray has worked out fine. The beverage dispensers are too small. Each accordian dispenser that you put in there for each accordian container we put in there seems to be around 1.05 times as big as the drawer's design. The drawers need to be about 10 percent bigger than they are. They're hard to open, hard to close, hard to get drinks in and out of. The freezing dispenser has worked fine. The eating utensils have worked fine. It is a necessity that they be held in place magnetically. The teaspoon, I still think, is too small. Although I have brought my large spoon down out of the command module. The miscellaneous column, the sleep restraint is extremely useful, versatile, and very good, I think. You can

Reference 3

Final
Dump Tape 154-03
Time: 13:44:09 to 14:18:19
Page 1 of 7

13 44 09 CDR — Hello, friendly tape recorder; this is the CDR on S183. The time is 13:44; it's that sequence number 1, has been initiated on star field number 252 on plate 006.

13 45 45 SPT — Okay, friendly B channel; this is the SPT at 13:45 with an M487-3A, subjective evaluation of the following equipment items. The OWS fireman's pole has not been used. I believe, that if it were in place, it would be a handy helper for - moving rapidly down the workshop and for carrying large objects with one hand; however, the strap, while it probably doesn't do as good a job - satisfactory job - and we don't have any present intentions of rigging the fireman's pole. Okay, the OWS dome and wall handrails, again, are adequate for their jobs, maybe even give them a very good. Their job is not to hand-over-hand it - you never hand-over-hand it around that place, unless you've got a lot of equipment in your hand and are carrying a large package, for instance, that you want to make sure you don't get loose. You ordinarily fly from one location to the next, and all you need when you get there is something to grab onto, and the handrails are perfectly satisfactory for that. I think the handrails in the STS, are very good. Once again, they're not for hand-over-handing. They're for steadying oneself at work stations, stopping when you come flying through the hatch. You want a handrail to grab to torque yourself around on to get into position to look at a panel. Having the panels circum - the handrails circumferentially around the various panels is a very good thing.

13 47 53 SPT — Triangular shoes. We all wear the triangular shoes most of the time. They're not at all necessary for translation or walking. And, of course, we never use them in that mode. They're extremely handy for keeping oneself steady at a work station while doing a job, leaving both hands free. We have several kinds of mushrooms and buttons for the shoes up here. My personal preference now, the way I'm going, is to wear the large mushroom on my right foot and the triangle on my left foot. The

	triangle is quite helpful when you want to concentrate on something else for a few too many minutes - want to lock yourself in and stay locked. However, it's a lot of trouble getting it in, and a little trouble getting it out. With two triangles on my shoe, it drives me up the wall, because it takes me 30 to 45 seconds to get locked in at a spot, which is a waste of time. Between the mushrooms, I've evaluated the medium and the large. I thought the medium mushrooms were adequate, but they were too easy to slip out with, and you had to concentrate too much on keeping your foot pressed against one corner of the triangle so that the mushroom wouldn't pop out. With the large mushroom - this is not nearly so bad. They're fairly easy to slip in and they hold very well. Sometimes they're a little trouble getting out of. Trying to get it out in a hurry, you have to sometimes look down and figure out which direction you have to go. I think, for that reason, Paul prefers small ones. I prefer big ones. In summary, triangle shoes are mandatory. If I had to make an improvement, I would have loaded two pairs of shoes on board for each crewman, so that I might leave the triangles in one of them to ride the bike with and put mushrooms in the other.
13 49 55 SPT	The water tank foot platform is handy but not required. If you're working at a dome locker for a period of time, it is very pleasant to be able to stick one foot into a mushroom or a triangle into one of the holes in the - in the foot platform. So, if you're just going there to get loose item of equipment, you can steady yourself on your hands, then open the locker, steady yourself with your hands again, reach in and get what you want, and steady yourself again, and close the locker on the way down. The portable EREP foot platform, I have not used. The portable PGA foot restraint, we have not yet used. The portable handholds have not been used. The portable tether hooks, I am currently using to try and rig ropes with handles to hold myself down on the bicycle seat while peddling the bike. The portable tether hooks hook you to the floor grid and the ropes are attached to them, and

various locations can be selected either forward or aft, of the - of the pedals to try and find the right axis along which to exert the force. The big difficulty here is that we didn't think, when we put all the extra junk in the experiment compartment, how handy those triangles were going to be.

13 51 23 SPT And on the right-hand side of the bicycle there is virtually no open grid work or holes between triangles to put things in. The shower is much too close to the bicycle. Okay, portable equipment, these three: The straps are extremely useful. The short straps, I haven't used too much. They are really too short to tie things to. But the long straps and the equipment straps are extremely useful. I have right now, the entertainment tape recorder strapped to the radio noise burst monitor here - monitor here at the ATM panel. Bungees we find very useful, particularly down in the wardroom and so on for temporary restraint of cameras and checklists. Smaller things than that, such as pads, the bungees are not adequate for me, because they - the pads slip out and makes it too flat or too smooth. But anything that's got hooks on it, like a camera, works out very well under a bungee.

13 52 29 SPT The - One item of equipment that is a pain in the neck, and it's not useful at all, are the large clipboards that snap in the standard snap pattern. Everytime you touch one of those things, they come flying off. On the other hand, it's a major operation to get them back on the snap. And we just made a bad mistake by assuming that we could snap something to a flat wall, especially something with any standoff, such as these clipboards have, and then exert any force against it. The ATM seat is very useful, although you don't really sit in it, obviously. You have to push the seat belt down pretty tight ah - if you want your back to be supported. I find it useful because it gives you a body-centered restraint from which you can work against. You can reach the whole ATM panel,

and you can reach the comm box, and the TV SELECTOR switch on your left. You can't reach the VTR on the right, and you can reach - myself, I can only reach the very nearest checklists and the checklist compartment. But, of course, by loosening the lap belt you can then reach the VTR, you can reach above you - all the lockers - you can reach the radio noise burst monitor, you can even ziggy over and see what time it is on the MDA panel, bring yourself back to the ATM. And you can work either with or without the foot rest. Without the foot rests - I mean the lap belt - without the lap belt, it just serves as a sort of a - nook. You know, your - body floats between the ATM panel and the chair, and it's useful, too. I think it's a great tool. I've already talked about the conical shoe cleats. I called them mushrooms. The fecal collection equipment - works, much to our surprise, if one is careful and takes it slow. Stand by.

13 56 46 SPT Okay, B channel, where were we? Fecal collection equipment. The air-flow method of collection appears to be practical. A larger air flow, I think, is mandatory on future mission designs. This one is marginal. However, the method appears feasible. And the urine collection, not only is the method feasible, but the flow is probably adequate or very close to it. The urine flush water dispenser, we have not used. Let me get back to fecal collection equipment to mention something I said on channel B before. Stand by a minute.

13 58 01 PLT That's all I could see, so I didn't bother.

13 58 08 SPT Okay, B channel. The lap belt on the fecal collection unit is a Velcro type thing, and it should be a positive lap belt, such as the ATM chair. The handwasher is quite useful, although I think, in future design, we could arrange an enclosed one, so that you could actually work with water, rather than having to soak everything up in a washcloth. It's - it's extremely useful to have a water dispenser in the head for taking a sponge bath and wiping things down, and a handwasher serves that function very

nicely. Okay, the - I talked about the lap strap. The handholds are fine, they're well-placed, and they certainly are necessary - in the fecal collection system. The handwasher handrail, let's just say, in general, that it's nice to have some handrails around the waste management compartment for parking you body. The foot restraints in the waste management compartment are not good. The locations are okay, except I notice that two of the foot restraints tend to interfere with the CDR and the PLT's waste compartment drawers, opening of same, something we ought to avoid in the future. The problems with the foot restraints as they are: number 1, they're Velcro; they are not - very easily adjustable for size; and they keep coming apart. Number 2, they are not large enough to admit the cleated shoe, and just the bare or slippered foot. And that problem has to be thought through and some better foot restraints provided. And foot restraints are very handy and even required in there.

14 00 09 SPT It's nice to have a small, closed compartment like that. You can go in there and close the door and kind of bounce around. The waste management system's ceiling handrail - didn't know there was one. The light-duty foot restraints, I think we've talked about. Our drying stations are adequate and handy. Things dry out very rapidly up there. And as for the zero-g shower, it's a pleasant experience, and I think it proves the - the feasibility of the principle that man can live in a small close space with water, and he's not going to drown, because the water does not fly through the air. It sticks to whatever is there, mostly you, partly the walls. Again, I think the air flow in there is grossly inadequate. The method of containing the water and getting it into a, you know, compartment where you can throw it away, is not good. It takes forever to dry both oneself and the walls, using the inadequate little vacuum cleaner that we've got, and some better method ought to be come up with. But the principle of crawling inside a shower and spraying yourself down is great.

14 02 17 SPT Okay, channel B, we're back to food management equipment now. The wardroom table, the eating station is fine, except for the comments on the foot restraints, which are of the same type as the head foot restraints, which are inadequate. The thigh restraints do their job, but require foot restraints along with them in order to be maximally useful. And the option exists of hooking the mushroom into a triangle. We do that sometimes. Again, there aren't enough triangles underneath these various working stations, in particular, in the wardroom, because so much of the area has been used up by structures of various kinds. So the idea of having a slip-in foot restraint there is good, but we need a better kind.

14 03 06 CC ... Hawaii at 14:14.

CDR Roger.

SPT Okay, food reconstitution dispenser, no problems, really. You need a little something to react aginst when you're pushing the food down into the water dispenser. Generally, you either brace yourself with your thigh restraints or you put one hand on the edge of - of the food table and pull at that while you push down with the other hand. The water gun is just fine. It's an excellent piece of equipment. The food tray is okay, except that the friction set should be spring clamped or something of that sort, so that it can tolerate food cans and, in particular, drink containers of a wider dispersion of sizes. A very common event is for a small food tray - small food can or drink container to just go wandering off, because it doesn't stick in the friction sets. Aside from that, it's a fine thing. The food cans are okay, with the split-the-seam proviso. The beverage dispensers have a couple of drawbacks. They are adequate; they are doing the job. But aside from the failure-type things, such as valves that leak air backwards and seam failures that we've had, none of which, by the way has been catastrophic, the problem with the beverage dispensers is that the tendency, when they are half full or less, is for them to suck air. And the nozzle you have to flip into the top in order to drink has a tendency to stay in place and allow them to suck air, which gives you a mixture of half beverage

Final
Dump Tape 154-06
Time: 16:23:21 to 17:44:38
Page 2 of

SPT Then you can point - you can slew back - to get the prominence toward the center of the crosshairs. You know your roll is right, you know your left/right is right, and the only thing you have to estimate is your up/down. End of message.

16 34 13 CDR Hi there, friendly tape recorder, this is the CDR, on day 154 and 16:35; for an M487-3 Alfa, subjective evaluation, guide 1. Work restraints/mobility aid: The OWS fireman's pole; we have yet to rig the pole, and we will do that sometime later on in the flight and give you an evaluation. Right now, we have been using the strap that runs from the dome to the grid floor, and that has been sufficient for us to transport ourselves back and forth, and I'm sure that the fireman's pole will be in the same category. The OWS dome and wall handrails have worked out very well. I rate them very good and - and really it's just that there might be a few places that you may add additional handrails, but we have not found that to be a problem in all, and the wall handrails, along the wall itself around the SAL, of course, we haven't really used. We've spent most of our time locking ourselves into the grid floor with our shoes, or holding onto the SAL experiments to hold ourselves in place while we operate them.

PLT This is Skylab. We're going to do a ... expose ... hold ... That ought to hold ... Nikon ...

SPT Wilco.

PLT While you're at it, how about the color of ...

16 35 59 CDR And the STS handrails are all right. But unfortunately in the STS itself, - the way you hold on to the handrails and so forth - we've had a great deal of difficulty in not touching the instrument panel and circuit breaker panel. And even with the guards on them, we have most likely with our feet, tripped a lot of circuit breakers and thrown a lot of switches inadvertantly,

and have not been aware of it at all. So, although I rate the STS handrails as adequate, the previous reasons were ... and just adequate and there is more to the problem than just handrails up in the STS. (Music) Now the MDA handholds and handrails are really quite limited, and there is enough equipment sitting around to find places to anchor yourself. But we could have done, I think, a lot better in thinking out how we were going to work up there with placing handholds and handrails in the MDA. So I'm going to rate the MDA as poor - because of the various items of equipment, and the difficulty you have in holding yourself down in there.

16 37 30	CDR	The water tank foot - foot platforms, for myself, works out extremely well. I find it quite comfortable to lock my feet in the water tank foot platform to work out the dome lockers. I've had no trouble with any of the tasks that have been involved. And I rate those as excellent. The ATM foot platform has worked well. We had the chair located at the center of it for the person that's working at the chair, another person can lock in at - either end and can talk over the SIA or to get into the 126-M126 checklist box; which we have to on occasion, and you don't bother the person who is working the ATM. So that has been good to work at. I rate that as excellent.
	CREW	(Music)
	SPT	You copy those, Paul?
	PLT	No, I didn't.
	CDR	Now the portable M512/M479/EREP foot platform: We have only used it in the EREP station so far, and I have used that at the EREP station to operate the C&D console. And I also rate that one excellent. The portable PGA foot restraints - I have not had an opportunity to evaluate yet - we have not done any suited exercise, and so we have not used them. We have found that we have not used any of the portable handholds. ... no reason to have portable handrails; and therefore,

		we have not used them. Portable equipment restraints - used no tethers, but we have used bungees quite extensively. We do use the universal mounts. We find them quite easy to use, and find them very handy. They work well on the camera. They work well on the portable fan and the TV. There are no big complaints or anything about the universal mounts. I think we can do a better job on bungees. I - I don't know exactly how. Fireproof straps - the fireproof strap has a lot to be desired. It doesn't work its way through buckles well, and is not very strong. And springs have a tendency to get permanently stretched - and the same bunch - the same strap type of material on either end of them makes them cumbersome to operate, although we do use them. I rate these spring bungees as adequate and I rate the tiedown strap as poor. I commented a little earlier on the ATM seat/backrest reatraint. I rate that as very good. Some of the improvements the SPT did, we have found that we would tilt it a little bit differently than you would expect it. In evaluating it at one g and - it does turn out that it probably would be nice if it were padded with some softer material; however, it's possible if you worked the back and seat pad arrangement out a little bit differently, you wouldn't quite get the same pressure points that you get. With that point ... I find it very good. From this - the sense of having to work the ATM panel being locked in at just my feet ... this chair, I have to rate the chair excellent. I think we would have got very tired, very rapidly, using our toes just to lock in to the ATM and to work the ATM.
	SPT	Hi, Paul.
	PLT	Hi, Joe.
	PLT	We got to talk - -
16 41 31	CDR	At this time, as of yet, I have not had an opportunity to evaluate the conical shoe cleats

with the grid. I have been using the regular triangle shoes - shoes - and they are - I would have to rate as adequate. They do have some shortcomings. If you're only working with one foot locked in, it isn't a short cut at all - for the duration of unlocking a shoe - that as it unlocks, it's a slow down. We have found out that it is possible somehow - at least my ... out without it being unlocked and then when you go to stick it back into the grid again, you find you can't get it back in. Then, when you find out that it's caught in the conical lock -

16 42 26 CDR Waste management and hygiene equipment - this whole area turned out to be a fantastically pleasant surprise. I probably was most adamant against the fact that I didn't think the fecal collection equipment would work, and we have all discovered pleasantly that it works in an absolutely outstanding manner, and I have to rate it as excellent. The urine collection equipment also, I have to say, after all the evolutions, works in an outstanding manner. I have to rate it as excellent. As yet, we have not used the urine flush dispenser. The hand washer does dispense water very well. We've had no problems with that. I rate that as excellent. The fecal/urine collector lap strap and handholds are an absolute requirement to the fecal collection equipment working correctly in that you do have to pull the cinch down and hold yourself down very close and firmly on the seat in order for the air flow to work correctly. And when you do do that, the fecal collection equipment works excellently, and therefore the straps are necessary. Perhaps - I'll call them straps right here - perhaps they could be designed to do a little bit better job of holding you down on the seat, than they do right now, but we'll work on it. ... this one does ... that equipment.

16 44 08 CDR The waste management compartment hand washer handrail is a very usefully placed handrail. We use it all the time. I have not used the waste management ceiling handrail at all. And the waste management compartment light-duty foot restraints are,

I think, excellently placed, but leave a lot to be desired, in that the strap over the foot restraint, which is made again out of that fireproof, not-very-strong material, is a pain in the neck. And it hangs up the CDR's urine drawer going in and out all the time. And they are difficult to fit. They don't hold well because of the excessive amount of plastic material, whatever it is. However, when you do get your feet in them, especially in front of the window, or using the mirror when you're shaving, washing your hands or anything, I find them quite adequate and ... very well, and they are excellently placed.

16 45 13 CDR The drying stations work all right. The towels have a tendency to float out into the work area. Due to the air flow, we have found ... does an excellent job. The shower worked very well, but it took longer than expected. The amount of water is adequate. It sprayed the water on and it's very good. The only thing is the amount of time it takes to dry it up afterwards, and that takes a fair amount of time. There could be improvements to the water container and that ... on the back side of where the controls are. It is difficult to fill and maintain a ... bring it around and back to the other side but these are all minor, and the shower works ... operate every day, make you feel very good. And other than the fact that it takes a little while to glop up the water, I think it's very good.

16 46 20 CDR The wardroom table - it's adequate as to the area ... off-duty rather than anyplace else. Thigh restraints worked very well. However, I think that the wardroom light-duty foot restraints and they - give them very poor again, because I can't use them because they're flat on the floor and the material is too stiff - it's hard to get your feet in them, and therefore most of the time, if I should have my triangular shoes on, I lock into the triangles. Next one. The water gun works very well. We have have no trouble with the water gun. The food trays are excellent. We had no

was going to be so big that we were going to get, you know, all this stuff that we have in there ... the best way to have it. ... a airlock, to go to a dome locker ... just take aim at wherever it is you want to go and take off. You can get pretty close. Every day longer that we're up here the better we get at that sort of thing. I know that over the - the line to the SAL - the SAL power cables ... and the SAL instrumentation cables are stowed in the dome locker, and it's nothing to just give yourself a little shove with your feet and you are right straight up in front of it ... in there and work in those lockers - the lockers that have the heavy gear in them. ... down in them ... equipment ... are well placed ... for ... people that I had no trouble working on any of the EREP experiments.

22 35 02	SPT	Another thing about that water ring, foot restraint, or whatever we call it is that I had a couple of tasks to do like stringing the water tank hoses and my favorite one - the portable water tank and a couple of other things, and again I - you can't hook your feet in them when you're working on it. And I just laid along horizontal or parallel to it and again clasped it with my legs, because you really don't want to sacrifice that hand for stability. You want to be able to maintain your stability with your feet. ... we better - we better move on.
22 35 53	CDR	Yes, ... let's talk about those things. The triangle wedge is a great way to lock yourself in except it looks like you could lock yourself almost anywhere and that's not really true at all. ... looking for places to lock in that we're working at especially ... equipment-like ... to get the heaters ... down here, something like that. ... all I can see just to find a place to lock it - the right side of the bicycle - they ... ergometer to shower. ... to try it. Yes. And, well, I ... to try it.
	SPT	... if you wear the button instead of the triangles then there are more places to - You're not quite as constrained as ...

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22 36 46	PLT	I think the ~~high~~ TT21-angle grid invention is a good idea - -
	CDR	Oh, yes. Yes.
	PLT	- - because you need something to stick your feet in. And this - the whole experiment compartment is kind of one-g oriented, and a lot of people have always said, "Aw, you don't need that. You'd rather - you know, you'll be hanging from the ceiling. You'll be hanging from the sides. We can make the nomenclature upside down." We don't do that. We, at least I, operate in here pretty much in the same body position as I did in training. How you get from one place to another is grossly different. You push off the float. But once you get there, you want to be stabilized by the legs or the thighs and the feet someplace where you can do the job. Yes, Pete mentioned there's one corner of the experiment there. It is so crowded and cluttered that I can hardly believe it. The one where the shower is. Between the centrifuge, the shower - and, that's a busy place. Fortunately, you don't have to step over the shower to get to the tool kit and that tool kit is the best idea that - anybody's had. We've been into that many times since activation for a lot of different reasons. One other comment, when you translate to a surface, it's good to have something like the blue handrails on the surface to grab hold of and torque your body or stop a pitch rate of whatever you're having. If it's a flat surface, you tend to do some scrambling around. In the wardroom, I noticed that the edges of the locker stanchion are recessed so that you can grab them with your fingers. That's a good idea on somebody's part. So much for that question. How about - you want to say anything about the compartment - the head - What are we talking about? Yes. We got carried away on that. Okay. Yes.
	SC	...
	PLT	Which restraint device offered the most assistance in performing tasks; which the least? If you want to pick out one device, in my particular case, I would

have to say the triangle shoes. I really think they are the most useful, versatile restraint device we have around. Let me think about it while we pass it on to Joe.

SPT I agree with that. I wish we had two pairs of triangle so I could put the triangle triangles on one and the button triamgles on the other and then I'd wear the button triangles for moving around all day and the triangle triangles to ride the bike. The least useful device maybe has been those cloth strap foot restraints that are in the wardroom and also in the head. You need something like that at that location, but the cloth straps don't stay put. They are too small to get in with your shoes. They are too hard to adjust with - with triangle shoes, that is, and they're generally cranky and poor design and we don't use them much.

CDR ... foot restraints. It may be - -

SC ...

CDR The other thing is ... the head ... said earlier ...

PLT ... elastic ... I think you already said it. ...

CDR ... Now, I ... all the way back ...

PLT Yes. Yes. Here's nonassisted verbal communications, that is hollering, how effective has it been?

SC Not very effective.

22 41 31 SPT Yes, right. Not very effective. At 5 psi, I guess, the sound doesn't - is not as strong or doesn't carry as far or something. Within the MDA you can - we always do - you're almost always hollering at somebody within the workshop, I think. You certainly don't shout - -

SC ...

SPT - - I know. It doesn't - that's right. We're all hoarse all the time. You certainly don't try to shout from the workshop to the MDA. That just flat doesn't work. The intercom boxes for IVA comm have been all right; for voice recording, they've been safisfactory;

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Time: 03:04:37 to 03:17:56
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03 04 37	SPT	Hello, B channel. This is for the follow-on crews and the stowage people. Is that - our triangle shoes, the shoe part is starting to wear out at the toes. Again, you drag your toes a lot. You tend to - You tend to try to stick them in the floor and we're having to put gray tape on them. We recommend that the other crews either bring extra shoes or bring some kind of toe protectors or something with them. End of message.
03 17 56	PLT	Hello, tape recorder. This is for Captain Bean and other follow-on crews. We strongly recommend that they bring up some sort of substitute materials for the plate in the foot restraints and the waste management compartment. The ones that are in there now are, for all practical purposes, unusable. And we think that - as I said, they ought to bring up something better. End of message.

END OF TAPE

CDR Yes, well, let me answer a couple of them.

CDR Question number 2 about EREP swabs. We got EREP swabs coming out our tape recorder. Swabs coming out our ears.

07 07 24 CC You've got a big squeal there. What did you say?

CDR I say, question number 2, which was how about an inventory EREP tape recording, cleaning swabs. We've got those things coming out our ears. Those guys don't need to bring any up on SL-3.

CC Okay, copy.

CDR And question number 3, the SPT does have all that data in his log book, and he will return it.

CC Copy.

CDR Number 4, and should the redesign of the waste management compartment foot restraint include acceptance of triangles, mushrooms and bare feet. If they just used a different cloth on the existing ones right now they will accept all of thos anyhow. And it's just that the cloth - it's that cloth that they're using - it's plastic and it just doesn't allow you to open it up or close it down, depending on what you're wearing on your feet at the time. They ought to be softer and longer.

07 09 01 CC Roger.

CDR We do recommend you look for some restraint for the rotating litter chair. What we're using is just a plain old strap up here and it does the job but it's not too suitable. And on S082A, did the flare execute flag indicate flare 082 is operated in the FLARE MODE. To the best of the PLT's knowledge, it did. Got number 7 - well question number 7, I'll have to put on tape. And CDR, 8, what is the status of 553. Wheel 1 is completely done on 553. Wheel 2 has the three balls that are not - that do not come off - done, and two that do come off - done. And I'm ready to return that for them to examine the whole wheel.

CC Roger.

PLT Oh, so do I. Talking about wall openings, only through a window down here.

CDR Yes. Well, wall openings - it all depends on where I am or where I'm going. I'd like to ... a lot around here.

SPT I'd like to give one other comment ... eating and waste management ... four hours a day possibly ... medical requirements. ... still cost a lot of time and electrical and ...

CDR Seven: "How satisfactory is the frequency of change of bedding and clothing?" I think it's been satisfactory on the flight. I would have preferred a few more - certain items of clothing. ...

PLT Yes, that's - I agree with you.

14 08 34 CDR Okay. That's the of 487-2 Charlie.

14 08 39 PLT Yea!

14 09 16 PLT Hello, tape recorder. Here's the PLT with the rest of his M487-4 Charlie, which is the subjective evaluation guide 1. I just realized that I was remiss, negligent in not filling out for you verbally before. On the equipment items: the fireman's pole we have now put up and - as we just finished debriefing on this round table discussion 2 Charlie, or whatever it is. A. Mobility aids: From the dome duty experiments area is handy. We were formerly using the strap. We put the fireman's pole up just to try it, and due to its rigidity, I personally prefer it, because you can just grab a hold of it, and you can change directions using the fireman's pole far better than you could with the relatively slack strap. The handrails: we still don't use them, the same as the STS handrails and the MDA and mobility aids. We use them all as stability aid when you're working in the area, but not as mobility aids. Triangular shoes in the grid I still think are good. That goes for the water tank foot platform. ATM foot platform we only use now as a base for the Captain's chair. And even though I don't strap myself into the Captain's chair, I do kind of half sit, half lie at it with my toes hooked over the

little tubular foot rest thing that goes around the bottom. The portable 512 EREP foot platform, I have not used for 512 or anything I've done there; I've not found it required. I have only used it once or twice in its EREP location and found it extremely handy for that. Portable P.G.A. foot restraints are very good and required. Portable handholds have not been used by me. Portable equipment restraints, we use a lot of. What can I say? They're there; we used tethers, bungees, universal hubs - the whole works.

14 11 25 PLT

ATM seat I just discussed. The conical shoe cleats, I don't like them. I haven't used them since I evaluated them the first couple of days because - for two reasons: One is, you have to keep changing back to the triangles to get on the bicycle ergometer anyway, and we have been riding the bicycle ergometer everyday, if not for experimental purposes, then for PT and general conditioning. So you have to change it. The second being that with those cones on there, you tend to catch them in the grids.

14 12 01 PLT

Under the waste management area, the fecal collection equipment and the urine collection equipment have turned out to work quite well. We, again, had a discussion of this on the two Charlies just a few minutes ago. It worked well. I - I can't say anymore about it. The urine flush water dispenser, we haven't used. The hand washer is a requirement - It's an absolute necessity. It worked well, except we yesterday changed out the valve. The valve has gradually become more and more plugged until we were hardly getting any flow through it, and we changed out the only dispenser valve on board yesterday. The fecal collector lap set and hand holes are a requirement. They are well designed. I give them a "very good" using your gage. The belt tends to hold me a little far back on the seat. I'd prefer to have something that, if you could, - that pulls more straight down, but other than that, it's been very good. The handwasher handrail is a requirement when using the washrag squeezer, and that's about the only time I use it. I may subconsciously - or unconsciously use it other times. The ceiling handrail comes in handy on occasion. Again, that - it's occasionally and without thinking. The light-duty foot restraints, we have griped. You've responded to these. Essentially, they're unsatisfactory.

CONRAD (CONT'D) for 28 days was adequate. The only thing I would like to add was more socks and maybe a few more shorts.

WEITZ I had a change of shorts for every other day, which was good enough for me.

CONRAD When we changed our shorts, we kept the used ones to exercise in. Those sweaty shorts we would throw away. We got 2 days of normal wear out of them, then we would wear them for 2 days for exercise. We put the fresh ones on for working. That worked very well.

WEITZ In moving around the vehicle and stabilizing yourself you use your toes a lot. You drag your feet over the grid, you stick your toes down in the grid, you hook your toes under things. We mentioned it, we have some pictures of it, we wore out the toes on both shoes, both the triangle shoes (the ankle-high shoes) and the gold boots.

KERWIN I wound up not using my slippers at all. I used my triangle shoes from morning until night. I would change from the triangles for the bicycle to the little mushrooms for general moving around and working. My general comment is that it serves as a restraint system. Wherever you stop to do a job, you want your feet restrained. I'm awfully glad we had the triangle shoes and the triangle grid all over the floor.

WEITZ Yes, the triangle shoes were extremely useful.

KERWIN The side restraints worked out better than I thought they would.

WEITZ I used them all the time. I never used the foot restraints. In M487 we debriefed the over-the-top straps which were the same as the ones in the waste management compartment, essentially unusable, because they are too stiff, unadjustable, and have a preset. They have been folded over in the same place for a year. I didn't use the triangle because I didn't wear my triangle shoes very much.

KERWIN We hardly used the portable handholds almost anything serves as a handhold when you're arriving at a location. Foot restraints are needed at the work stations.

Thermal control - We didn't have any thermal control, we just lived with what we had. I thought I was most comfortable when the temperature was lowest. The 70- to 75-degree region was reasonable.

WEITZ When we started getting up to 77 to 78 degrees, we could really tell the difference. I think that's because I am sensitive to radiant heat. I could just feel the heat coming off the OWS circuit breaker panel and through the walls.

KERWIN I'm a believer in the comfort box now. If the wall temperature is warm you begin to get uncomfortable about 75 or 80 degrees; if the wall temperature is cold, you could probably live with air temperatures of 85 degrees.

WEITZ It made more difference than I thought it would to use a little portable fan to blow warm workshop air in over the workshop heat exchangers.

KERWIN I thought the MDA was too cold for comfort most of the time.

WEITZ It was quite comfortable when we had enough power to turn the MDA wall heaters on and until the vehicle temperatures started coming up to the point to where they thought they had to turn them off. Below 65 degrees in the MDA was cold. You radiated body heat to the cold walls.

KERWIN I'd go to my sleep compartment and get my jacket when I was going up to the ATM.

CONRAD Let me go back to one thing on the triangle shoes. I noticed on both feet there were ways I could put a load on those triangle shoes that made them come out of the grid work without unlocking them. I think you will see in the M151 movies where I will stop and turn the triangle up and reset the lock because I could pull my feet out of those triangles without unlocking the shoes. I never did figure why.

KERWIN Let me mention one thing that happened to me three times on the bicycle. I would change my mushrooms to my triangles to go ride the bike. If you don't cinch the wingnut down good and tight in those triangles, I found that they came loose while I was pumping the bike. Once the thing is loose there is no way to unlock it. You move your foot and thing doesn't unlock. I would up having to take my foot out of the boot, get off the bike, finishing unscrewing the shoe from the triangle and go get a screwdriver from the tool kit and wedge the thing until it unlocked it.

WEITZ I found the only way you could satisfactorily tie the triangle down is with a pair of pliers. You couldn't do it tight enough with your fingers.

We used most of the tools.

CONRAD We used just about every tool in the tool box.

WEITZ We are sure glad we had that extra set in the MDA. One ratchet fell part on us, and that ratchet is a valuable tool to have. We have a backup in that one torque wrench. It is bigger and more clumsy.

CONRAD Joe used the tool caddy for activation but I never needed it. I used my baggy pants pockets to carry the tools.

CDR Well, I still think that there is a little powers. It happened that the two crannies were there was just pure luck. I'm not convinced in may mind that the particular right hand cranny on the real world panel was big enought to take that hook. I spent alot of time trying to get that hook in there.

PLT The hook swelled up in the vacuum

CDR Riiiiight. The cranny closed in the vacuum.

PLT Ok

SPEAKER On the film transfer task, I think you have commented on the film transfer boom operations but is there anything you would like to add on the speed or smoothness of the booms.----------

SPEAKER How well did the floor grids work as compared to a solid floor and things like that. Do you thing the gridding is better for floor surface than solid------

SPT Well, we needed places to lock the feet in, and it worked great for that. In fact, occasionally, I was impatient with the smount of structure that was bolted to the floor, because it took away triangles that I could have used. But the floor was extremely solid.

CDR I would thind that any future design, where you want the mace multi-layered vehicles or something. That without complicating up you ECS function. I think it was damn good and it worked real well from the ECS flow point of view, that we had, you know, not solid floor. That air could pass through that floor and it made the circulation system work damn well, and I think that for future design if you want the solid floors, you would be defeating yourself. Cause I don't think its necessary to have a solid floor. And I think that not having a solid floor lends itself more to adapting for foot restraints and stuff where needed..

SPT The only penalty you pay is that you can't make the compartment light tight. and those compartments that you want to have light tight are goint to have to go somewhere.

PLT Well, we did discuss at one time, now the penalty you pay is the fact thay you have quite a few food spills of varying magnitude in the wardroom. Some of them went throught the triangles to end up who knows where.

CDR Yeah, but I think its easier to clean up the food containers than to pay the penalty of making the eating compartment completely solid.

PLT You are the one that said the grid wasn't any good, not me. (laughter)

SPT No, no, Paul's right, I remember making a comment-------

PLT I knew somebody did

SPT The dining room might ought to be solid or you're going to pass air through it so you might want to look at filters or some kind that would be removeable.

PCT You mean you could---

SPT liquid squashes itself.

PLT You could do it just like we did it in the waste management compartment.

SPT You could do it that way too, with screens

PLT Its no big thing, I think it would only be a factor if you had a three year continuously manned station, for example, maybe something like that.

SPEAKER Would curtains in these be a hinderance, rather than a help, in order to solve this particular food transfer problem?

SPT Anythin ghat you have to rig and unrig would be a nusiance.

CDR Not food transfer now, he's talking about strictly free-----

PLT spillage

SPEAKER free floating food

CDR Well, we can attribute, we can attribute 95 percent of what spills that got away from us to two food items

PLT Yeah

CDR You know, roast beef and filet mignon gravy. That stuff was just - with that seal in there, and being hot and hulged, it was just hard not for some of that to get away from you on initial opening.

SPEAKER ? Before we leave that grid, you guys wore out will have the toes of shoes, hooking your toes in that.--------would a different pattern be better for that kind of use?

PLT Well, if your going to stick your toes in it, it would be nice to have it a little bigger.

CDR Well, no but---

PLT Your talking about a hex instead of a triangle, something like that.

SPEAKER Yeah, or maybe a rectangle

CDR I don't think it was the shape as much as the fact that you had a relatively sharp, 90 degree top and bottom edge on the grid itself.

SPEAKER It was the edge that was wearing!

CDR Well, your shoe is shaped like this, and you jamming it down into a relatively sharp corner on it, that grid work, and it just wore that stuff, thats all.

SPEAKER Yeah

SPEAKER	How about toe caps? Would they fit inside the angle
CDR	Yeah, but if you put a toe cap on it that makes the shoe less flexible and then you can't, you got to jam harder to get the thing in there. What you would really like, is something that wouldn't abraid that was soft.
SPT	The answer to your question is maybe. I think that maybe another shape might be better than the triangles.
SPEAKER	I don't think that anyone anticipated that you were going to do what you ended up doing.
SPT	Thats right
SPEAKER	Hanging on with your toes like that.
CDR	But, there were many occassions that just to make it easier to lock in I went barefooted.
SPEAKER	Under what conditions?
SPEAKER	We tried this mode before, as a matter of fact, a longtime ago when there was a posibility of a $5\frac{1}{4}$ inch grid in the workshop. An it appeared to us that you probable needed to have some kind of protection in the shoes, to keep from getting pressure points on the top of your instep. Did you ever have any of that kind of problem?
CDR	No, it doesn't bother you that much. As a matter of fact, if you had a larger triangle you could get more of your foot in there and that would probably have been better.
PLT	Right, right
SPT	I agree
SPEAKER	A $5\frac{1}{4}$ inch would let you get your feet in
SPT	I didn't use them the way Pete did very often, because to me, they were kind of uncomfortable. You could dig in---

CDR Well, your foots bigger than mine.

SPT Short job, but for a long job they got pretty uncomfortable- I used my mushrooms alot of the time.

SPEAKER Maybe you need prehensile toes

SPT Also, you know, some of us can get our hands through those triangles and some of us can't. Just a little bit of increase in size or rounding of the shape, and you wouldn't have that problem of losing stuf or not being able to wipe up in between the two.

PCT That's a factor too, because theres a great big blob of some kind of grany on the underside of the S-190 container- Something thats just

SPT Just couldnt reach it

PLT Couldn't reach up in there to clean it out.

SPEAKER Do you feel that you had any the impact on the hardware that was defective, you know, when you were moving around, you know intentionally or otherwise.

CDR No, we got so we could keep out on the short end of the stick on that

SPEAKER Resisted pretty well, huh?

CDR You know those movies are awful, the TV is awful deceptive. I think everybody down here figured we were really clobbering ourselves. I don't think you realize how slow your moving or how little it takes of just sticking the hand out or something to kill whole show so that you--your body is completely relaxed up there. It in it self absorbs you know, like you'd spun off one of those water ring lockers and it looked like you'd took a hell of a clout. And it appears thay way to me, looking at the TV.,but its not that way at all. Were not really hitting that stuff anywhere near as

PLT: That's really checking you six, right?

CDR: Right

SP: and normally, about how many collections a day did you average

PLT: Probably averaged one a day. Maybe more than that, eh? Total i'm talking about.

CDR: You mean per individual or total?

SP: Either way

PLT: Well, we brought back four stacks of about 12 each, so some where around 50 bags is what we brought back.

CDR: Which says we really didn't average one a day per guy

PLT: That's right

CDR: Which is about right because-----

PLT: So it's little less than two a day-which sounds about right

CDR: Yeah and I know that I had cycles that went from maybe not going for 5 days to occasionally going every day for 2 or 3 days, you know, and that was--I was surprised that the freqency varied like it did see, and we were so stabalized on chow, you know, but it, and I can't put my finger on why.

PLT: You had a basic problem anyway.

SP: If we hadn't had problem with the interference with the urine drawers, you think a restraint of the type of the shower foot restraint in that same position would be a sufficient restraint for that kind of an activity. We'd talk about, there was at one time the possiblility, somebody asked if we could put it in there and we looked at it and determined that there wasn't a good way to get it out of the way of your drawer in particular.

CDR: I'm going to say no to that one----

PLT: Me too

CDR: I found that the other foot restraint, had we had the softer strap on it, that is great either with two feet or one foot. You know, and you could put one foot in just one of them and that gives you a nice anchor because you can push your toes against the little grid-work you had and everything. And what the guys have come up with, with the metal thing and the softer cloth, I think is goint to make that work fine. The only problem still is going to be the fact that you'll have to remove it and lay it over to get the urine drawer out. In fact I don't see anyway around that problem. You know. I Think if you are goint to design it again all you'd had to have done is to recess those foot restraints about an inch and a half down in the floor and then you'd been able to pull the drawers in and out, but the drawers evolved from a different thing and we were stuck with what we had but if we are going to do it in the future all you have to do is to drop anything like that an inch and a half into the floor if you got to pull the drawer over it and it's goint to clear.

SP: It's an advantage to have the capability to get just one foot in?

CDR: Yeah, that's fine, you know. Or waste management compartment was small enought so the free floating business was relatively easy to do. You weren't you wer just kind of-you could get yourself stable in there free-floating and you weren't going anywhere. The little bit of torque you had on your body anyhow-you might drift towards the ceiling or a wall but you only had a few inches to go.

SP: I think we have answered pretty much this one and we've covered this.

SP: Dick , I'd like to ask you a question if I may.

SP: Ok, Al

SP: Really the function should be the driver, there's no preference to the type of orientation

PLT: Yes, sir

SP: Possibly one-g, do you feel that the advantages of training in one-g would be worth driving a compartment design to a one-g type orientation or should we---

PLT: I think it is a consideration Dick, but again, utilization of available space I think should be a consideration.

SP: Of the crew restraints we had, we had the knee restraint that we used on the mounting on the condensate tank.

PLT: They worked very well. Pete said he used them.

SP: All the various restraints we had in there which one did you like the best? Did it depend on the type of task?

PLT: It depended on the type of task, yes. I like the triangel shoes because you had certain freedom, not near as much as you think when you really start going around and especially if you want to hook both feet in. There weren't as many available traingles as you might think by looking at the floor.

SP: We kind of filled the place up

PLT: Yes. You know everywhere there is a beam, that interferes that couts out a bunch of them. And at the--what else do we have? Thigh restraints--did you get our discussions on these, at the wardroom table, you know, we sometimes used them like they were designed and sometimes we didn't.

SP: We understood from what you said Thursday that you very seldom used foot restraints with them.

PLT: I never did. I think Pete used the traingle thing on occasion and I think Joe did use the foot restraints.

SP: And the thigh restraint itself seemed to work pretty well?

PLT: Yes

CONRAD (CONT'D) in the chair and without moving out of it or floating or or hanging onto it. I did use it in a chair mode. I also found that hooking my feet in the little bar at the bottom was what I liked to do, and the chair allowed me to have something to bend my back forward rather than my holding it forward or relaxing and having my back bent backwards.

SPEAKER Could you state any comparison between that type of restraint and your wardroom food table and thigh restraints?

WEITZ The chair gave you a little more freedom to do what you want, to have the flexibility that Joe mentioned, and you didn't have it with the thigh restraints.

KERWIN The only thing that bugged me about the thigh restraint was that there was no satisfactory way for me to stabilize my feet.

KERWIN The triangle holes may have been okay, but I was always wearing the mushrooms when I was in there. So my feet would kind of scrabble, and you like to have your feet pinned down when you're going to be someplace for a while.

WEITZ There's another key thing about the ATM chair. I learned to dislike those triangle shoes because they were like combat boots as far as I was concerned. Therefore, when

WEITZ (CONT'D) I went to ATM, I could put on those soft, brown boots and restrain myself perfectly adequately.

CONRAD That's another comment that I think is true. We shifted shoes, or at least, Paul and I did during the day, depending on what we were going to do. I'd shift into those more comfortable shoes if I was not going to work at the SAL or have to restrain myself - my feet some way. I used the triangles to lock in and sometimes used the thigh restraints when I was eating; but you are in the mode of holding yourself forward with your stomach muscles when you're eating. There was another mode I got into in those thigh restraints where I would get locked into them just the way I am now. Just crossed my feet, free from the floor, and I would read there and I would just take a moment to stabilize myself so I wouldn't rotate. I was actually just free floating with that pole between my legs and I'd just hold the book out here, and once you could stabilize with your elbows you could get to roll out of it, and after that you could relax completely. And your feet would lock in and your back would curve back, and that was a nice reading position.

SPEAKER Could you reach the TV and VTR switches when you were strapped in the chair from the ATM console?

KERWIN (CONT'D) to settle down and restrain yourself, you've got that monitor, and the STS windows are so small that you can't point the TV camera and mount the monitor on. So that's laying off on its own string and you're trying to see what's on the monitor and it's unsatisfactory.

CADWELL So it was not just a matter that you lacked the restraint.

KERWIN For something delicate like pointing the TV camera, hanging on to one other thing with one hand isn't satisfactory, because your feet tend to move out on you, and then you've got to move the arm and the TV camera moves around.

CADWELL That's good information, because we're looking for a threshold air restraint system. It's clear that we're adequate in some places, and it's clear that we're completely inadequate in others and then we're looking for this, and how to tell when we have an adequate system or inadequate.

CONRAD Where do you say it was clear that it was inadequate?

CADWELL Well, for instance, it was inadequate in the head, waste management compartment, apparently through poor detail design on the foot restraint.

CONRAD | The foot restraints themselves were located in an excellent place in the waste management compartment, but it was purely a function of that material. But that kind of restraint works very well for doing those kind of tasks in there.

CADWELL | Right. No disagreement.

KERWIN | Foot restraints are mandatory. We couldn't have done without the triangle shoes.

CADWELL | I gather that there is still something to be desired in this combination of foot restraint and shoes. That is, the triangles worked after a fashion, the buttons worked after a fashion in the different restraints, but we should seek something a little better.

CONRAD | There's two things that are overriding in my mind that I want to make sure that you appreciate. One of them is the fact that we did so well without restraint, and the less restraint you've got to provide, the more efficient in many respects a guy is going to be. Because there were times when I could have locked my triangles in the floor, but I would choose to use body momentum or some other way to accomplish it to frankly save the unpleasant task of having to go through the exercise of locking in, do a very

CONRAD (CONT'D) simple thing when I was locked in, and then unlock again to go someplace else. There were occasions where I had a simpler way of restraining myself. Those shoes were pretty simple. You know, I would have done it because it almost got to be a tradeoff; the amount of time was the same. It took me longer to do it unrestrained, but I had the satisfaction of not having to go through the exercise of restraining and unrestraining myself.

SPEAKER You mentioned that you and Paul changed shoes several times a day. The shoes were laced. I suppose, if nothing else, we could have a slicker way of changing shoes.

CONRAD We discussed that a little bit. When you put a load on those triangle shoes, I was happy that I had high laced-up triangle shoes. I don't think that I would have liked the zipper arrangement to get into those shoes because I had the feeling that the zipper would bother me, but I don't know that that's true.

WEITZ Lacing and unlacing those shoes bugged me.

CONRAD Yes. It was a pain in the neck, but when I wanted to have that kind of support, I was glad I had it.

KERWIN An easier way would be appreciated, but I made an input earlier that we didn't want zippers, I think, because I was worried about the fit, and also failure modes. It seemed to me, a lace is an easy and accustomed thing. Could we have shoes in the future like boots where the laces are very few, all you've got is a couple of laces to thread and tie and you're there.

SPEAKER Eight laces.

WEITZ Or hooks that stick into eyelets on the high weather boots.

KERWIN I don't know if I ever mentioned it, but I failed one of my triangle shoes. I literally tore the metal on one occasion.

SPEAKER Under the instep?

KERWIN About an inch from the toe. Yes.

WEITZ You said repeatedly that you didn't have any particular difficulty in handling objects and moving masses about. Did you ever psych out anything that you thought approached a series of thresholds like a family of curves in terms

222 02 04 37 PLT Okay, there we are. Let me put this ... Channel B, right?

CDR No, I put that on B, so you go on A.

PLT Oh, yes; right. Okay, this is M487-2A, day 222 at 02:00. It's crew debriefing, roundtable discussion. Question 1 is: What particular aspects of the orbital assembly seem well designed and arranged for living and working in zero g? What aspects are you changing and how? Huh! Anybody got an answer.

222 02 05 29 CDR I got a start. I think one of the best things that we have in the workshop are these triangular grid structures on the floors and ceilings. I don't think there's any way that you can tell before you fly just where you're going to need to position yourself to do different tasks. One, you can't think through everything just as planned; and two, plans change at the last minute. So it means that, really, all over the spacecraft, you have to position yourself from time to time to do work. Sometimes it's possible to use a handhold to do work. Sometimes it's possible just to float by and do it. Sometimes it's possible to get your buddy to hold on to. Most of the time, to do real constructive work, you've got to be stabilized, and these triangle shoes seem to be able to do the job real well. My only thought would be, on a future space station, that we ought to have a similar-type device. Now maybe there's an improvement - magnetic shoes or some sort of grippers or something. But we're going to need a device that can be used almost anywhere and have it accomplish the business of tethering the - the man, himself, so he can do a job. And certainly, the triangles are one of the best.

222 02 06 37 CDR Now there's one disadvantage to these. There's a lot of places where the triangles, themselves, are not useful because structure is - is taking up the place where the triangle goes. I would suggest, if we built another one just like Skylab, which, of course, we have no plans of doing, we could, somehow, offset the grid by the depth of the little triangle from the main ... beam. And you could do it with a little standoff - probably be just as

easy. You could have built - They could have built the I-beams that way or put a number of washers. That way every place that you went, you could put your triangle down. This would mean time savings and, certainly, that's what the name of the game is. So that would be - one thing - one of my first thoughts. How about yours?

222 02 07 19 SPT

I second the motion that we need to stabilize ourselves. I'm not as happy with the triangle shoes as I think I'd ought to be, however. They do work well enough. They hold you where you need it and, without it, we'd be in a heck of a lot worse shape. But I think we had ought to work hard on something like a magnetic device that you could tether yourself to even more easily than the triangle shoes.

222 02 07 37 SPT

Now going on to other things in there. We ought to have some other thoughts. The - Oh, for example, the mineral supplements down here in the food. The mineral supplements in ... are a sorry mess. They come in very tight packages. They are arranged in a locker so that it's almost impossible to get them slid in without catching on the little, thin metal plates that cannot be seen. And when they do catch on those little metal plates, they normally tear off some of the mineral supplements that go with them. Now these things should ought to be in some sort of an easily-dispensed - device so that we could just meter them out - one, two, three, or four out of little spigots or something like that. So a complete redesign of - of ways to take pills and things like that - vitamins and so forth - had ought to be redesigned.

222 02 08 28 SPT

As far as the food is concerned, some of the cans don't fit the size of the slots. There'd ought to be better control on the position. I had to put napkins around some of my small cans to make them fit into the slots so that they don't all float out and get lost. They should have been done better. Most of the wet - wetpacks - I suppose they are satisfactory by Apollo standards, but they're not very satisfactory by Earth-based or even Skylab standards. Too many of the food packages - When

	opening, near the ceiling in the experiment compartment or the floor in the forward compartment would be perfect. It would allow you to grab them and zip in. Presently, we're just using the edge of the hatch, which works okay. But it's perhaps conceivable that, if we didn't have this triangular grid where our fingers grab real good, we would be at a loss there.
223 14 34 35 CDR	Having handholds at workstations are a little bit wasteful, mainly because it turns out that, when you go to a workstation, you want to anchor your feet and do some work there. Now if you're coming up to a squawk box, such as I'm holding onto right now, you definitely need - definitely need these little bitty - standoff switch guards and handholds to react your forces against. So they're useful things and very good to have, but you certainly don't need a handhold near this box, if I were - And the handholds running around the dome that essentially we thought would lead you hand over hand down the dome are never used sometimes people fly up in the dome to do something and they grab one, but it's not needed. We should not have put them there. Definitely should not use handholds as a pathway. The technique for moving in the space station is more of a flyaround where you're at one position, you fly to the next and fly to the next. So that would be my comment there.
223 14 35 34 CDR	STS handrails. They're good things, the reason being you don't do any work in the STS. You merely stop there and read some gages and the like. You don't need to put your feet in anything firm, and that's exactly what they allow you to do. Now there may be a - an excess of those handrails, but they're not noticeable, like most excess.
223 14 35 57 CDR	MDA handholds and handrails. There are not a lot of them there. I'll have to look at them later and give you an evaluation of them but I can't say that I've used very many of them. There's plenty of objects and boxes and small containers - EREP - that allow you to use them as sort of handholds when you need to.
223 14 36 20 CDR	Triangular shoe cleats and grids - excellent. Those are excellent things. The only suggestion I could make would someone try to come up with a triangular

		shoe cleat that would be easier to engage into the triangular grid. The grid itself is good; it has only one bad feature and that's that much of the area of usable tri - or triangles of triangles is not usable because the beams and other supporting structure is flush against the floor. My suspicion would be that we could have added stand-off of about one-half inch in length and thereby making almost all the triangular grid usable. In some areas, particularly up near the food lockers, there is a shortage of grids. Now there is some shortages of grids around the food compartment. I think these can be improved. We do definitely need, in a future space station, something like a triangular grid or the next generation, let's say magnetic shoes with some kind of magnetic floor Anyhow, you need the ability to pin yourself down at any point to do work because there's no way to forecast beforehand where the different work experiments will be performed or particularly where they'll be stowed. So there's a need to have an ability to lock one's legs down at all different points.
223 14 37 33	CDR	Conical shoe cleats and grid. - Have not tried them but will. Water tank foot platform. Have used it several times, not just for fun. Found it to be an excellent restraint. It has the disadvantage of being heavy and being in the way when you're not using that restraint and, certainly, if you had triangle grids there, which you do have fairly close, it would be adequate. My suggestion would be those are special-event sorts of things. Maybe - They're much better than the portable handrails, so that - so maybe that's the sort of thing we should want to have made portable with a pin where you could fly it out, pin it into the floor and then use your knees to hold yourself on.
223 14 38 12	CDR	ATM foot platform, excellent. Same comments about it ap - The comments I made about the floor applied there; same thing. I'm going to have to leave now, but I'll return and pick up on PGA foot restraints.
223 14 43 14	SPT	Okay, SPT recording on channel A. This message is to Dr. Paul Patterson in the ATM science room. We do have the Polaroid camera activated now and our first pictures are really pretty good. I don't

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223 19 17 00 CDR Hello, hello.

223 19 19 19 CDR This is the CDR and recording some information on 487-3A for the PIs. You know I had to stop recording several hours ago to do an EREP pass. I'd like to give some ratings to some of the things I have not, although I have discussed them. Let me go back. The OWS fireman's pole; I'd give an excellent. The OWS dome and wall handrails, I'd give poor to adequate. STS handrails, I'd give adequate. MDA handrails, poor to adequate. Triangular shoe grids and cleats, probably adequate, but as I have discussed, there could be easier ways of using them. Conical shoe cleats, I have not evaluated.

223 19 20 04 CDR Water tank foot ploy - platform, I give very good and it would go up to excellent if it were somehow portable. The concept of using your knees is an excellent one. Portable equipment restraints - port, no, portable PGA foot restraints - I would give them an excellent except for one thing. The astropin method of keeping them there is very poor, so I'd have to give them a very good. There's no need for a complex pin like that. It could be a simple clip pin. It could be a sliding lever. It could be almost anything. To go to something as wild as the astropin just to hold something to the grid is - or anywhere else defeats the purpose. It's too difficult to operate and understand and there is just no desire on the part of the crewmember to fool with it all the time. Portable - P - portable handholds, never used them on the wall. I don't think they could be used. As I suggested where - our handholds should be mainly in traffic areas because it always ... traffic areas have solid walls and bolt them toward the ... toward the - except these portable restraint. They look like they might be useful in some areas but I have not used them yet, so I could not say.

223 19 21 40 CDR Okay, next one is the portable equipment restraints, tethers, bungees, universal mounts. The universal mount is an excellent device, needs to perhaps be a little stiffer at the - angle, so that when you

getting accustomed to floating around and in transporting mainly the larger packages we had to transport.

223 23 11 32 PLT — The workshop dome and wall handrails, I guess they're okay, but we don't ever use them much. We just float between hatches. Seldom use the handrail unless we - seldom do we need to go there. The only time we need to go there is to put something in the workshop hatch or possibly do a little vacuum cleaning. But normally there's no need to be in between the dome lockers and the hatch. So the workshop dome and wall handle - handrails really aren't used very much. STS handrails are those I presume in front of the EPS/ECS control panel. Oh, they're used when we're there to stabilize ourselves. But they are not used for mobility. They're adequate; there's probably more of them there than we need.

223 23 12 30 PLT — MDA handholds and handrails; there aren't many handholds and handrails in the MDA. Probably could use some, not necessarily for hanging onto things, or getting in a stable position, but more in getting from one end of the MDA, from the STS down to the command module. I know that when I go in there I tend to use the handrails in the airlock very much in - in mobility from one end of the airlock to the other. Then I kind of float over to the ATM, grab on to the - the writing board there on the ATM, and then grab whatever else happens to be sticking out or available. So there aren't many good - handhold - handrails in the ATM.

223 23 13 28 PLT — Triangular shoe cleats and grid. I gave them a very good; I think it's been a definite advantage to have grid in as many places as possible, because you never know where you need to stand or where you need to anchor yourself and you certainly can use the grid we've got to good advantage when ... and ... The triangle shoes, I wear - they - one on each foot all the time, except when I'm sleeping, of course. I found them very handy. I've noticed that they tend to - perhaps I have them too loose. That's the way I like them, but whatever position they are, they tend to come out of the grid in the locked position;

		frequently have to reach down and twist them around to line them up so they'll go in the next time.
223 23 14 26	PLT	But the triangle shoe cleats are great and I haven't used the conical shoe cleats at all. I haven't tried them. I might mention that one place you really need some handholds is right around the film vault. There's nothing there to hang on to. That film vault is just a big square object and you just can't grab on. You don't have any triangular shoes on and you're pretty much out of luck in that film-vault area. Frequently go up there with our socks on late at night and put cameras away early in the morning, before you get your triangle shoes on, and it's a real unhandy place to be without handholds or - or foot restraints.
223 23 15 13	PLT	Portable PGA foot restraints - correction - ATM foot platform is very good. I use it all the time when I'm at the ATM, but don't use the chair. And I always have myself anchored by one foot at the ATM.
223 23 15 31	PLT	Portable PGA foot restraints are - I tried forgetting this. I'd rate them excellent. The extra little pins that were put in there to keep the feet in there, the PGAs down there by themselves were a very good position. And the portable foot restraints worked very well in suiting up, and they also worked very well on the EVA the other day when we carried a set outdoors to put up the sail.
223 23 16 03	PLT	Portable handholds. I haven't used any of them yet. Portable equipment restraints, tethers, bungees, universal mounts and so forth I would rate them as adequate to very good. The tethers - they're really not used very much except for the tether that we strap onto the arm of the suit to use for EVA. Be nice if there was a way to fasten the EVA tether down to your arm with some sort of elastic or something. One wasn't any use because otherwise it flops around and catches on things. The bungees we've got, we've used them all. We've got them all over. I don't like the ones with the sharp hooks on them because there's

223 23 19 36 PLT The handwasher is - is - used frequently. It seems to work all right. Usually when you get some water out of it get it on your hands, why a few drops will splatter around and they go where they may, mostly in to the back of the stainless sink area, and they just collect on the wall. The hand washer is a good deal; if you get soap on your hands you can't very well rinse it off because you can't get that much water on there. So you wind up washing you hands with a little bit of soap and then put a little more water on there, which makes a little more suds; then you wipe it off with a towel.

223 23 20 21 PLT Fecal/urine collector lapstrap and handholds. First day or two I used the lap - lapstrap, and it was very handy. I don't use it anymore. I do use the handholds. They're in a good location and I use the footholds on the fecal collection position as well. Most for stabilization. Triangular shoes fit quite well-not to be confused with the foot restraints on the floor.

223 23 20 53 PLT WMC handwasher handrail. I guess I've used that periodically but mostly when you are in there, well, you use the foot restraints, no place to hold your hand. What you're doing in there most of the time is working with your hands. There's no - there's no extra hands to grab onto things. What you need is good foot restraints.

223 23 21 12 PLT WMC ceiling handrail. I haven't even noticed. Maybe I've used it and maybe I haven't. I don't know. You sure don't need it to get in and out.

223 23 21 21 PLT WMC light-duty foot restraints. I guess they're okay for bare-footed operations. But most the time, you're not in there barefooted. You're in there with your triangle shoes and that's a very inefficient setup in there. There ought to be some triangle cutouts in that floor like there are around the wardroom table, so you can fasten yourself down. Particularly true over in the SMMD area and over by the fecal dryer area. You need some foot restraints over there. You're just floating and struggling there all the time. And sort of wed - I sort of wedge myself in between the wall - the two walls, with my feet and

my elbows up against the other wall. The foot restraints in there are almost nonexistent with triangle shoes. Little wider or new straps - installed to use with the triangle shoes really don't do the job either because the triangle foot's on that floor and your toe comes out real easy. The foot restraints often get in the way of yanking out the urine drawers to the point of frustration sometimes and pinching fingers other times. So foot restraints for triangle shoes in the wardroom or waste management compartment are unacceptable.

223 23 22 55 PLT Drying stations work very well. I give them an excellent.

223 23 23 01 PLT The shower I haven't had a chance to use yet; just haven't had time.

223 23 23 05 PLT Personal hygiene kit. I like that hygiene kit. I've used toothpaste, toothbrush, comb, the dental floss, the safety razor, the shaving cream. I've used the shaving lotion every day. The shaving lotion that we brought up, Old Spice, I like very much and use it every day. And I used primarily the windup shaver to shave with; although it's - has certain deficiencies, too. If you ever let any of your whiskers grow out a little bit long or you miss some, why they're going to keep on growing because that windup shaver doesn't catch anything but real short whiskers. So at - I've still got the same head I put on when we got here. It's been 2 weeks, now; it's still working pretty good. And every once in a while you've got to clean it out using the overhead ventilator and - and the windup shaver is working very well. Well, once a week I use a safety razor and the shaving cream to get all those extra, longer whiskers near the sideburns that the - the mechanical shaver can't get. One thing that's not on here is the vent overhead in the waste management compartment. It's very good for collecting things. It collects most everything up there, and if you ever want to hang onto a checklist or anything, why you just put it up there and it'll stay there. All the junk stays up there very well until we vacuum it off. We leave it on all the

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Time: 227:02:09 to 227:03:28

227 02 09 14 SPT Okay, back to this discussion on mobility aids. Dome and wall handrails, I never use them. STS handrails, I don't use them very often - take it back; STS handrails are used more. That's our principal means of locomotion back through there, and I think they're very useful in that area. And the same thing is true for the MDA. Shoe cleats, triangular, those are basically what we all use. I wear two triangular shoes all the time and find it the most convenient thing. I've not even tried putting on the conical cleats yet. I may get around to it, but I haven't done so yet. Water tank foot platform I find useful. I've used it on a number of occasions on getting in and out of dome lockers or up around there for the TV work and so forth. The ATM foot platform I always use. The portable PGA foot restraints we use for the suit donning stuff, and we use them to tie down our suits for the drying interval. And so they're handy to have, and of course they were indispensable on the EVA. Portable handholds. As far as I know, we've never used them.

227 02 10 27 SPT Stand by.

PLT Okay.

CC One minute from LOS.

PLT 19. Okay ...

227 02 15 05 SPT Okay, back on the M487 portable handholds, never use them. Tethers, bungees, universal mounts: universal mounts we do use. We have barely enough, might not even hurt to have another one or two, but they are used quite often. We used them today, for example, for S063 camera which is sort of an unscheduled use. Tethers and bungees - I think we need more of those things around here of various kinds - need to spend some time just thinking about just what they ought to be. But we need these things that'll strap across the front of our lockers in the wardroom. And the ones that are on there with these little wires are sort of dangerous - potentially dangerous as they don't stay well or anything else.

227 02 15 48 SPT We ought to have things that are permanently mounted there and designed into it and planned to be used, and snap rings too. So those bungees in there are very useful; the ones we've got are only half adequate.

227 02 16 02 SPT ATM seat/backrest restraint - tried it once and threw it away. It works a lot better to just put your feet in the triangles and stay there. That dadburn chair does nothing but annoy you. You try to sit down in that thing and you feel like you have to be strapped tight to it. You strap yourself tight to it and then you can't reach the panel where you want to; it's nothing but an encumbrance. Pardon me, Pete, but (laughter) we'd be better off without it. And let's see, waste management and hygiene. Fecal collection equipment, inadequate, but better I'm sure, than a - than a bag would be by itself. In fact, once you get used to it, it's not too bad. But there are probably some design improvements that could be made. Have to talk about those at some other time.

227 02 16 48 SPT Hand washer - if we have one onboard I don't know where it is. I know what you're talking about, though; it's the one that's supposed to be a hand washer; the only trouble is that you can't use it to hand wash. You put your hands in there, you try to pretend you're hand washing and you splatter water all over the compartment so all it amounts to really is a place to dampen your wash rags and towels, and the whole concept of the hand washer needs to be re-thought through because the one we've got is not one at all.

227 02 17 13 SPT That lap strap is essential for the use of the fecal collector. I wouldn't want to try it without. The orientation is such that you do need to grab hold of the handhold to keep from what you would call floating up in one g, but it's toward the overhead of the compartment. The handhold is a necessary aid when using the fecal collector, but the strap is absolutely essential. WMC hand washer handrail - well, shucks, I don't know. Hadn't thought that much - leave it there if you

want. The whole hand washer, as I talked before is - needs to be re-thought through. Ceiling handrail - didn't know there was one. Light-duty foot restraints, lousy. The whole idea of foot restraints in the head needs to be re-thought through. Three of them are in front of the urine trays where they either mess up the trays or have to be removed as we've done, and the whole idea of foot restraints in there is very poor.

227 02 18 21 SPT Shower - we haven't even gotten around to using one here because first of all we haven't had time; secondly, we didn't think we needed it. So we don't need it very often. Personal hygiene kit should be personalized. Not this blanket, cotton-picking thing that's got a set of stuff that probably nobody wants more than 50 percent of. They should have been tailored to each individual. It wouldn't have been much trouble to do that. Now we would have liked very much to have the things that I want in there.

227 02 18 45 SPT I'm still up here trying to figure out how to trim my moustache, and it's been 18 blinking days. And I'm still not sure how I'm going to do it. As a matter of fact, I haven't even trimmed it yet, and until I figure out how, I won't. And so I hope to figure out something. If I'd had my own personalized hygiene kit I'd have had a pair of either short tweezers - short scissors in there like I have at home, or better yet I'd have had a proper razor with a - with a moustache trimmer on one edge or whatever they're called. I thought one was going to be on board but it apparently didn't make it. But the personal hygiene kit should have been personalized, and I think it's an oversight, a significant oversight, that it was not.

227 02 19 34 SPT And I guess I got some more on food management: wardroom table, not bad; thigh restraints aren't bad; wardroom light-duty foot restraints, hardly ever use them. Every time I put my shoe in that triangle that's down there on the floor, try and unlock it, it unlocks halfway and then I have to

reach down by hand, and get the thing twisted right. It's the one triangle all over the spacecraft that doesn't work right for me. Food reconstitution dispensers work fine. Those things really do a good job. Water gun is great; food tray is fine. Food cans - well, some are good and some are bad. The wet packs, I think, are lousy; beverage dispensers are fine. Seasoning dispensers are lousy - well, those salt things - good grief! One-third of them have already been cracked and leaked out, and the salt is therefore caked. Whenever you try to pick it off you get free salt floating all over. The next one-third, when you try to open them up, you pull the flaps back and then the salt sticks to that and you squeeze them, and it squirts about 60 degrees away from the direction you were pointing. So it either goes all over your buddy or all over the tray or all over the air. Now the final third you usually get on your food, so they're about one-third efficient and the other two-thirds are all over the spacecraft. Very annoying.

227 02 20 46 SPT I consider the only seasoning dispenser we've got to be very poor, and we could certainly do a lot better if we thought through. We'll have to do that on the ground when we've got some time, not up here because we don't have time to go through all these things right now. The other seasoning we don't even have. I've given up on the pepper because my first attempt to pepper just managed to fill the compartment with pepper. I've tried to put it away into a bag and every time I open that locker I still smell pepper, and I've given up on pepper even though - although I'd like to use it.

227 02 21 17 SPT Any other seasoning is too much trouble to fool with, and so I'm just getting along without any seasoning. Eating utensils are not bad. They need a better place to stow them. That little - my spoon flies out everytime I open the drawer, have to go retrieve it and have to Velcro it down with that strap.

best there is to - We spend very little time in the airlock itself. We're mostly in transit when we go through airlock, and the handrails there are used extensively. As I mentioned before, there are no suitable ones - mobility aids in the MDA. You just sort of grab whatever you can and - very inadequate mobility aids availability in the MD - STS.

232 18 53 27 PLT Personnel restraint devices - Stand by 1.

232 18 54 41 PLT Okay, here we go again on personnel restraint devices, M487. The best restraint devices we've got are the triangle shoes and the more of them you've got located around, the better we do. We have quite a bit of it down in the experiment compartment, and so that's the best restraint device there is. We're not using any tethers at all, except to - to hang on to things and go EVA. But then we're not hanging on to body, we're hanging on to equipment against the ri - rip tethers.

232 18 55 19 PLT So the best personnel restraint device we've had is the triangle shoes. I used the leg restraints, along with the triangle shoes or the toestraps in the wardroom. And I think they do a very good job. Personnel restraint devices not employed much in the sleep compartment. You just sort of drift in there, out without fastening yourself down. The worst place - one of the worst places is in the head. The restraint devices are inadequate there. You always hoist yourself between the walls to do the job, to - to restrain yourself. There should be some cutouts in the floor for your triangle shoes. The toestraps ate inadequate because they don't fit over the triangle shoes, even the lengthened ones. Even though you can get your feet under them why the bottoms of the triangle are so slippery that if you put any force at all, your feet slip out. So we have inadequate restraint devices in the head.

232 18 56 24 PLT The only one that's adequate is the handholds and the feet restraints that keep you down when you're on the - on the one-holer. The - it's a - in fact, a very annoying thing to go in there and try to

do your work, to - to change your urine drawer out, to change the fecal bags and weigh them and put them in the fecal dryer. You're just continually floating around there. You can't even hold yourself down to write something. You've got to wedge yourself against the wall in order to write on the little chart we've got in there. And it's a very inadequate, poorly designed from the restraint device standpoint. The airlock module doesn't have any personnel restraint devices and probably doesn't need any. The other place that the restraint devices are poor is in the MDA. We've got a good restraint device in front of the EREP and in front of the ATM panel with the triangle gridwork. However, any other place that you want to work, you got to wrap your legs around things.

232 18 57 36 **PLT** If you want to take pictures of TV out the window, if you want to work on S192, or if you want to work on the - do the VTS or any other place you want to go in the MDA, there's just nothing to grab on to. You've got to find - find your - some place to wrap your legs around. And so MDA-wise, the restraint devices are something that has to be improved on also.

232 18 58 06 **PLT** Thermal comfort. The temperature has been quite satisfactory in here. It was a little warm in the workshop when we first got here; the sail took care of that. It gets cool in the night when we're sleeping and most of the stuff is powered down. Wind up putting a little extra blanket over late in the mornings. The MDA is always quite cool, and it's uncomfortable to come up here, matter of fact, for me anyway, without any - or in my underwear, which is sometimes the way you work up here because you have to work up here just before you go to bed. And you come up here to get the pads and do some other things. So the MDA is a little cool but tolerable; in fact, sometimes a pleasant place to come when things get a little warm down in the workshop.

232 18 58 57 **PLT** Whenever you get the high-intensity lights on down there or midafternoon while we're working, it seems to get a little warm down in the - the workshop area. The sleeping compartment does cool off at night near the ventilator the - the floor.

238 18 16 53	CC	Okay. You've done a total of 31 telecasts, 13 from the TV Ops Book. All of them are great; 31 of them have been broadcast.
	SPT	That sounds like what we heard last night, Story. And then there were a few comments about technique, and so on.
	CC	I guess you got it already.
	SPT	Thank you.
	CC	Jack, if you're through with your attempt to lock onto Alpha Crux, go ahead and select Achernar to 52012 and a 50000.
	PLT	Okay, I was - I finished up the shopping list item 2 and I can't see the Ellerman bombs on the sun-spot. I wonder-or on active region 8 - wonder if they'd like to have another shopping list number 2, say in that prominence you just mentioned at 290.
	CC	Stand by.
238 18 19 37	CC	Jack, we'd like you to run another shopping list item number 2 on active region 8.
	PLT	Okay, I'll do it again.
238 18 23 38	CDR	Story, are you still there?
	CC	Yes, sir; about another 6 minutes.
	CDR	How about making a suggestion to the fellows that work on these foot restraints? They built us some new ones to go in the wardroom here because of Pete's comments. Mainly his comments were you can't get your feet under there with triangle shoes on because they're not big enough. But we got these up here now and you can't - My comment is you can't get your feet under them when you got triangle shoes; they're too little. So, whatever design they used was erratic and they tended to make them the same height as the old one. There may be a fraction greater because right now you can't get them under if you have the Velcro engaged. So, ask them to have another go at that and get some triangle

shoes, put feet in them, and stick them under there and make sure that - that that's where the Velcro begins, instead of where it ends. Send six up for Jerry if they can. And then also the ones in the head - they're working better, they're not big enough for Velcros - for triangle shoes either. But the main thing in there is they're still just in the way. They ought to try to figure some different type of restraints for in there; either on the wall or maybe on the ceiling or somewhere else besides on the floor in front of those urine contain - urine drawers, or maybe on the drawers themselves or something. They ought to have another go. We ought to learn to lick this problem in Skylab so when it comes up in shuttle, we'll have a good answer ready. Those are really the only two restraints that seem to be bad.

CC Okay, got that, Al.

238 18 25 21 PLT One thing, Story. I can't seem to get the star out of the window now. I've had a star lock up at the proper angles for Achernar, and - slewed outer gimbal all the way from say, 3300 down to 27, and it says locked up. And it doesn't go back to where - to any new position when I let go of the stick.

CC Stand by 1.

PLT Now it unlocked again. I'll try it again. Maybe it's going to work right this time.

238 18 26 36 CC Jack, have you been seeing a star presence?

PLT Yes, I get a star in the window and then I slew off a little ways and it doesn't go back to where it was - supposed to be. I doesn't matter - seems no matter where I put it, it - it just stays where I leave it and still says star.

CC So you're - you're seeing a star presence over a wide range of outer gimbal angle?

PLT Yes, I got a star flag in the - on the flip-flop

CC Jack, you can go to AUTO right now; you're close enough, and we're a minute until LOS; we'll see you over Guam in 25 minutes.

Reference 19
TAG Tape 257-05/T-590
Time: 257:12:00 to 257:13:30
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SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

257 12 32 10	CC	Skylab, AOS Canaries and Madrid for 13 minutes. We'll be dumping the tape recorders at Madrid at 12:35. And, Jack, we need the DAS for dump inhibit.
	PLT	You got it, Story.
	CC	Okay.
	CC	Jack, the DAS is yours. We're seeing a good Nu_Z update. And could you verify that you closed the shutter manually?
	PLT	That's affirmative, Story; I closed it manually.
	CC	Thanks.
257 12 38 22	CDR	Story, just completed the water reservoir check, and they're all up.
	CC	Thanks.
	CC	Jack, 54 is in a double sequence; we'd like a STOP there. We saw the same problem yesterday.
	CC	And it's looking good now.
	PLT	Okay, thank you for ... that one.
	PLT	You there, Story?
	CC	Yes, sir, another minute and a half.
257 12 44 05	PLT	Okay, I received a message this morning, a general one about boots, shoes and that sort of thing, and I had reported that one of mine had torn out. And I think it was misunderstood that it was one of of the soft boots. The boot that tore out was my triangle shoe boot, and I been holding it together with tape. The other question was "does anybody use those stretch whatever you call them, for - in place of the triangles?" The answer is, "Al tried them and thought them to be not suitable." And I looked at them but didn't try

them and decided that the triangles would be a lot better. So we're not using those; we're using the triangles.

CC Okay.

CDR The reason they're not as good as the others, Story, is because they're not passive. You can go somewhere and hold yourself in, readily, as long as you keep your mind on it. But the minute you start concentrating on a pad, one of your shoes or the both of them come out and you float away. So it's - the triangles, if you once get them in, and they're adjusted right, you can then concentrate on the job and don't have to worry about holding your feet in place.

259 12 45 19 CC Okay, thanks, Al. We're going LOS here. We'll see you over Carnarvon at 13:12.

257 13 12 40 CC Skylab, this is Houston through Carnarvon and Honeysuckle for 14 minutes. Over.

CDR Okay, Bruce.

CC And Skylab, we would like you to stay off the DAS for a moment so that we may enable momentum dump, and also we'd like you to command the star tracker shutter closed again. It doesn't seem to have closed. The Nu_Z that you've got in is good. Over.

CDR Okay. Just went closed, and you're right, it's been stalled in AUTO.

257 13 14 55 CC Skylab, this is Houston. The dump enable command has been sent. The DAS is yours. Out.

257 13 25 31 CC Skylab, this is Houston, 1 minute and 20 seconds until LOS. Next station contact in 35 minutes through Merriott Island at 14:00 Z. Out.

END OF TAPE

BEAN (CONT'D) possibly. They ought to look at that again. Just about anything you can do in one-g, you can figure out a way to do in zero-g and you don't have any danger. Our recommendation is to get some good epoxy up there. You could bond some things in there that would allow the chiller to work correctly. It could also bond down that rubber grommet in the urine system. If they're worried about flammability, take one and put it in a beta cloth bag, or something like that. There's no spark sources up there, and I never saw any sparks or anything, did you?

LOUSMA No.

GARRIOTT We did notice a little bit of static electricity toward the end of the flight.

LOUSMA As far as those things go, you need the same kind of things to work with as you need at home in your tool bench. Epoxy is one of those things you don't get along without at home and I think you need it up there as well.

12.4 CREW SYSTEMS

LOUSMA Restraints and Mobility Aids: That's a pretty big subject there, Ed. I think the biggest and the best restraint we had was the triangle shoes, I never tried anything different because they worked so darn well and they seemed to be what I needed, but you sure can't get by without them.

BEAN

I tried the double mushrooms and found them to be okay. They are easier to get into than triangles. The only trouble is that there is not a passive restraint, so if you start getting your mind on doing something at the same time you're being restrained and let your legs relax, which you intend to, at least I do, then a lot of times I'd float out. So I took them off after a couple of days use. I used the little mushrooms one day and the big ones the next. Generally, I like the big ones better than the little ones but I didn't like any of them relative to the triangles. I thought that the triangles could have been improved somehow, so that you could get them in the triangular spaces better, by providing more clearance between the triangle and the space available. On a space station you've got to have some way to connect yourself to the floor. One of the nice things about the EREP C&D panel was that you could use your triangle shoes, so it gave you both hands free. One of the disadvantages of the VTS was that you didn't have any foot restraint and you were always trying to put your legs around something else or hold on with your hands which meant your hands weren't free to hold something else. I think maybe in future applications we ought to try to always have some sort of foot restraint at every station. That allows you to move your body and do work with your hands.

LOUSMA

I think that the restaints were basically pretty good except on the following places: The one that Al mentioned at the EREP VTS. Another was in the waste management compartment. Another was in front of the film vault. Another was over by the food lockers. There was no acceptable restraints in those areas. One restraint that we had and never did use was the chair in front of thy ATM.

GARRIOTT

I actually tried that chair and found it unsatisfactory. It was just like the M131 chair, you "sit down" socalled in quotes and you float right out. You have to tie yourself down, uncomfortably, to even attempt to use it. And it's just tying you in a posture that there is no reason to be in. It's an attitude and a position that you don't want to stay at very long. So I did try it and found it unsatisfactory. I'll just say a couple more things about the restraints. The SPT's triangle locations in the wardroom at the dinner table are such that the little socket for your triangle apparently is rounded off or something, because very frequently when you take your foot out, you end up with the triangle half cocked. So it will neither go in the next time or come out reliably. And so as a result, I used the thigh restraints about half of the time, maybe even more at

GARRIOTT (CONT'D) the table in the wardroom. I found that the thigh restraints there worked pretty nicely. And I think that was another different kind of a restraint which did work rather well. As far as future designs, not relative to Skylab, I think magnetic designs or something like that, or a whole host of other varieties like that ought to be considered. We could get along without the triangles, perhaps, but still have something to serve the same function.

LOUSMA Mobility aidwise we used the fireman's pole at first and it's mounted now, but we took it down quite early in the mission and I think we got around better without the fireman's pole being there. Another place where mobility aids are noticeably lacking is in the MDA. The MDA is just a hodgepodge of projections sticking out all over and there's nothing that you really can grab onto to rotate yourself around, unless it's the ATM panel. I think that the MDA is built like a spacecraft that we don't want to build one like in the future.

BEAN Lighting System: By the way, we got numerous comments on restraints and mobility aids under crew systems in the M487 experiment recordings.

LOUSMA I know it, looks like we're going to have to go through that again.

BEAN That's a fact.

LOUSMA We have discussed the fact that you need another camera body so you can have this low-light-level film on hand. We have suggested that it be the CSM camera.

BEAN I think you want to provide time during activation to get your cameras out and get them in position. Then they are out for the rest of the time and usable.

LOUSMA Have you ever heard the possibility of not having to put them back in the vault?

BEAN Yes, that's a good suggestion.

Flight data file: I thought the flight data files, both the CSM and the SWS, were excellent.

18.2 SWS

LOUSMA Foot restraints in waste management and wardroom.

BEAN The foot restraints in the waste management compartment are still not very good but you can stay in there and do the job. You would have to say that it's not mandatory that they be changed but at the same time, it's still not very good. If you had it to do over again, you'd need to revise them. I don't think Jerry wants to take any extra weight or anything

BEAN (CONT'D)

else up there to revise the ones that are there now. I'd go ahead and accept it and just say it's a bad show. If we ever rebuilt that compartment, rebuild it so it has triangles on the floor. I don't think the head gets any dirtier or difficult to clean than the eating compartment. They could have made the floor in the head just exactly like the one in the eating compartment. It wouldn't have made much difference. You get water drops around but that doesn't make any difference. You don't throw around anything else. Certainly urine doesn't go any further and no fecal matter ever seems to get loose. I think they could have constructed that compartment pretty much the same as the others, with the exception they would have to seal it off so they could pull a good suction on it for fan purposes. As far as flooring is concerned they should have had a regular triangular floor.

LOUSMA

My tendancy in both compartments was to use the straps for barefooted or stocking-footed operation and to use the triangle in the wardroom when I had my triangle shoes on. I don't think it's reasonable to try to modify the ones in the waste management compartment. You will only make it worse. They are no good for triangle shoes the way they are. I don't think they can be modified to be useful for triangle shoes. It's just a bad design. There isn't anything you can do to fix it.

BEAN

Same thing for the ones in the food compartment. I think they can live with them. I wish that the first time they corrected them, they would have made them big enough so that you could put both your triangle-shoed foot and your non-triangle-shoed foot in. We made an inflight modification only to mine because I was the only one that cared. The other two are not modified. It is certainly useable - not nice, but acceptable.

Digital multimeter: Good addition. We used it a lot. It's easy to read. It has good batteries. I would suggest that you keep it off between uses. It's a good addition to the toolkit and we probably should have had it initially in the toolkit.

LOUSMA

The only problem is that, when you take the little pins out of the probes, there is no place to put them. The little screwdriver that goes with it floats around. It's going to get lost one of these days. You have to tape it down. There is no good place to put it.

Shoe repair kit (toe): It seemed to do the job. It protected the toes anyway. It is a little bit difficult to line up the holes and get the screws back in, but after working at it awhile, you can do it.

QUERY Would you fundamentally change the array of clothes that we have now or would you start with what we have now and modify them?

BEAN I'd get rid of the shirt use the undershirt as the shirt. I'd eliminate some of the extras on the clothes, like the comm that we never used. If you did have to use comm, you could clip it on to the clothes somewhere. Make sure that the comm has little clips. I'd get rid of the little booties. Nobody uses them, and they don't seem to have a function. I'd get rid of those gloves, maybe.

LOUSMA There was a lot of discussion preflight about one piece versus two, and I think two is good because it gives you the flexibility to stay at whatever temperature you want.

BEAN The convertible long/short pants were good.

QUERY Al, were you talking about the gloves in the clothing module?

BEAN Yes, flight gloves.

QUERY Jack, if you just used the triangles all day, what did you do when you went to the head? There are no restraints in there for the triangles.

LOUSMA That's right. I just floated around. That was our complaint.

GARRIOTT	You can tuck them in that slot above the urine drawer or behind the urine drawer, if you want to. You can use them or not use them, it doesn't make any difference.
BEAN	But you weren't going to bother taking off your shoes. It was easier to float around and be uncomfortable than to bother taking your shoes off.
LOUSMA	Those foot-strap restraints in there were unacceptable for triangle operations. You really had to concentrate on holding your feet down or they would flip out.
BEAN	I still think low-top triangles would have been useful all day long, except for use on the bike. It was hot wearing those high-top tennis shoes.
GARRIOTT	Two months in one pair of shoes was also inadequate because we wore them on the ergometer and you sweat a little. They did rip out, a time or two. One pair of shoes for all of the functions was inadquate.
BEAN	I would prefer to have a set of low tops to wear all day with my triangles. Then when you got ready to bike, you set those aside, put on your tennis shoes, then put the others back on after biking.

Reference 22
TAPE 2, SIDE 2

SPEAKER (Cont'd) we have got now, has essentially a horizontal floor going down the length of the spacecraft. Its anywhere from probably eighteen to twenty-five feet, depending on the payload. It's built in sections. Basically, I guess what I ask, is the floor that worthwhile, knowing the way you used it in the experiment compartment and on the second level of the workshop, versus an MDA type vehicle. Again, we're talking about a vehicle that probably two to four feet bigger in diameter, the MDA, I think is about ten, could you comment, can you extrapolate at all the utility of the grid, maybe not necessarily that grid, although it may be great. But just a uniform platform that you'd use to work off of versus a 360 degree vehicle like the MDA. Orientation doesn't really matter.

PLT Yeah, I have a very strong feeling about it. I don't know about Al, but I hope we never build another one like the MDA. I hope we build it more like the workshop, where things are oriented kind of like they are here. Not because you need to do it that way, but it just works out better if you do. The MDA everything was just ---you could live in there all right, but its just all kind of a hodge-podge, you know. I didn't like the arrangement at all. I much preferred that in the crew quarters experiment area.

CDR I agree with Jack one hundred percent. It seemed that we always -- the thing that was noticeable is to do any useful work and you didn't always plan the vehicle to know where useful work was going to be done--is you had to have your feet locked in, somehow. And the best thing that we ever put in that vehicle were those triangle grids. I really never thought they were going to be as useful as they are. But that thing allows you to go anywhere in the workshop and work. We had to put some up around the dome lockers, which we used a lot. I really didn't think those were going to be too useful. You got to lock your feet in if you are going to do useful work. You can't hold on with one hand and work. You certainly can't hold on and then work with two and come back. You got to get your feet locked down. The only thing, I think, is wrong with this--you got a floor here of some universal type. You need a floor that you can--you need some way to lock yourself in at unknown--everyplace. How's a guy going to work up here on that floor. That would be my only comment here. This floor's great as long as you are going to work within six feet of standing here. But I don't know how you are going to work up there on the dome.

SPEAKER Well, let me ------

CDR Have you thought about putting a floor in the middle? Are you going to put some sort of, kind of halfway floor up here, half way up, like you did the floor around the ring lockers?

PLT Floor on the wall there.

CDR So you got a floor like this and this so a guy can work this area from that floor and this area from this floor.

PLT You know that blue floor in the -- below the dome lockers was very useful; anytime you wanted to get into a dome locker you lock your feet in one of those triangles and you went to work. That was a good choice.

CDR Yeah, not only does this allow you to work, but it cuts down time. You get ready to go up there and do anything, you don't have to try to daydream up a way to hold yourself in position as you stand there thrashing around. You just float up there, headed that way, and you know that when you get there, you are going to put your feet in the floor here, or here, or here and that's it--go to work.

PLT The other thing about the MDA is, I shouldn't bad mouth the MDA I'm not meaning to do that. I just didn't like the layout of it, but the reason, besides what Al says, is that except unless you were in front of the ATM, or in front of the EREP C and D, there was no way to fasten yourself down. Unless you wrapped your legs around something. Also, it was difficult to find things in there unless you went in at the same orientation every time. If you didn't do that, you had to stop and say " well lets see, there's the gold box, I go from the gold box, the rate gyros have got to be up here. It was an orientation problem and I think you can work more efficiently in a known layout situation which is more common to the one you have trained in here on earth which is built to look like one-g. Even tho its not necessary to be built that way, its just more organized.

CDR Its conceiveable you could come in with a floor here and here and then work either side of the floor. We never found much problem in hanging upside down.

SPEAKER Let us go back and --------I think what we'd like to do after you get through with ever----- you've got to do now we'd like to show you some of the layouts we've got in fomecor. Maybe, further pursue this point of how you best layout a fourteen foot or a twelve foot diameter vehicle.

TAPE 2, SIDE 2

CDR O.K. Remember the most important thing, to my mind, is that you've got to be able to secure yourself with your feet in range of everything, somewhere. That's the number one thing to be able to do. Sorta like here. In order to work here, you've got to be able to stand or sit and work on something. Same thing up there, it doesn't go away, once you can find those places everywhere, you've got it made.

PLT I remember when the MDA was layed out, there were a lot of other factors that enter design besides ease of working in there. But I hope that, if possible, we can avoid those kind of requirements in the future.

SPEAKER O.K. Very good, appreciate it.

END OF TAPE 2, SIDE 2

PLT — We worked in different attitudes, we floated horizontal, or semi-upright or any other position between. I thought it high enough.

CDR — Yeah.

SPEAKER — How about floor orientation versus radial orientation. I think you've covered that pretty much in your discussion of the MDA.

CDR — Floor is much better.

SPEAKER — Any particular restraint method that you felt other than, you mentioned the triangle shoes were the best, do you have any other comments about restraints. The thigh restraints, I think there were some comments on those in the wardroom, they seemed to work fairly well, didn't they?

CDR — Owen particularly liked them. They worked great, if you had the thigh restraints and put your shoes in too, you were locked in about as good as you could ever want.

PLT — I used them early in the mission, but later on I got so I just folded them down out of the way. Sometimes I'd use them, but I really didn't need them. It was either the triangles or the straps.

CDR — Those little blue thigh restraints that had been on the dome lockers, which were removed, worked well, too. Those were kind of clever and not too heavy. It seems to me that since we have to, it would appear to me that it would be desireable to invent a universal foot restraint so you could foot restrain anywhere, like the triangles. In the next space station we ought to make everything fit that. In other words, we should eliminate the thigh restraints on the food table, because you could make the others work perfectly. The fact that we had these little add-on triangles under the MDA, those were great. The ones by the C and D panel were good. We should have had something like that over by the VTR. Some of these other restraints that were concocted for development, we ought to find something, whatever it is that we're going to use is the restraint that works with your feet. We ought to try to use that all over the workshop.

PLT — I agree.

CDR — Then you're always got your, you're always ready to use that restraint and get to work. If you want to, by the way, the one in the shower worked great. That was a nice little restraint.

SPEAKER That could be incorporated into various panels and so forth like that or into the other structure perhaps.

SPEAKER Was it pretty secure? I mean, did you have to put much pressure outboard pressure, on the thing to really stay there?

PLT Just kind of touch it.

SPEAKER Of course, you didn't need it, taking a shower. But extrapolate that to being at a panel about that far away.

CDR You wouldn't want it as a -----. It's not passive. You want your restraint to be completely passive, where you put your feet in and forget it.

SPEAKER Yeah, that one in the shower, you've got to contain it.

CDR That's right, you've got to think about it, and work your toes.

SPEAKER For being at a panel for a long period of time that wouldn't be good?

CDR No. The triangles were great for that.

PLT Yeah, that's the only way to go.

SPEAKER Did you have any inadvertant operation of the airlock circuit breakers, particularly?

PLT Airlock circuit breakers?

CDR We had several and almost all of them were when Owen was taking pictures out the window. Of Aurora in the dark.

PLT Oh, you mean 201, and 202, those panels in there?

CDR Yes, Right.

PLT Right.

SPEAKER Do you think it was barguard design? Or anything specific that you could pinpoint?

CDR Barguard design was probably not as good as it could have been.

332 17 45 01 PLT Non-equipment. Okay, that's item number 3: How effective is non-equipment-assisted verbal communication? I'd say - say when you're on the same level, you have no difficulty communicating. And this is because of the noise level and the way it increases as you go up and down the X-axis of the workshop. So when you're trying to shout to somebody who is separated from you by more than 10 or 15 feet along the X-axis, you find it extremely difficult to communicate. When you are communicating on the same level, say in the X/Z plane, you have no difficulty. Of course, that restricts you to a limited distance there, probably no more than 20 feet anyway. Also, I think probably the shape of the workshop, the fact that it's round, helps a little bit to focus sound and especially when you're communicating on the same level. I would say - I think I've already given the distance - I'd say, oh, 15 to 20 feet. When you're separated by more than 15 to 20 feet along the X-axis, you actually have to shout.

332 17 46 12 PLT Okay, item number 4: How satisfactory are the food management and dining accomodations? I would say they were satisfactory. I think that's what I would give them. I like the water guns; they're real good. The dispensing system is good. One of the things, the foot restraints, - they have already been picked to pieces; I don't want to cover them. I don't like them too well. They clock your triangles, but they don't unclock them; so when you get out of the foot restraints on the - on the wardroom table, you got to reach down and exert quite a bit of force with your fingers to unclock the triangles so that you can use them in the grid. And this means that - It's a little bit unpleasant, and you sort of tend not to use the triangles in the pedestal around the food preparation table. Foo - Foot restraint is - is essential when you're around the - the wardroom table though, and that's where I usually step back and just use the grid, because I'm a little bit lazy and I don't like to reclock the triangles.

332 17 47 17 PLT The - How well does the food adhere to the utensils when eating? It adheres quite well; however, you

Reference 24

Final Dump Tape 332-11/D-138
Time: 332:23:42 to 333:00:43
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332 23 42 30 SPT

SPT at 23:42. Subject is M487-2A. And I'll be giving my comments now, the CDR will - the CDR's comments will be coming in a little later tonight. First question: What particular aspects of the OA seem well designed and arranged for living and working in zero g? I'd say probably the best part is the MDA. That's because we've made - well - good use of the wall. I think the lower compartment, that is the experiment compartment, and oth - the other quarters on the lower floor of the OWS are okay; however, the upper compartment could certainly be much better in that the walls are not utilized for anything. It's strictly a one-g design. The bottom experiment compartment is also a one-g design, but because of the height, you probably gain more by working on the floor than you do on the walls. I think the whole OWS has been a one-g design. It's been that because of - well, for many reasons, mostly engineering. In terms of optimum work, I think something like the MDA is best for working at a given location in modules and so forth. If you need the free, large, open space for experiments, then the upper part of the OWS is fine.

332 23 44 30 SPT

What restraint devices offer the most assistance in performing tasks and which the least? I think the best that we have are good, old triangle shoes. They seem to work real well. The ones that worked the least probably are the restraints that we have, or the lack of restraints that we have in the head and also the foot restraints in the wardroom. The foot restraints there always tend to unlock your triangle so that you end up with the inner part locked and the foot coming out, which means it only takes a good 15-20 seconds of - of pushing and pulling in order to get your triangle shoe back in shape. So the net result, you never end up using your triangle shoes.

332 23 45 24 SPT

In the head, we just don't have any. There are some little ones on the floor which - which are all right if you're in your bare feet, but they don't help at all if you're in triangle shoes. I would suggest that we make walls, ceiling, and as much as possible out of something which you could

		hook your shoes on to, whether it would turn out to be triangles in the future or squares or balls or whatever it'd be. I think that much of the environment should be made of that particular material.
	SPT	How effective is non-equipment-assisted verbal communication throughout the OA? It's okay if you are in the same compartment - that is, if you're, say, in the lower bot - lower storage well of the OWS or the upper compartment or in the MDA or in the command module; but if you're trying to go from any one of those four compartments, it's awfully hard. You can't do it because there is usually too much noise, or there's too much absorption of sound. If you happen to be in the experiment compartment, then you can usually call up to someone above you, but it does take a fair amount volume.
332 23 46 36	SPT	How satisfactory have the intercom boxes been for IVA communication? I find that when they are not squealing they're okay; however, the problem with the squeal just makes these things almost obnoxious at times. I think that it's a shame, and I think that they could have been designed better. I don't think there's any reason for - with the technology that we have at our disposal - that we end up with comm boxes that have squeals for three missions. We have come up with an alleged fix for these; however, when we put the fix in, we find they still squeal; maybe not quite as bad as the other guys have had it, but they're still squealing. Every time you press one of those buttons, they squeal, and then you run around for a good 10 - 15 seconds trying to find out which box it is, and then calm it down. Air-to-ground also works the same way. I find it's not such inconvenience, but a real time waster. I think whoever designed that thing just incorporated an awful lot of wasted crew time and a lot of - he created a lot of nonproductivity into the whole mission. Locations are not too bad.
332 23 47 49	SPT	How satisfactory are the food management and dining accommodations? They're not too bad. I could find - I could think they could be a little more pleasant in the wardroom. They're - Functionally, they seem to work reasonably well. I don't have any real major complaints right now.

answered a couple of questions. And all I can add is that I think I could have seen the barium cloud injection against any dark background - whether it be Earth - un - unilluminated Earth or space background, stars - and possibly after it hit hit the discone and sort of bleeped out the wardroom window. I probably - If it hadn't been for that, I probably could have seen it for a - another minute and a half, maybe 2-1/2 minutes at the most. And I did see the barium cloud there as soon as it was injected.

333 03 05 06 PLT PLT; end of comments.

333 03 06 28 SPT You are on channel B, Bill.

CDR Hey, Bill.

SPT You're on channel B, Bill.

333 03 06 41 PLT Okay, PLT remarks on S233 operations. And in the remarks section of the day 332 pad, it says, "Take all three exposures at the same camera position." This is virtually impossible, because you have to destroy your camera setting each time you change the focal distance. And it's very difficult to get it back in the same position, although we tried to do that. As far as locating the comet, the instructions, the little - little chart you sent up on teleprinter, is excellent. And I've already commented on the ... - the coma of the comet between last night and tonight.

333 03 07 49 CDR This is the CDR at 03:08 Zulu with an M487-2 Alfa debriefing. Question number 1: What particular aspects of the O/A seemed well designed and arranged for living and working in zero g?

333 03 08 12 CDR I would say that the - the forward compartment and the experiment compartment, the wardroom, the sleep compartments are all well designed and well arranged for working in zero g. I think that probably the most important aspect - the desing aspect that makes it so well designed is the fact that we have the grid and that we wear the triangle shoes and that there are multiple places to anchor yourself in order to do the work that you need to do.

333 03 08 47 CDR

I've given a little thought to the dome area and whether or not we need some more handholds. I'm not really convinced that we need any more handholds than we have because we don't do much up in the upper dome area. There's a lot of blue handles up there that we don't even use. Around the ring lockers, I think it was a very good design to put the - the ring of triangles - the blue ring with the triangle holds in it. There is no ring locker that you could get to without - that does not have some sort of a foot restraint available on the blue shelf. And I think that's a very good design. The ring lockers are very handy; they're nice and large. I think the Samsonite-luggage-type ... latch and raising mechanism are really very good. The experiment compartment is well laid out. It's a bit crowded. But it's an experiment compartment, and I think, functionally, it - it fits pretty well.

333 03 09 59 CDR

For the wardroom - The only bone I might have to pick with the wardroom would be the foot restraints in the wardroom. The triangle foot restaints - restraints at the floor of the table, I'm sure you've already been told, are not exactly the same as the rest of the grid. And when you lock yourself in with your triangle shoes, that's all fine; but when you get ready to unlock yourself, it releases you before you get your triangle fully unlocked. And then you find yourself skipping along on one foot, ricocheting off the walls of the overhead, trying to reach down and get your triangle popped back into the neutral position so that you can stick it into the grating somewhere else. So that's a very definite design deficiency with the wardroom.

333 03 10 49 CDR

Around the table, I think probably the best thing to have been - to have done there would have been to just leave the whole floor area out and just make it all the mesh - the gridwork under - under the table and maybe only have one or two triangles filled in on each side with a loop for a bare or boo - booted foot, so that if somebody who wants to eat barefooted or with a booted foot. I think you've probably got 20 times too much brown area down on the floor. Completely unnecessary, and

it would have been, I think, a lot better off with just more open grid.

333 03 11 32 CDR The sleep compartment. I think for the room that is available for those, I think the sleep compartments are well laid out. As you lay here in your bunk, everything is within reach - the radio, the lights, your locker - and I think that that's a good design situation. I think - Well, I just can't think of anything else to say there. I think maybe a little more work could have been done in the lockers to personalize them a little bit more. The lockers are really just the plain old sterile lockers that are available in all the rest of the area - your open areas or with straps in them for retaining bundles. I think one locker probably should have been - maybe the second or the third from the top; probably the second from the top - should have been designed to open out only horizontal and provide a writing surface, sort of a little desk, much like you find in the stateroom aboard a navy vessel - in - in the officer's stateroom. I think - You know, a Ben Franklin desk sort of think where you can pull down the door and it would stay horizontal. You could lay in your bed and write. And in the locker itself, would have been - I think it would have been good to have a bunch of little pigeon holes and various little ways of restraining pieces of personal equipment and things like that. Last but not least, on the lower deck is the - the waste management compartment. I think the equipment in there is very good. The pot and the urine collection devices, I think, are surprisingly easy to use, and they're very effective.

333 03 13 31 CDR I don't know how much better you can get those. Of course, I - I must admit that when I - before I got here, I had very grave reservations for the ability of these two systems to work well. And I must say I was very pleasantly surprised, oh, on the first time in using both systems. I found that - that they worked as well as advertised. The big problem, I would say, in the waste management compartment is lack of proper foot restraints. We kind of boxed ourselves in, literally speaking, when we put the sheath over the floor and - thereby

dealing ourselves out of the gridwork available for locking your seat down. And unfortunately, we didn't do much to remedy the situation once it was done. The designed foot restraints that are in front of the urinal and the pot interfered with the drawers; so we've had a lot of design modifications and a lot of fiddling around. And the final upshot of that is that we've ended up with nothing. And changing out a urine drawer in the morning is pure hell because you've got no way to lock yourself down to do the work that you need to do. And you're forever trying to jam yourself up against the wall or lock your feet here or there and get yourself in position so that you can do the urine sampling and the urine bag change op. The same goes for when you're finished using the commode, the fecal collector. You find yourself in a tough situation with a tough cleanup job left to do and no way to lock yourself down so that you can stabilize yourself and do the cleanup you need to do.

333 03 15 18 CDR

You've also got to weight the feces, put in a new bag, mark the feces label, get it into the oven. And so then during the whole period of time, you're just ricocheting around in there with really not much of anything to lock into, nothing but a couple of handholds. That's the most serious problem in there. The - the mirrors, I think - We could have done a better job on the mirrors. I think there are better metal mirrors available than what we've got. Those are just too dull, too difficult to see yourself in. I think the water dispenser and the - the squeeze bag are very good pieces of equipment. Right offhand, I can't think of a - a better way to go about doing that. I think for those of us who shave with a razor, a blade razor, you need some way to clean it out. And I think that would be something that can very definitely be designed for future spacecraft - some sort of a little see-through compartment with a jet - water-jet nozzle inside of it that you can stick your razor in and seal it and then turn on the little sprayer and rotate your razor or - or squirt it and - and knock all the - the lather and the hair out of the razor so that it can be used again without wiping the blade. I think that -

one rather bright little area in it and active region 87 seems to be picking up some, too. They're getting much more closely to the same intensity at this time. That's about it for now.

333 23 29 31 CDR — CDR out.

333 23 44 38 PLT — (Music) PLT on the M171-1; the subject is the SPT. Percent O_2, 71.83; Percent H_2O, 4.06, Percent CO_2, 2.04.

333 23 51 41 PLT — (Music) PLT with an M487 update for people that are interested in restraints. Time is coming up 23:55 Zulu. I just though of a couple of items that may be of interest. One is triangle shoes. Although they are very useful, this isn't - doesn't mean they cannot be improved. And one of the problems that we have with them is getting them off. It takes an awful long time to get them off and get them on; it's awkward. I don't think the lacings that we have on these shoes is the answer. It's awfully time consuming taking them off and putting them back on, and we have to do this several times a day because of medical experiments or one thing or the other. Working out, when you clean-up, at random - probably putting our shoes on and taking them off - probably four to five times a day. And the lacing gets to be an irritation. And it's time consuming.

332 23 52 37 PLT — Another point on triangle shoes, of course, is wear, that you've already heard about. The toe caps have been installed on the CDR's and the PLT's. They seem to be working okay, but we're also chafing the heels of these things, and I don't know why, but the back - up the back of the shoe. Third point is that the triangle slips along the groove, and I think - any - if we go this way in the future, one of the things that would be very useful would be to have some kind of toothed or toothed track which would hold - tend to hold the thing firmly to keep it from slide fore and aft, and then the - the little wingnut that we use would not have to bear the full brunt of the stress that's given to the - the triangle cleat part when you move around.

		You can tighten it as tight as you can with the channel-lock pliers, and in about a day, they're loose again. So, there needs to be a - a better method of keeping the triangle from moving.
333 23 53 40	PLT	Second unrelated point, but still I - in the way of restraints, is that - again the drawers and the poor design of the drawers that we have. In the food compartment, the pudding drawer is completely inadequate. The puddings are always floating out of their restraints and getting upended when you pull the tray out to put on top of the food preparation table or the trays to heat food. The puddings all come floating out. The tray is required to restrain the puddings in the tray there - that is reserved for pudding.
333 23 54 16	PLT	Another point is - I mentioned yesterday in the M487 about the difficulty in restraining the pieces of paper - managing the pieces of paper. One of the things that we - we found that would be - of course, clips are very nice, but once they're off of the counter bungees, it's very useful. However, when you're using the bungee, you almost have to have a convex curved surface, so that the bun - bungee or rubber band or whatever it is, is stretched across a slightly curved surface. Or else the friction is lost, and we've lost - temporarily lost a lot of pads this way, by putting the paper under the spring, and the paper will float free. If the spring's stretched across a flat surface it tends to not hold the paper as well as if it were stretched across a curved surface, is something to bear in mind any time you're designing a surface for writing.
333 23 55 06	PLT	PLT out.

END OF TAPE

Reference 27

Final Dump Tape 336-06/D-173
Time: 336:17:29 to 336:18:33
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336 17 29 01 PLT PLT. Tape recorder measurement following the first EREP pass, tape measurement on the takeup reels, from the tape onto the outer edge of the reel, 2-7/16 inches or 6.2 centimeters.

336 17 33 02 CDR This is the CDR at 17:33 Zulu. I have a question for the M487 people. If you'll remember back in my M487-2, I think it was Alfa, my comments - one of them was the fact that the brown panels on the floor around the - the food pedestals, used up too many triangles in the grid and briefly restricted the use of the grid around the table and really wasn't worth the trouble. I have a question. Would you ple - please look into the possibility of what would be involved in our removing one or two of these brown plates on the floor. If it's feasible, we'd like to know if we can do it. We would like to raise - remove one of them or two of them and evaluate the eating area without the brown thing down. And we'll return some photos on what it looks like and what we've jury-rigged to make it work.

336 17 34 04 CDR CDR out.

TIME SKIP

336 17 59 54 PLT The PLT recording the monitor readings. Alfa 1 is reading 51. Alfa 2 is reading 60. Alfa 3 is reading 87. Alfa 4 is reading 60. Alfa 5 is reading 67. Alfa 6 is reading 0, full-scale low. Alfa 7 is reading 18. Bravo 1 is reading 50; 2 is reading - Bravo 2 is reading 57. Bravo 3 is reading 75. Bravo 4 is reading 71. Bravo 5 is reading 75, good. Bravo 6 is reading 55. Bravo 7 is reading 32. Bravo 8 is reading 1. Bravo 9 is reading 57. Bravo 9 is reading 57 and the cue card says it reads - it should read from 0 to 5.

336 18 01 18 PLT Okay, I'll watch it.

PLT Charlie 1 is reading 0. Charlie 2 is reading 55; 3 is reading 88. Let's check that again; Charlie 3 is 88, which is a bit out of scale. Okay.

	CC	Skylab, we're a minute from LOS. See you over Vanguard in about 22 minutes at 21:11.
337 20 49 59	CDR	Roger.
337 21 12 08	CC	Skylab, AOS Vanguard, 9 minutes.
337 21 13 44	CC	Bill, Houston.
	PLT	Yes. Go, Story.
	CC	Bill, we got a couple telemetry points down here which are contradictory. We'd like you to check a circuit breaker on panel 200, that's OWS HEAT EXCHANGER FANS, number 2. Tell us if that's OPEN or CLOSED. If you find it OPEN, leave it OPEN. And it's on the lower left-hand corner of panel 200.
	PLT	All four of those breakers are CLOSEd, Story.
337 21 14 40	CC	Okay, thanks; and I got one other message for you and the CDR, and Ed, too. You got a GO to remove those foot restraint plates around the wardroom table. As you all know, it'll take two bolts - remove two bolts from them. And after you get the bolts out, you'll probably have to pry the plate off as it's bonded to a shim below the plate.
	PLT	Okay. I'm sure Jerry heard that.
	CC	Sounds like a good idea.
	PLT	I think it's an excellent idea.
337 21 20 52	CC	Skylab, we're about 20 seconds from LOS. See you over Hawaii in about an hour at 22:18.

END OF TAPE

to where you're going. If anything, that fireman's pole was an encumbrance because if you got on one side of it, you had to go around it in order to get where you wanted to go. Supposed to have been right next to the hatch and you found yourself sometimes on the wrong side of it and going up it. And that slows you down more than, I think, not having the thing at all. If anything, what you might want are larger hatches and a pole running right up the center, right on the axis of the - of the spacecraft. Well you have a dome - OWS Dome and wall handrails. I'd say those are excellent; if anything, we need more of them.

338 03 20 38 SPT STS handrails: Again now, those were good. I think one thing we do need more of though are things to hold checklists. MDA handholds and handrails. We could use more in here; there's hardly any at all. That would be much more useful to have - So I'd say at least a factor of 10 more than what we have in there. What we have in there is very little. Shall I call those inadequate? I call it poor.

338 03 21 17 SPT Triangle shoe cleats/grid: I give that a very good. I think they're very useful. They work very well. Drawbacks are that they have covered up too much of the grid around here and there never was enough to begin with, so that you don't have that much choice in where you put your feet.

SPT It's always on the floor or ceiling. You should have more on the walls and we ought not to have as much covered up as we do. You know it looks like a lot but there are very few triangles which are really useful. If you manage to get your triangles in, it works. IAlso I find that when I'm not working, I just go around in stocking feet or light shoes. I find the heavy knits are those - the best of those shoes. Just a little - somewhat an encumbrance and I just don't enjoy zero g as much with them on.

338 03 22 12 SPT Conical sho - shoe cleats and grid, I have not tried. Water tank foot platform: I guess for a job you're going to do, it's very good. I - not really much up there. Water tank - portable 512/M47 [sic] foot platform: don't use it very much - hardly at all, once for the EVA. So again, I can't evaluate it.

	SPT	ATM foot platform: I'd call that adequate. What I'd like to do is to have that foot-pad moved down a lot more than it is. We find ourselves really hunching up over the panel, trying to get our heads in the same position they were in one g. And we can't move that thing down any more. Useful to have much more, greater range to travel on. Portable PGA foot restraints: Okay, very useful. I give them an excellent.
338 03 23 03	SPT	Portable handholds; specify where and how used. I guess - I guess the problem is - they're probably adequate, but the problem is, for me, I don't have time to run one - run one up and then try to figure out where to put it. I'm interested in getting the job done and I sure don't have time to construct things in order to do it. If I used footpads many many times, I might do that, but I have not run into that situation yet.
	SPT	Portable equipment restraints, tethers, bungees, universal mounts, et cetera: Okay, most of that - heck, let's go at it. Tethers: I've - I've not used any inside except for the small lanyards that we put on our checklists, and I'd say those are very good. The bungees are - If you're talking about the spring ones, they're lousy. They - they stretch out too easily, and I give those a poor.
338 03 24 05	SPT	Universal mounts: I guess for the job they're going to do, they're very good. ATM seat/back rest restraints: I haven't tried it. I have the feeling it would be very much - way too confining. When I'm working on the ATM, I have material mounted all around there. And I swing my body completely back, to the right side, to the left side, straight up, in order to get to the material which I have posted for cue cards and one thing or another. Sitting in that chair would really tie me down. So that's why I haven't even attempted - I may drag it out one of these days when I get a chance.

SPT Fecal collection equipment; urine collection equipment: Okay, the fecal - I give those a very good. The only short-coming I have is that the whole operation takes too darn long. It takes a man about half an hour. I'd say the bags are the weakest point. There's just too many - too much green - green stickum to pull off and things to try to piece together and make stick. That bag is a very poor design. But, in general, the system works pretty well.

SPT Urine collection equipment: I give that an excellent. I think the problem we had with it, that takes all the time, is the requirements of experiments and not the equipment itself. Hand washer: Okay, I guess I'd give it a very good. I don't know how else you'd do it, that's why. It still is a little bit inconvenient to have the water splashing all around when you spray, but I've learned how to get around that, so it's not too bad.

338 03 25 50 SPT Fecal/urine collector lap assembly and handholds: Okay, I've never used the lap belt. I get the thing on very good. Handholds are just in the right place. Lap strap - never used it. Just gets in the way. WMC handwasher handrails: Okay, yes. I guess it's useful where it is. I could put a few more handholds along the side there, would be very useful. As matter of fact, we don't have very many handholds in there at all. So I guess I'd give those - that an adequate because there's not more of them.

338 03 26 32 SPT WMC ceiling handrail. I'm skipping by the foot restraints. Fact is, those are nonacceptable. They are just - with gross shortcomings. The problem is that we don't have any triangle grid in there to lock shoes so you can do any work. The only few we have are the two that you stick your feet under, which are too - too big for your regular feet and too small for triangle shoes. I have just not been able to make those things work at all. The only reason we can get away with doing any work in that room at all is it's so darn small. We just need much better foot restraints, more of them. I like the idea of having something you can put your stocking feet under, and not just triangle shoes.

		I think we ought to retain that. Drying: Okay. Light-duty foot restraints: Well, here I - hold on; I'm moving on.
338 03 27 24	SPT	WMC Ceiling handrail: Don't use it very much. I guess it's adequate for - but I just flat don't use it very much at all. I guess when you ever need it, you might - you might find it convenient, but I'm usually using the walls. WMC light-duty foot restraints: Okay, going back to that ceiling handrail, I'd give it a inadequate also because it really doesn't have that much job to perform.
	SPT	Okay, the light-duty foot restraints: I'd give those - I'd give those inadequate also. The problem is they're - they're not big enough or they're not small enough. They ought to be smaller if you're going to use your stocking feet in them, and they ought to be bigger if you're going to use triangle shoes in them.
338 03 28 16	SPT	Drying stations: I think they're too crowded together, so I - I'd give them - inadequate. They do the job, but it's just, I guess, too - too packed together.
	SPT	Shower: have not used it yet. I use sponge baths, and what's the difference. I guess I really can't give you a rating; I guess I'd give it an adequate, but what scares me off is all the frapping time it takes just in order to get the - the thing set up and to clean up after it. I find I can go on in and give myself a good sponge bath and can do the job just about as well as that shower in about half the time. We've been pushed for time up here, so I just haven't had the - haven't had the time to - the luxury to go on in there and try that. Looks like fun and I'll probably - I'm sure I will try it quite a few times.
338 03 29 11	SPT	Personal hygiene kit: It's all right, except the place that they have it stowed is inside a small locker. I'd much rather find a place that we could stow it permanently outside so you wouldn't have to dig into a small locker and fiddle with it all the

time. I find that kind of inconvenient. So I guess the kit itself is very good, but the location is poor.

SPT Towels and washcloths: I guess I'd give those a poor. I think the fire guys really got away with something when they made us go with that kind of material. I don't think it's absorbent enough, and I think it's too hard.

SPT General utility wipes: Okay, those are all right, except they're a little bit hard to get out of the container. I'd give them a very good. Again, we don't have enough of them.

SPT Wet wipes: I think they're too hard to open up; I'd give those an adequate. They're good once you get them open. Biocide wipes: I'd give those a poor. No one wants to go on in and get that biocide all over your hands whenever you want to clean up one simple thing. I think we ought to have a plastic handle on a sponge which has got something - which has got a way of getting biocide into the sponge, and then can be kept at a location where it won't dry out.

338 03 30 40 SPT Utensil wipes: Adequate. Again, tough getting the bag open.

SPT Trash and plenum bags: I'd give those an excellent; I think they work real well.

SPT Urine/fecal bags: I'd give those a very good. Only thing is they do tend to - a little bit hard to roll up and get them all squared away.

338 03 31 06 SPT Wardroom table, eating space: I - I guess I'd give that, oh, an excellent. I think that works pretty well. Thigh restraints: Adequate; they don't really hold you in there. You got to work at it pretty hard; what we really need is a good pair of foot restraints in there. Wardroom light-day - light-duty foot restraints: They're unacceptable. They just - they don't hold your shoes; they're too - way too small and you really can't get your stocking feet in them because you can't hold yourself that well

with your stocking feet ... Food reconstitution - well - We're getting away from the foot restraints.

338 03 31 50 SPT

I'd give the foot restraints an unacceptable. Two reasons: first your triangles always become locked and they still come out. So you're going to have to get in there and try to unlock your foot restraints with your fingers, or try to squeeze them back into those foot restraints to try to get it - to square it away and get it working right again - get it working right to pull your foot out. And secondly, there is only one location. I think we should have just done away with that completely, as we planned to do - planned to do, and just use triangle grid. Let you put your feet wherever you want them. That was really a make-work project there. What we also really need are some lightweight foot restraints that just snap into the triangle grid, so you can put those anywhere you want, because there - I could just go in there in my stocking feet, or with light shoes on and work that way. That, combined with the thigh restraints, would probably be a good system.

338 03 32 52 SPT

Food reconstitution dispenser: Okay, it works pretty well. Little bit hard sometimes in order to get the - I'd give that a, oh, very good. A little bit hard to get the food you're reconstituting out of it at times, but that's no real major problem. What I would like to see is a way of selecting how much you want, as we have, but also a way of letting the little - marker run up and show you how much you are actually getting at any given time, so you can shut it off right when you wanted to. I think the - Also we ought to go up to 8 ounces on that because many of the drinks are over 6 ounces, and it's a two-action move there in order to get it all in there. What I'd like to have then is, going back to the present system, is a way of seeing exactly where the cylinder is; that is, how much is in the cylinder at any given time while it's charging. That way you can cut it off by going from CHARGE to DISPENSE at any moment. I think especially if you had 8 ounces you might just leave it at 8 ounces all the time. It's a lot more bother moving the thing back and forth, and just

It puts the Ground into a full-scale panic to even touch those things. So I guess I'd say that poor to adequate would be the rating I would give the handrails. And as far as the MDA and STS as a working area, as far as restraints are concerned, I'd say it's unacceptable. Real shortcomings all over the place, and the MDA is just a lousy place to work.

344 21 41 22 PLT

Triangular shoe cleats/grid: I would say very good to excellent. Conical shoe cleats/grid: I've not used yet. I want to get around to using those; I'm going to try to fit up my second pair of shoes with conical cleats and try them out. Water tank foot platform is excellent for working dome lockers. It's no - not much good for working water tanks. I'd say it's poor for working water tanks because of the crouching action that has to take place. By the way, a crouching action is very difficult in zero g; so if you design a foot restraint where there's - this posture requires a crouching action, then you're not helping us at all. In fact, it's a great hindrance to have to go into a crouch because you have to hold your abdomen very stiff and your leg muscles very stiff and you're at a constraint strain even putting on shoes. When you bend down to put on your shoes - If you bend down, it's difficult; if you pull one leg up at a time, it's not too bad to lace shoes.

344 21 42 22 PLT

Portable M512/479 foot platform: Not applicable except for its EREP purposes. So - And that's very good except it's very limited. It's only good for the C&D panel, and that's about it. The rest of the thrashing about for the C&D and the VTS operator is done without foot restraints and is difficult. The ATM foot platform is good. Portable PGA foot restraints: I did get to use them the time - Because I was - I had to use my PGA foot restraints for the EVA - foot restraints for the S193 maintenance. Portable handholds: Not used. Portable equipment restraints - tethers, bungees, universal mounts, et cetera: Tethers and bungees, in general, are - are - are very nice to use; however, the ones with the little, fine wire hooks on them are really bad. They - The wire comes out

344 21 49 02 PLT The leg strap and the handholds are not - They're essential. They - In fact, I would say that they are very good. But I think that the whole thing is designed for an improper posture. WMC hand washer handrail: I find that very useful. WMC foot restraints: I don't know where they are. They're - As far as I'm concerned, there aren't any WMC foot restraints. Those two straps in there are not very useful for anything. In fact, we're always ricocheting all over the place in the head. In fact, I would say that the foot restraints in the WMC are unacceptable and even worse than that. That looks like very little thought was given to that problem. And you're - you do an awful lot of work in the head that requires thrashing about, - dumping urine bags, putting urine bags in and doing all the - the measuring and - of the urine and sampling of the urine - and you have no foot restraints for this. The head is very, very bad as far as foot restraints are concerned. In fact, I think that they really - somebody really deserves a thumbs down on the efforts in there as far as foot restraints are concerned. WMC ceiling handrail, I never use unless I'm out of control.

344 21 50 13 PLT WMC light-duty foot restraint: Well, I would guess that's - Again, they sort of flattered themselves to call them foot restraints because they're - they're highly unusable. There was not enough Velcro on there to - to open them up. To use the loops as large as they ought to be, you run out of your Velcro match points. I just think that there was very little thought given to those WMC foot restraints, if you - you want to call them that.

344 21 50 42 PLT Drying stations: I don't know what that is other than the electric towel holders, and they're excellent. Shower, I would say, is very good to excellent. Personal hygiene kit: Well, the loop - the elastic loops in there have little pads on them, but they are not long enough. I find that I end up just sticking stuff in from the side in the loops. It'd be nice if the little pull tab on the elastic loop was a little longer because - and also there was just a little bit more limit to

upstairs, the diffuser collector. And the wardroom table as an eating station is not bad. It's - I would say that it's adequate. Okay, the thigh restraints, I don't use. I - I use the foot restraints, and I use them out to the side, not on the pedestal, because you got to re-clock your triangle cleat every time you do that. We talked about that before. Wardroom light-duty foot restraints are just like the head - they're unaccepted. The - Yes, unacceptable. They're not - they don't even serve the utility function for which they were designed.

344 21 56 25 PLT

Food reconstitution dispenser: They're a little bit stiff - get more a bit stiff to work at times, but I really can't complain too much about that, other than the fact that in the future - See, we have to reconstitute many, many, many items. In fact, most of them, they require more than, I think, the 6-ounce max limit of these things. I think that a food reconstitution dispenser should fill to a volume equivalent to the max required to the reconstitution of an individual food item. Not if you're trying to fill a contingency water bag, okay; I'm going to give no argument there. I'm not saying that if you don't have a quart of water in, to be able to put a quart of water in there, because that could be un - undesirable. But I think we should be able to charge that thing with enough water to fill the food items which require, say, 8 ounces of water. Water gun is good. I would say that's - in fact, would be given an excellent rating.

344 21 57 23 PLT

The food tray: I mentioned this a ... - a little bit earlier. I don't like - The magnets aren't strong enough. The tray lid, of course, has been bad-mouthed quite justifiably. That's a pretty lousy design, that little latch on there. Let me see if I can think of anything else on the food tray, beacuse there were some comments I want to make on it. The timer, we don't use. We just turn the thing on. It doesn't put out that much heat. You can just turn the heater on, and it's never going to burn anything, for crying out loud. It - it just doesn't put out that much heat. Food cans: They've already been - Let's see. ... food tray is adequate. Making sure of that. Water gun is excellent.

344 22 17 08 CDR

Those handrails that are up there are quite adequate, and I don't see that's there's any - any need for any great - great amount of change there down in the lower part, in the wall around the dome lockers and everything. I'm going to class the water ring structure as dome and wall handrails, and I found that they were very, very convenient. It was a very good idea. I would call those excellent because you got a place to lock your feet in while you're working with each of the dome lockers, and I think that's very handy. As you get down further into the - the dome compartment, the handholds become a little bit more far between; however, you've got a lot of other things to grab because there's lots of things down in this area that you work around. I think it would have been a great improvement if we had had some handrails on the side of the film vault because you get over there and start working those doors and things. And it would be good to have a handrail on the side of each film vault.

344 22 18 26 CDR

STS handrails are adequate, and that's about where it ends. MDA handholds and handrails are poor to unacceptable, and I won't discuss that again because I talked about that at my last debriefing, about what I thought was necessary. Triangular shoe cleats grid: Those are excellent. I think the bit thing we need to do is not to clutter up the grid too much. The grid itself and the shoe cleats are fine and dandy, but we unfortunatly have a lot of things clamped down on the grid. And makes it - It greatly limits the places we can go and place our feet. The conical show cleats relative to the grid: I'll have to say "No comment" on that, because I haven't had time to try out the conical shoe cleats. Water tank foot platform: I called that excellent; I lumped that in with the - the handrails.

344 22 19 35 CDR

Portable M512/M479 foot platform: Those are very handy for suited work, but I think they could - could possibly be dispensed with. I would say that they're - they are excellent; they are good, you know, but I don't know that they're all that necessary. We find that getting in and out of the suit is more of a get-out-in-the-middle-of-the-dome-area-and-kind-of-wrestle-around sort of a situation, although I must

admit, the guy who is helping you get into your suit is certainly well anchored in those foot platforms. That foot platform also was extremely valuable out on EVA, and I think the modification that was done to it in order to take it outside and use it for the M1 - S - or S193 antenna repair was very good. I think the rating I would have to give the platform is excellent, but it's not used as often as it - as it - as I - one would expect, I think.

344 22 20 49 CDR

The ATM foot platform: Both of the ATM platforms are excellent. Again, because of the grid and because you can lock in and you have a various - various different ways that you can position yourself, they're very good. Portable handholds: We haven't used the portable handholds very much. We have a couple in here on the grid floor and in the forward compartment, and they're just really not used that much. We have none in the MDA, any of the portable handholds, and really have lots of places we can use handholds as I mentioned last time in my 487-2, I believe it was, but no place these particular handholds could be fastened. Portable equipment restraints - tethers, bungees, universal mounts, et cetera: Universal mounts, I think, are - are very good. We found them to be extremely useful and versatile. The bungees also; very useful, very versatile.

344 22 22 01 CDR

It's - it's a good idea that they put the snaps as well as the hooks on them. I think the later ones with the metal, wider flat hooks are much better than the - the ones with the little round wire hooks, the earlier models. And the main reason is because they're less dangerous. There's no - little or no change of - of jabbing one of those flat hooks into your skin, but certainly the little sharp ones are very dangerous. Tethers, wrist tethers and waist tethers have been extremely valuable on EVA, and I've always been a very strong proponent of them. I would rate them as excellent. The long shorts and short - long straps and short straps: I don't see them listed anywhere; so I'll hit them here. I think they're very handy. The only trouble is that they're very heavy and bulky. Seems to me there must be a lighter way

344 22 25 52 CDR I think the only possible improvement - Another way to go on a handwasher would be - also, again - again, - I believe I mentioned this before - the - the idea of a see-through container or something that you could put items in to was them, like your razor or something like that. Also your hands might possibly - Somewhat like - Oh, in many garages you have a little sandblasting rig where you put your hands in - in gloves and you put your - the item that you want to sandblast or clean inside. Then you close it up, and your hands hold it inside the box, and you - you spray it with the sandblasting equipment. Some - some - Something on that order might be quite valuable for the handwasher. Fecal/urine collector lap strap and handholds, I find very good. I use them, and I find them to be very handy. WMC handwasher handrail: That's also quite handy.

344 22 27 03 CDR Foot restaints: I've already discussed that. They're lousy - absolutely lousy. That's probably the most - The biggest single disappointment in the waste management compartment is the foot restraints. And I don't see any sense in going into that again. I think I waxed philosophical about that pretty much in the last one. WMC ceiling handrail: Very seldom used it. I would call it very good, but I don't really see that that was too terribly necessary. With proper foot restraints, I don't think you need a handrail. The light-duty foot restraints: Really, they're no good; in other words, unacceptable. Drying stations: I'm not sure I know what a drying station is. If they're talking about the - the little cups that we stuff our towels and washcloths in to hold them, I would say those are excellent. Those are extremely handy, and those are - are very simple and unique. I think that probably they should be spread out more in future spacecraft instead of being so close together.

344 22 28 27 CDR The shower: I find the shower to be very, very satisfying, very nice. I think for a first - a first try of a shower in space, I think that I would certainly rate this as - as adequate. The spray nozzle is very good. I think the scheme of charging the bottle with - with hot water and having a hot - hot spray is very good.

344 22 36 05 CDR It is not too terribly difficult to do, to - to take a whole lot of time, and that's probably a pretty good system. Food management equipment. Wardroom table: I pretty well hit the wardroom table on the last one. I would give it a rating of very good. The foot restraint problem down there - Let's see if there's a foot restraint - Yes, there is a foot restraint. I'll get to that later. Okay, the thigh restraints: I find them to be very good. I found them to be quite helpful and useful, and I use them every meal. The light-duty foot restraints: I guess that means the straps. Those are not too good because you can't really keep your feet in them. SPT used them with the ... on them, but that still doesn't do it.

344 22 37 07 CDR The other foot restraints, the triangle foot restraints in the wardroom table area, I've already discussed. They're unacceptable. And we have not yet got around to taking one of those platforms up in order to get access to more of the grid restraints, but we will, and we'll give you a report on that whenever we do. The water gun is handy and easy to use. It's ridiculously large, and it takes up a lot of weight. I think from a weight-saving standpoint, they should be redesigned in that to change it. The rating on that would be very good. Okay, the -

CREW ...

CDR Okay, getting on with my report here.

344 22 38 38 CDR The food trays, I would say, are excellent. They do a very good job. I think the little time-study thing is quite handy. The food cans are very good. I'm afraid - Well, let's say adequate on the ratings of the food cans. Those things are dangerous, really. Sooner or later somebody is going to cut themselves with that, and I think we need to find a different way to put our food up. But those food cans do do the job. They are adequate. It's just that I'm afraid they're dangerous. The beverage dispensers are good. They only problem with the food cans and the beverage dispensers or whatever the food comes in is essentially in the food itself. The food outgasses. It causes bubbles.

Reference 31

Final Dump Tape 347-08/D-280
Time: 347:18:49 to 347:19:24
Page 1 of 7

347 18 49 37 SPT The other day I had to take plants, elodiza plants - elodea plants out of the agar, and I used the table - actually, the food tray itself with a couple of cans. And there wasn't very - it's not a convenient place to use the table. The restraints for that table are awful - primarily to foot restraints. I think the best thing they could have done was to yank those - never put those foot restraints in there; simply stick with the triangular grid. If - if anything, people may want to use soft shoes in there, which is a good idea. We should have had foot restraints light - lightweight foot restraints which are portable. You can move around the foot down there if you want them. Right now you've got those triangular foot restraints down in there. Do nothing but move your triangle so that it locks. But your foot is out, and you have to ... chasing around. The net result means you're very, very careful putting your foot in it. The rest of the blooming thing just keeps you from putting your feet in the triangle grid. It's a lousy design and a lousy idea. Thigh restraints seem to work all right. You've got your option whether you want to use them or not. Sometimes I do; sometimes I don't.

347 18 51 10 SPT What sanifra - sanitation problems have developed, and how often have you dealt with them?

SPT No real major problems. No major problems. Probably the place we really got a disaster - seems like one in the wardroom, and there you do it piecemeal. Any time something flies out, you clean it up. Or if something looks - looks as though it's building up a little - little layer of crust, you clean it off. You do all of this piecemeal.

347 18 53 05 SPT The other location where we have our problem is the head. But everybody's pretty conscientious there and cleans up after themselves quite well, although potentially it could - could be quite a problem. Okay, that was number 4. I'll pick up on this in just a moment.

347 18 53 45 SPT SPT out on 487-2B.

other pieces of hardware in on top of it. Okay, yes, I understand. They had the number there, and people directed them to put something in on top of it. But, man, there is nothing to keep me from putting a - some kind of decal on it that had a big arrow and said, "Hey, dummy, look here for 322, or what ever it happens to be, 157."

356 19 31 54 PLT

It - The volume of the compartment is great. Ceiling-floor proximity is not good enough. It is too great for the paucity of crew restraint. Ingress, egress provisions: No problem. Trash collection: We ought to have a place to locate a gab in every large compartment like that. Ought to be two trash bags' locations, one near the CSM hatch and one back near the STS. ATM is a high-activity area; there ought to be a trash bag there. Stowage volume and access: Stowage volume is - I'd say is adequate - entirely adequate as far as the volume. And access is terrible because some of those doggoned doors are really hard to open. The pins are hard to get out, and they're hard to get back in. And I realize that these things are mapped to be made like a mausoleum vault because of the film protection, but that does not mean they need to be hard to operate. Temporary equipment restraints: Almost nonexistent. Personnel mobility aids: Very poor. Personnel restraint devices: Very, very, poor. The - the foot restraints for the EREP is good; for ATM is good. When you use the foot restraint for the 512, it's not very good. In fact, I stopped using it yesterday, it was so bad. I could get along better without the thing. It holds your body in the wrong position. Thermal comfort is cold, but it's sort of a nice relief from the workshop, which is hot. It is too bad we don't have a better way of - of transferring hot air up to the - the MDA to get - to cool off some of the air for use down in the workshop. Noise level is fairly high in there. We have commented on this. I took some M487 rating 2 - 2 days ago, and it is fairly high. Illumination is satisfactory.

356 19 33 39 PLT

And let's see. To go back, the - the locatability of items in the MDA is so bad it almost looks like you'd have to go out of your way to design it that way. I mean to - trying to find a number in that place for - If you don't happen - If you know where

to be taken off of the S190 window and stowed. I find it much easier to put it in the stowage location than I do to put it back in the use location where it's protecting the S190A window. Of course, we've already commented on the complete lack of assistance in - in terms of crew restraints in the MDA in general. Okay, so these - these - that is a general statement. It applies to almost everything, in that there's no temporary restraints at - either in the dome lockers when you're taking stuff out - Getting the PCU's out was a real fierce task. We had to replace a PCU, and those things were bolted in there with Stillson wrenches or something and that was a real - real chore there until we - to get those out. And there's no re - body restraint around the dome locker. Your - your - your feet - You can put your feet in the rings, and a lot of times that's great, but if - sometimes you have to come out of there in order to get up close enough to the item to - to work on it. So a lot of times the foot - foot-in-the-ring foot restraint wasn't good enough, particularly if the item was located high in the locker or in the lid of the locker.

025 12 08 31 PLT

Okay. Tool kit 1, tool kit 2, doesn't mean a thing to me. I don't know what - what that is. Let's see here, the tool inventory, that's what I'm doing. The repair kit, I don't know what that is. The 190 maintenance kit, I assume that those are the items up in the - the locker 130, but I don't know what that specifically is. M512 tools, processing facility, EMU maintenance kit. Okay, maint - let's see - Their - Their system is mainly okay. Miscellaneous support items: Okay, I'll just go through them. Tool kit 1, I'm going to skip over that because I don't know what that is. Tool kit 2, I don't know what that is. I think tool kit 1 is the stuff in the experiment compartment. Tool kit 2, I think is the one that's in the MDA and if that's the case, the biggest gripe I've got about the tool kit 1 is that the items come out of their stowage locations and jam the drawers. I've already mentioned how bad I think the design of the drawers in the compartments are in the aft compartment

Reference 34

Final Dump Tape 031-09/D-769
Time: 031:23:08 to 032:02:19

031 23 08 15 SPT

SPT at 23:08. M487-3 Echo, foot restraint evaluation. Characterize the large mushroom for just about the total day here. And my evaluation is, according to your point, first of all, ease of engaging. I found it very easy to engage the triangle shoes or, I should say, the mushrooms in the floor grid. Not much easier than the triangles, now that I've gotten use to the triangles. But still you usually get a hook in, then get a location. However, the big drawback that I see is the difficulty a - of having them remain engaged, that is, while you start working, unless you hold any kind of pressure against it, one way or the other you sort of get a friction around the shoe here at the floor or that you're always forcing the triangle or the mushroom up against the grid, your foot comes out. And I find this - this kind of tough to work with and kind of annoying. Also, slows down your work pace once you're at a given station. Which type of restraint would I prefer? If - I prefer the triangle. I've gotten used to it and I have not tried the mushroom for a long period of time. Maybe I'd get to know its in - ins and outs after a little while.

031 23 09 35 SPT

But the real advantage I see to the triangle once you learn how to insert in the grid, which - I can do quite easily now - just look at a spot and put my foot there in the triangle hole. It seems just like an automatic reflex now. Once you got your triangle in there, it stays there. And you can very easily disengage it too, when required. In either installing and removing the cleats, I found taking them off to be no real problem. But I used the large pliers on the wing nuts to make sure that they were on good and tight. And I used the large pliers at the base of the mushrooms also to tighten them up. And they're fairly easy things to put on and off. I would not want to do it many times a day if I had that chore coming up. But it can be done fairly quickly and not in a time-consuming way at all. Another thing for the M487 folks is the other day I did have a maintenance task and that was fixing the MARK I exerciser. And I was going to take it up to the screen, but it turned out, to unbolt that thing

Reference 35
Final Dump Tape 032-01/D-770
Time: 032:02:46 to 032:03:38
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032 02 47 13	CDR	This is CDR at 02:47 Zulu. The subject is M487-3 Echo, foot restraint evaluation. I tried the mushroom cleats today for a while, and I found them very easy to engage. Also extremely easy to disengage; in fact, they were so easy they were a pain. In some of the cases, I found that they were not easy to en - disengage. To be more specific, I found that once engaged, that you had to keep a constant foot muscle - foot and leg muscle tension going, or you would come out of the - the mushroom again. You would drift back out, which was a bother that made them rather useless, I thought.
032 02 47 59	CDR	I found, also, that any time I wanted to move on - I have gotten so used to using the triangles that I would rotate my foot and try to pull it up. ... wrong with the mushroom. Of course, rotating the mushroom doesn't do anything ... does nothing for you, and you end up with your foot still locked in. And I almost twisted an ankle by stepping off in my usual manner as if - as if I had a triangle on, and finding out that my foot was still anchored after I'd already started moving my body on. The difficulty of remaining engaged, like I said, is strictly a muscle thing; you have to keep your muscles tense, or keep a strain on the mushroom all the time in order to hold it.
032 02 48 46	CDR	Which type of foot restraint, triangle versus mushroom is the best for which kinds of activity? Well, I think the triangle is better than the mushroom at all times. But I will frankly admit that I've gotten used to the triangle and I'm very much prejudiced toward the triangle. I think it's a very fine foot restraint, and frankly, I can't think of anything any better. The only improvement that you could do on the triangle would be, have more triangle grid area available for use. Now that's - One advantage of the - of the mushroom is that it can go into places where you don't have a complete triangle available, just the one apex. And as long as you can get your mushroom through the hole, and into the apex, you have got a place to put the mushroom. And that's an advantage there.

032 02 49 33	CDR	Ease of installing and removing the cleats from the shoes? No problem. They're quite easy to install and remove. And adequacy of the restraint systems: I just don't think they're adequate. And I think the triangle restraint is far superior. And I don't - I think after you get used to the triangle and learn to slide in, that I can - I can get locked in with my triangle just as quick as I can with the mushrooms. And it's a secure lock; and I feel a whole lot better about it than I do with the mushroom on. I think the triangle shoe does require a little bit of training. You need to kind of develop your technique. But when you do develop it; I think it is by far the - the superior way of foot restraint.
032 02 50 20	CDR	The CDR out.

TIME SKIP

032 03 34 43	CDR	This is the CDR at 03:30 Zulu reporting Earth observation handheld photography. At 02:31, I got a picture of Sakurazima in southern Japan. It was an IR photo - Correction, it was not an IR photo. It was Charlie X-ray 49, not an IR photo. And it's frame number 2, taken at 4.5, 300-millimeter lens, 1/1000. The smoke was blowing directly down the bay which is about south-southeast in direction. And there was not a whole lot of smoke; fairly fine stream of it and not too much indication of a wide spread pluming at the end of the smoke as we had before.
032 03 35 37	CDR	The next photos taken were with the IR photo. Charlie India 13 is the magazine number. At 03:20 I got current in sunglint north and south of Merriwa, Australia. These are frames 18 through 20; f-stops 11 and 4 - and 8, 55-millimeter lens, 1/500. And then at 03:30 as we came up to New Zealand, I was for the main part watching the Tasman Sea that - to look for any indications of current in that area. The Tasman Sea was completely clouded over all the way from Australia to New Zealand. However, out east of New Zealand the weather was clear. I got pictures of extensive coastal blooming near Christchurch, New

Reference 36

CARR

It's so nice to be able to put your foot in and lock it in and not have to hold it in. That was one of the disadvantages of a mushroom. Once you put that foot in there, you had to keep the pressure to hold it in th[illegible] it would drift out and you might, when you're busy with something else, find yourself floating off. Then you would have to stop what you were doing and reanchor. But there are things to be said for a type of restraint which allows you to quickly get in and get out. It would be nice to be able to swap foot restraints or swap the type of shoes you wear. As for the shoe itself, Ed and I wished that those shoes had been low tops instead of high tops. We didn't feel that our ankles were in any danger at all and it would have been better. Bill liked the high tops.

POGUE

Still, I would have gotten along just as well with the low shoes and there would be less effort lacing them up every time.

CARR

Well, laces could have been done away with too.

POGUE

That's right; we don't need laces.

QUERY

Mechanically the shoes were not ideal?

POGUE	One of them broke.
QUERY	Did that limit you to one-foot operation, Bill, when you damaged that shoe?
POGUE	No, I fixed it.
GIBSON	With enough gray tape you can fix anything.
POGUE	It looked like I had a baseball taped on the bottom on my shoe because I put so much tape on it, but it worked all right.
GIBSON	The only disadvantage for me was that I hated something massive on the end of my feet, and those triangles were fairly massive. But when I wanted to do any work at all, I just had to put the triangles. There was no way around it.
CARR	Once we got the suits on in the pre and post EVA, we sure missed those triangles.
POGUE	The IVA crewman really had a time at the ATM grid. I was continually working to hold myself in position when I was suited.
QUERY	That's very interesting because Orbiter and Spacelab are both at a position now where we must baseline some sort

QUERY (CONT'D)	of floor, and I guess we would conclude, until we invent something better, that we would probably go along with the triangle.
CARR	The big thing on the floor design is to be careful that all that good floor grid doesn't get blocked out with struts and stanchions.
POGUE	There was very few triangles in the food stowage locker area you could use. And you had to come out about a foot away from any particular area before you could start using the triangle because you can't lock your foot in and out.
CARR	Another area was where we took the floor plates out was in the wardroom - those foot restraints around the pedestal. We improved the restraint situation by probably 500 or 600 percent by doing it, but there were still a lot of triangles we couldn't use because of the beam structure that supports the pedestal.
QUERY	We should make an effort to stand the floor off in a manner that doesn't restrict movement.
POGUE	And that should be removable for cleaning up.
CARR	Right.

Reference 37

GIBSON As I recall, it was straightforward, no problems.

CARR Water System Gas Bleed:

POGUE Water system gas bleed, water sample, H_2O system flush, H_2O system bleed, WMCH activation: I didn't like the design. The procedures were well written. Everything was nominal except for the error on me. It was recoverable. All it did was cost me time.

CARR Triangle Shoe Distribution: I was very relieved to get them. I was tired of not being able to anchor myself properly to do anything.

GIBSON I think the triangle shoes are a perfectly adequate way of restraining yourself. The more grid you have available around a work station, the easier it's going to be. My only regret is that even though we had grid, the floor people had managed to bollix up at least 50 percent of the available triangles. I'd say at least that.

CARR I remember being impressed right at the outset with the triangles shoes. I wish we hadn't gone for hightops. I wished we'd gone for low-cuts. I never did lace my shoes to the top. I always laced to about two or three eyelets short of the top and tied the laces around my ankles. I would have much preferred low-cut shoes.

GIBSON | I did that, too. I did it to try to allow the calf muscles to get a little more exercise. Rather than have the ankle restrained with the hightops, sort of make them into a low-cut. We get more exercise in the legs. I think it would be an idea for the future. Those hightops, if anything, gave you support that you shouldn't have had.

CARR | I'm sure that was the purpose of the hightop, ankle support, so you wouldn't hurt your ankles.

GIBSON | Yes. The problem is that you want to work your ankles so you don't lose all that strength. You keep your legs in trim. That's one reason I tied them down a couple of eyelets. We should have had lowcuts instead of the hightops.

POGUE | I like the hightops. I have weak ankles to start with. The point you're making is very good. There's no reason why we couldn't have had both. They don't weigh that much. I ended up breaking one of my shoes. It would have been nice to have a backup there.

CARR | Yes, we should have had backup shoes.

GIBSON | Foot-plates. All we had was a canvas cover. One evening I tried to put the toe-guards on mine. I spent 2-1/2 hours and nearly put the screwdriver through my palm a few times trying to get them on. I thought that was a poor way to go. We

CARR (CONT'D) chiller for IMSS equipment there should be a separate IMSS chiller. The food chiller should be left strictly for the food.

GIBSON We had so many things mixed in there, from penicillin to cans to heat sinks and all those should have been in a different chiller.

CARR There was no restraint system inside the chiller, either. You just had to open the door and put stuff in and try to keep all the other stuff from floating out. When you wanted to get in there to get something, you had to pick what you were looking for from among all the other floating objects while trying to keep the others in, so you need some sort of a restraint system in there.

12.4 Crew Systems

CARR Restraints and Mobility Aids: We should temper debriefing of this whole area of Crew Systems with the fact that we've already given extensive debriefing on M487 on these very things.

CARR Mobile aids in the MDA, relative to the workshop, would have the rating of about 4.

POGUE Handholds and footholds in the MDA were too few and far between for my way of thinking, in some places nonexistent. ATM was good and the EREP and C&D panels were good. There were

POGUE (CONT'D) none for the VTS operator. The one for the material processing facility I didn't use on the M518 sequence.

CARR For 487 I used the one triangle in the upper left-hand corner, because that was the closest one. It was poorly placed for the furnace work.

GIBSON I always wished that the ATM foot restraint were lower. We all found that we were hunched over when we started operating the ATM. We got a little better as we got used to having a higher head position relative to the panel but we always seemed too high on the panel. I would much rather have that thing gone down about 6 to 10 inches.

POGUE You tend to get a cramp in your abdomen from tensing, because all the work stations were set up for normal one-g work. Your body tends to hold itself erect, and even slightly arching the back, so you are always held away from your workstation. I thought the aids around the MDA and STS were very poor. It was very difficult to do some of the tasks which were required. In fact I put up long straps, and ended up tying my ankles to single handholds, in order to have a good stable body position for doing some of the early work in the Coolanol servicing loop in particular and for some of the EREP instruments' calibrations.

CARR There was just no way for restraining the cameraman for the television work in the MDA. In the airlock module, we just had a few handholds, but not much work is done in the airlock module.

POGUE The aft airlock was the big one. We had to charge the PSS and we had to vacuum the OWS heat exchanger vanes and remove the cover and replace it. Those were two tasks I felt were very poorly helped because of the absence of restraints. You just had to wedge yourself in and use body english, to hold yourself in position.

CARR Now in the forward compartment area, I was in general very pleased with the restraints and mobility. Of course, the grid floor is the greatest part. I found the grid ring around the bottom of the water tanks to be very useful. I was never at a loss for foot restraints while I was trying to get into any locker.

GIBSON I found that the walls of the OWS were not really used as much as they should have been. I would have liked to have seen not just the one-g design in that total structure, but a three-dimensional design which would have put restraints in the walls. In that sense, I like the MDA because we did use all the walls all the way around, although the restraints there were poor. In the OWS, I would much rather have seen a lot of the dome wall used, as well as down in the forward compartment.

CARR There was a lot of blank area up in the dome that could have been used.

GIBSON I would have liked to seen triangle grid up in all those areas; we could have done a lot of useful work there.

POGUE You mentioned it earlier, Ed, that the work over there by the food lockers was very difficult because so much of the triangle grid was occupied by hardware installation. There were really very few places where you could put a foot triangle.

CARR Let's have comments on the aft compartment.

POGUE The head was probably the worst.

CARR That was absolutely impossible, but the experiment compartment really was generally pretty good. There weren't many places where you needed to put your feet that you couldn't find a couple of triangles to lock yourself in. The proximity of the overhead, the ceiling, I thought was good because you could reach out and hold on with your hands, if you wanted to, or if you needed to lock a foot in the ceiling, you could do that. I think the experiment compartment was by far the best place to be, as far restraints were concerned. The waste management compartment was terrible.

GIBSON | You were just like a ping pong ball inside of a little cup; you bounced around in there. You never really restrained yourself. You just ricocheted off the walls.

CARR | Of all places, where body wastes are handled is no place to be unable to control body position. That was just absolutely ridiculous. The folks who designed that did a nice job of making sure that all the smells were retained, and that you had privacy. Unfortunately, when they did that, they eliminated all opportunities to properly restrain yourself.

POGUE | The restraints that were in there got in the way when the urine drawers were pulled out. They weren't very good for really holding your feet in.

GIBSON | We should have, at the minimum, had a triangle grid on the floor.

CARR | In the wardroom, until we took the floors that go with the pedestal out, I considered that to be pretty much unsatisfactory, too, because for the most part we refused to use the foot restraints that were there. We would stand to the side of them or we would lock ourselves in somewhere else to eat. Once we finally found the time to get in there and take those floors out and get rid of them, the wardroom became much easier to get around in and lock yourself down. But there still was a pretty

CARR (CONT'D) high percentages of triangles that were unusable, even when those floors gone, because of the beams underneath that were supporting the pedestal.

POGUE Restraints and mobility aids need to be explored in regard to their being tailored for a specific task location, for example, around a SAL, around a film vault, around an area where you are going to do paperwork, et cetera. I don't want it to be interpreted that we think that is all that needs to be said about that area because a multitude of comments could be made.

CARR Restraints and mobility aids in the sleep compartment. There were enough triangles in the crew compartments to adequately give us any restraint that we needed in there. The sleep restraints themselves; I think you have three opinions on that. I found them to be quite good, and was fairly well pleased with them. We found on occasion that they would loosen up and get pretty noisy. Bill's particular restraint seemed to be broken to the point where we couldn't tighten it and keep it really quiet.

CARR Lighting System: I thought the MDA lighting was more than adequate and you could pretty well set up almost any way you wanted to.

CARR It might have been better because it requires that you get the finger in the - in between the wickets to throw a switch; whereas, if you bump it with a foot or something, it will protect it. But you've got an engineering tradeoff there because a whole bunch of wickets are such much heavier and space - use up a lot more space than just a bar across the top.

QUERY True. You commented in the debriefings on the ATM foot restraint position and the fact that it generally was too high for all of you by about 8 or 10 inches. Did you move the ATM foot restraint from its position and what position did you use?

CARR It was all the way down, as far down as it could get.

QUERY It was all the way down?

CARR Yes. See the thing is your natural posture is essentially - standing is just very slightly bowed, with your back hunched just a little bit, your legs flexed just a little bit. And what we ended up with was the eye level right at the top of the panel instead of where we had had all of our training where you're sitting in a chair and you're looking at the panel like this. You had to look at it like that. And the same thing in the food area too. You're not sitting

CARR (CONT'D)

down, and so we shouldn't have put the food tables at the sitting down, chest level sort of thing. We should have recognized that people are eating standing up. And so the upshot was that at the food table and at the ATM panel, you had to hunch down in order to get a decent level and -

POGUE

Tense your abdomen.

CARR

Yes, but your abdomen and your muscles tensed up and you just got tired of it. What we need to do is remember postural situation up there and the fact that it is quite natural to be standing up, so you might as well get all of your work surfaces and everything, your eating surfaces up here.

POGUE

And the thigh restraint didn't help that any?

CARR

Yes.

QUERY

That's one thing, which crewman's restraint methods worked best and worst? Did you have any?

POGUE

Triangle shoes.

CARR

Oh, they were by far the best, yes. It took a little while to get that eye that you need so that you could come right down and put your foot in a triangle and snap it. You know, the first few weeks it was put your foot

CARR (CONT'D) down and fiddle around with your foot until you finally got it to drop in the triangle and then lock it. But you get an eye for it later on. You got to the point where 50 percent of the time you could float free right down the floor and hit the triangle and lock yourself in without ever having to grab something and make sure you didn't - And the other 50 percent of the time you missed the triangle and propelled yourself back up.

POGUE Yes, and if you have both hands full, you're off and running again; couldn't grab anything.

QUERY Do you have one that you selected the candidate as being the one that we shouldn't look at anymore?

CARR Restraint?

QUERY Yes, restraint types.

POGUE Straps. Those foot straps are no good.

CARR Yes, in the waste management compartment. Also don't ever cover up triangles for another kind of foot restraints.

POGUE Yes. The waste management compartment is the worst in the whole vehicle. I think that's even worse than the MDA/STS, if it could be.

CARR

And the floor, you know the plates you had on the floor around the food pedestal? Once we got rid of those things, we probably quadrupled the number of triangles that were available to us to anchor ourselves in. And we still didn't have very many because of those intercostal beams that are in there that blocked off the triangles.

QUERY

Bill, you mentioned that the M512 foot restraint was a little bit off for some of your work with the furnace, that you had just used one triangle I believe, and you felt the body position was a little wrong.

POGUE

Yes; now Jerry, I think, used it all right.

CARR

No, I had the same problem though; all I could anchor was my right foot. The other one was off - -

POGUE

Okay. I ended up not even using it for the 516, because the 516 work was so limited. Now the flammability, that was another matter entirely, because that required the continual presence there at the panel, and Jer spent several hours doing that. So on 516, it wasn't even worth the problem.

CARR

The work chamber, the furnace chamber was here. And the floor started here at my right foot and went off that way. So I could anchor - The most comfortable thing was to

CARR (CONT'D)

anchor my foot in the forward left-hand corner, and then the rest of me was hanging out over the end, and I was working with one foot restraint. We just didn't have it in the right place, that's all.

QUERY

Apparently they - when it was originally planned, it was organized for - -

CARR

The C&D panel.

QUERY

And for the activity back there in the back and the preparation and not actually for ...

POGUE

Oh, for all that stowage and everything.

CARR

Yes.

QUERY

Yes. For handling all the other stuff. And maybe that is why, because of the particular type of experiments that were flown on your mission, we didn't have any comment about it on either of the other two missions.

POGUE

You know, thinking out loud and not trying to redesign, but, I guess, really suggesting it; you could have something like that foot restraint there, but where you had different levels of the triangles that would telescope and slide out, giving you a longer - which could be rigidized by tethers, maybe. But the idea was excellent. The triangle - when

POGUE (CONT'D)	that thing was moved around for C&D work, it was great when - as long as you were right at the C&D panel. But that's all it was good for. But it was excellent for that.
CARR	Yes, we really fell into it, I think, on the triangle shoes thing and the triangle grid. That was - that just really came out beautiful.
POGUE	Yes, that was really so convenient.
CARR	Far and away the best restraint system that we have ever seen.
POGUE	I used the mushrooms once. I think I would have used them more, except that you couldn't use them with the bicycle.
CARR	And it was inconvenient to change - -
POGUE	And it was just that simple.
QUERY	Right.
CARR	- - What you had on your shoes.
POGUE	We needed two pair of shoes is what we needed.
CARR	Yes.

CARR	Okay.
QUERY	I guess one thing - about the only thing that I haven't seen covered on the shower was the shower foot restraint. How useful did you find that? And was it satisfactory?
POGUE	Satisfactory.
QUERY	Any comments on it?
CARR	I think it would have been nicer if it had been a little softer. You kind of abraded your toes a little bit trying to come under there.
POGUE	And I tried to use it to squeeze a - shove it under and squeeze out washcloths and try to soak, you know, pick up the water. That didn't work too well, but it is an idea - it gives you an idea of a configuration that would be useful. But for a foothold, I guess, it was satisfactory.
QUERY	Do you think that concept of the type of restraint for temporary use would be adequate for other - -
POGUE	Yes, make it - as Jerry said, if you could make it a little softer.
QUERY	Yes, right.

POGUE One where you - you know you could feel comfortable about jamming your toes into it.

CARR Yes, that's not a bad system at all. I might mention one thing about the shower, and that is the QD's for the water were sure hard to work. That was a very, very tough QD to make, both in the water heater when you were drawing water out in waste management compartment, and also when you were connecting the water tank up to the shower. That was a pretty hard connection.

POGUE Yes, I had put my feet in - you know, when I was in the waste management compartment, I put my feet up on a wall over - if you were facing the lavatories, the basin, the one way over high on the left - I actually put my feet over there in order to get the QD on. That's how hard it was.

CARR Just like a lot of spring in the QD.

POGUE Yes, it just took a tremendous force.

QUERY On the waste management system, you originally were dumping the urine bags, and then you went to using the urine dump. On about day 50, you had a little problem with the urine dump system, and, as far as we know, it operated

POGUE On that, on removing PCU, on removing just about anything from the dome ring locker. If you were high; you see you had the blue ring with the real nice foot restraints in there. By the way, they held your toes in a position so that you came out real easy. Oh, I was grateful for having them. I forget exactly what it was. But you were always coming out of them. You had to consciously hold your feet in the right - legs in the right posture to stay in them. But if the equipment that you were trying to remove from dome ring locker, assuming you had to use tool and high-torque grasp, you could come out - It was hard to get to. And one of those was the OWS heat exchanger fan.

CARR But it's the same old thing, that if you can't lock yourself in order to put torque on something, then you've got to use one hand for restraint or counterforce and the other hand - and it reduces the amount of torque that you can bring to bear when you've got to use one hand for countertorque.

QUERY Right. The - you mentioned about strength being required for your for that - for your Coolanol work and all extra restraints that you made up. Tool kits and spares conveniently located?