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SKYLAB EXPERIENCE BULLETIN NO. 1

TRANSLATION MODES AND BUMP PROTECTION

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National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
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MAN-MACHINE ENGINEERING DATA APPLICATIONS
OF
SKYLAB EXPERIMENTS M487/M516

SUMMARY

BULLETIN NO. 1

Very few items of hardware, operational or experimental, aboard a


manned spacecraft TRANSLATION MODES AND BUMP PROTECTION by personnel

or from occasional use as a mobility aid or a temporary restraint

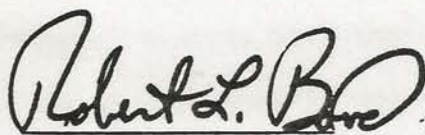
This document is the first in a series of releases which are intended to make available to NASA and contractor personnel those results from the Skylab Man-Machine Engineering Experiments which have design and requirements relevance to current projects and programs. This method of data distribution has been instituted as a convenient way to provide early access to Skylab experience and is intended as an interim measure, to be followed up by a thorough experiment report six to nine months after receipt of all Skylab flight data.

such happenings as the prime mode of protection is an unrealistic and impractical approach to zero-g operations.

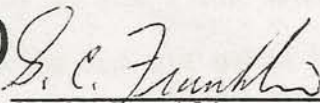
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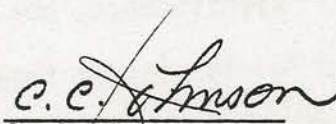
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June 1974

PRE-SKYLAB EXPERIENCE

Since Mercury and Gemini crewmen remained restrained in a seated position during their missions, the problem of crewmen bumping equipment or inadvertently operating switches was of little consequence. The only times the problem arose was during sleep periods when the crewmen's hands were unrestrained or during periods of Gemini EVA when the egressing and ingressing crewman could sweep the cockpit interior with his feet and legs while wearing a pressurized suit. Having practically no tactile feedback of the contact he might be experiencing with various items within the vehicle he presented a significant hazard to cockpit hardware. Protection of displays and controls was the prime concern in these cases, but even with protective devices installed there were occasional instances of inadvertent actuations during EVA operations. Gemini had some protection for the displays and controls and these provisions were carried further in Apollo.

Apollo presented the first opportunity for IVA excursions of any significance, but even then there was no volume into which a crewman could venture that would leave him out of reach of some structural component. Apollo also presented the first requirement for module to module transfers of personnel and equipment, but the distances were short (about 4 to 5 meters) and the route was very restricted so that velocities were small and sufficient aids were available to allow rather precise attitude control of both personnel and equipment. Additionally, most of the experimental hardware was stowed and deployed from EVA.

positions so that very little scientific equipment was exposed to IVA locomotion hazards.

SKYLAB DESIGN

Skylab provided a completely different IVA architectural environment from anything previously experienced in manned space flight. From less than 8.5 cubic meters (300 cu. ft.) available to the crew in the Apollo Command Module, Skylab offered more than 340 cubic meters (12,000 cu. ft.) available for their use. Seven modules, including the Command Module, were available, necessitating numerous IVA work stations and storage locations. These different work and storage locations required, in turn, frequent and comparatively long (up to 20 meters) IVA excursions from one work area to another. Also, hatches and passageways between the various modules were required to permit the translation of men and equipment. Potential locomotion paths were anticipated to be many and varied, depending upon the operational and experimental needs of the moment, thus various sizes and shapes of mobility aids and restraint devices were distributed about the interior of the Skylab modules. The grid floor provided in the Orbital Workshop was intended to serve as a major personnel and equipment restraint.

SKYLAB EXPERIENCE

TV and 16 mm films of the Skylab crewmen's in-flight activities have been analyzed along with the in-flight transcripts and the various

post-flight crew debriefings to determine the modes of translation and the need for protection of men and equipment during IVA activities.

These analyses are presented in the following paragraphs.

IVA Translation

In general, all three crews quickly developed similar techniques of translation through the Skylab vehicle. These techniques varied with the amount of free volume available to the crewmen. In the rather large forward compartment, a free flight mode of pushing off in the general direction of the destination was quickly adapted. This mode was described rather well by the Commander of the SL-3 mission in Reference 2, Appendix, page 3.

"It's been a lot more fun. You're--you do things repetitively, and flying around inside this workshop is really a ball. The Command Module zero-g is okay. But there's no where to go, and you can't zoom along. Here when you can zoom 40 feet and that's what you do normally, like when we were EVA prepping the other day, it--it's quite fascinating. And you get now where you don't--you don't ever go by handhold anywhere. You always grab and push off, kick off, or something like that. And you don't try to be too accurate I've noticed. You just tend to head in that direction and then if you don't quite make it you just kind of ricochet off, you don't bump into it but you use your hands or your feet to kind of give you a mid-course correction or two. And so you end up headed towards--head first sometimes and then feet first and then by the time you get there you kind of belly towards it. And it seems to be very natural and it's a lot more fun, because you can sort of utilize all the space that's here. The whole three dimensions."

Apparently, translating through the large open area of the forward compartment was quick and easy. The crewmen soon learned to orient themselves as they translated to a particular piece of equipment or direction in each compartment of the workshop to maintain the proper feeling of knowing where they were. If they entered a compartment improperly oriented, they would have to take a few seconds to find themselves. Reference 39, Appendix, page 55 indicates how the crews accomplished their orientation within the various compartments.

In the more confined areas, such as the crew quarters and experiment deck, the crewmen developed a different translational mode. Generally, they would assume an erect but slightly crouched position, with their legs pulled up somewhat to shorten their overall length and to relocate their center of mass. Then they would merely thrust themselves toward their destination with their arms. Upon arriving, it was a simple matter to grab anything close at hand to stop their motion. Also, they would sometimes push off with their toes against the grid and utilize their toes in the grid for midcourse corrections. This mode was used sufficiently to cause the toes of their shoes to wear out.

The erect mode of translation was employed primarily in the earth-like orientation of the experiment deck. This allowed the crewman to arrive at his destination in the same orientation as the equipment, and was probably influenced by the lengthy training period in the one-g environment. Reference 6, Appendix page 10, contains a discussion of translation on the experiment deck. Of the in-flight movies, cassettes number 79,

frame 68071, number 46, frame 80561 and number 49, frame 26731 are good illustrations of this translation mode.

Apparently any object, be it wall, floor, ceiling or item of hardware, was suitable to push off from and to stop against. The following references contain comments primarily directed toward the various translation modes in the spacecraft.

<u>Reference</u>	<u>Appendix Page Number</u>
1	1
2	3
3	4
4	5
5	7
6	9
7	11
8	12
9	13
39	55

The rates (determined from 16 mm and TV film analysis) at which the astronauts translated varied with the task they were performing. The ordinary point to point translations were made at rates from 0.4 to 0.6 meters/second (1.5 to 2.0 feet/second). When moving large or massive hardware the crewmen were much more deliberate, slowing down to a velocity of from 0.15 to 0.30 meters/second (0.5 to 1.0 feet/second). Occasionally,

apparently for the fun of it, the crewmen would zip along at as much as 1.83 meters/second (6 feet/second) when engaged in off-duty gymnastics in the forward dome area of the Orbital Workshop.

Use of Equipment as Mobility Aids

In spite of the quantity of devices specifically provided for crew use as mobility and restraint aids within Skylab, frequently there would not be such a device properly positioned to support a given need and whatever was available would be pressed into service. A good example of equipment used as a kickoff point is the thermal parasol container.

The thermal parasol which was deployed through the scientific airlock during the SL-2 mission was left attached to the T027 experiment canister within which it was packaged. The experiment canister then became a permanent fixture in the solar airlock for the remainder of the program. Concern ran high about the vulnerability of this installation to impacts from translating crewmen or moving cargo, and thoughts were given at one point to developing a netting of some sort to screen this area from traffic, especially the maneuvering unit experiments scheduled to be flown in the same compartment. However, even with this concern being evidenced on the ground, a 16 mm sequence from cassette CI-07 shows this item of hardware being used as a motion initiation aid (frame 74637).

Nearly anything was usable as a kickoff point or as a grabbing point to permit the crewman to change his direction of travel or to halt his progress. The film sequence mentioned previously, cassette CI-07, shows the same item of hardware being used as a motion arresting aid (frame 74709).

Another example is the food trays at the wardroom table. The food trays were attached to the wardroom table with a latching mechanism which was quite adequate to cantilever the tray from the pedestal in zero-g, but began to be severely stressed as the missions progressed due to the constant use of the trays as the prime mobility aid for moving about the table (Figure 1). Numerous 16 mm and TV scenes from all missions verify this finding.

The following references address the need for mobility aids.

<u>Reference</u>	<u>Appendix Page Number</u>
1	1
3	4
7	11
8	12
9	13
10	14
11	15
12	17
35	47

Use of Equipment as a Restraint Aid

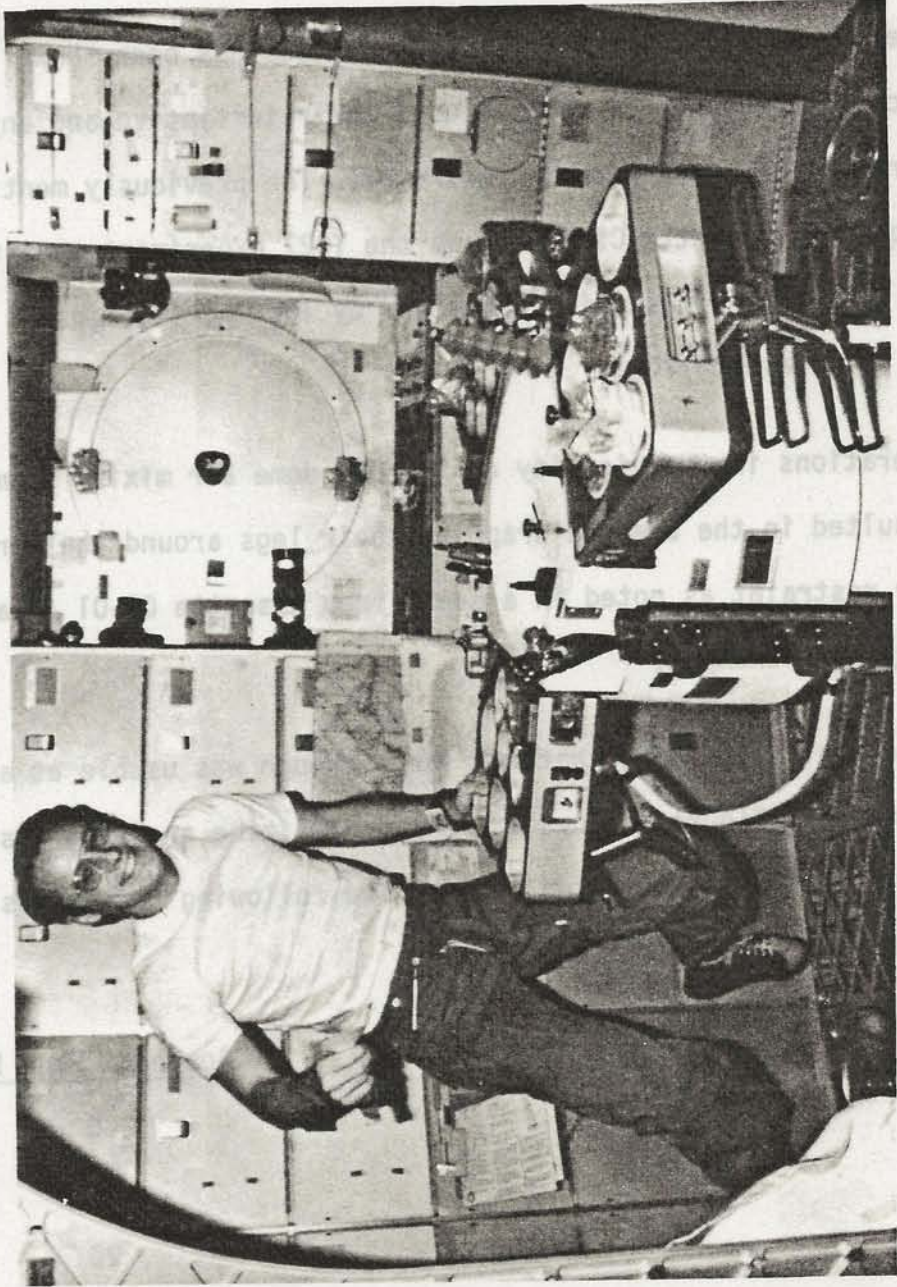


FIGURE 1

Use of Equipment as a Restraint Aid

The need for additional restraint devices has been shown in the preceding section. Again, the crewmen used their initiative and any available hardware became a natural restraint. The previously mentioned film sequence, cassette CI-07, shows the T027 experiment canister being used as a temporary restraint, employed by locking the legs on either side of it (frame 74770).

Operations in the vicinity of the OWS dome air mixing chamber usually resulted in the crewmen wrapping their legs around the ventilation ducts for restraint as noted in a scene from cassette CI-01 (frame 83136) as a typical example.

Practically anything that was large enough was usable as a restraint when required. Figure 2 shows a crewman utilizing an EVA pressure suit as a restraint while he worked on it. The following references primarily address natural restraints.

<u>Reference</u>	<u>Appendix Page Number</u>
4	5
13	19
14	20
15	22
16	23
32	42



FIGURE 2

Equipment Protection Required

It has been explained that, due to the mode and velocity of personnel training in the spacecraft, the primary hazard was the crew member's contact with the equipment. On some occasions, contact between crew members could occur. In such instances, the equipment following the event would be damaged.

Equipment Protection Required

It has been explained that, due to the mode and velocity of personal translation through the spacecraft, the chief method of changing direction or halting travel was the crewman bumping into or grabbing an item of equipment. On some occasions, however, the contact between crewmen and hardware would be completely inadvertent and could occur without the crewman's knowledge. Regardless of the circumstances, there were frequent interactions of this type, and some of the equipment involved was ill-designed for these types of contact. The following references illustrate the crewmen's concern about this inadvertent bumping.

<u>Reference</u>	<u>Appendix Page Number</u>
6	9
11	15
17	24
18	26
19	27
20	28
21	29
22	30
23	31

Inadvertent control actuation also was a continuing problem in Skylab as evidenced by the inflight transcript remarks and post-flight debriefing comments of the crews. Switches and circuit breakers seem to be the most vulnerable items in this category, particularly when located along a primary locomotion path that receives high traffic, such as the STS area of Skylab. However, the problem is by no means limited to such locations as evidenced by the inadvertent kicking, and for some time undetected closing, of one of the water tank valves by an SL-4 crewman while attempting to restrain himself in an area not specifically designed for the purpose of supporting the somewhat awkward task he had to perform at that site.

The following references illustrate the magnitude of the problem of inadvertent switch actuation.

<u>Reference</u>	<u>Appendix Page Number</u>
24	32
25	33
26	34
27	35
28	36
29	37
30	38
31	40
32	42

<u>Reference</u>	<u>Appendix Page Number</u>
33	44
34	45
35	47

Crewmen Protection Required

It appears obvious that, if hardware needs protection from crewmen because of the translational mode, crewmen also need protection from the hardware. Several areas of concern were voiced by the various crews which should provide worthwhile examples.

One potential problem was indicated by the pilot of SL-4. In reference 36, Appendix page 49, he indicated that he had caught his finger in a hole a couple of times when going through the hatch in the floor of the forward compartment. Had he been translating at a high velocity, he could have severely injured himself. In reference 37, Appendix page number 50, the same crewman pointed out the potential of someone riding the ergometer being bumped hard enough to cause injury by someone else translating past them. A similar potential personnel injury was delineated by the commander of SL-3 in reference 15, Appendix page 22, in his discussion on the airlock.

Padding contact surfaces or sharp points provided some relief. However, some areas of potential contact were left unpadded. The following references indicate some of these areas that were painfully contacted by the crewmen.

Reference

Appendix Page Number

6

9

38

52

1. Nearly all hardware items aboard a spacecraft will be utilized as a mobility or restraint device and will probably receive impact collisions from personnel or other hardware.
2. Equipment mounted in a spacecraft should be designed to accept impacts from transferring crewmen without causing harm to the equipment or its function. If this cannot be accomplished, the equipment should be protected by some type of protective shield to prevent damage to the equipment or injury to personnel.
3. Any switch installation should be protected from inadvertent actuation by crewmen's hands or feet.
4. Equipment items should not be installed or stowed, either permanently or temporarily, in the main traffic paths.
5. All sharp edges and/or pointed items must be eliminated or covered, especially along traffic paths.

CONCLUSIONS/RECOMMENDATIONS

1. Nearly all hardware items aboard a spacecraft will be utilized as a mobility or restraint device and will probably receive impact collisions from personnel or other hardware.
2. Equipment mounted in a spacecraft should be designed to accept impacts from translating crewmen without causing harm to the equipment or its function. If this cannot be accomplished, the equipment should be protected by some type of protective shield to prevent damage to the equipment or injury to personnel.
3. Any switch installation should be protected from inadvertent actuation by crewmen's hands or feet.
4. Equipment items should not be installed or stowed, either permanently or temporarily, in the main traffic paths.
5. All sharp edges and/or pointed items must be eliminated or covered, especially along traffic paths.

RAW DATA APPENDIX

<u>REFERENCE</u>	<u>SOURCE</u>	<u>PAGE</u>
1	SL-1/2 Dump Tape 167-12, page 2 & 3	1
2	SL-1/3 Air to Ground MC 479/2	3
3	SL-1/3 Dump Tape 232-05, page 7	4
4	SL-1/3 Corollory Experiments Debriefing, page 6 & 7	5
5	SL-1/4 Dump Tape 022-06, page 20 & 21	7
6	SL-1/4 M487 Debriefing, page 15 & 16	9
7	SL-1/2 Dump Tape 155-12, page 5	11
8	SL-1/2 Technical Debriefing, page 18-10	12
9	SL-1/3 Dump Tape 223-08, page 2	13
10	SL-1/4 Dump Tape 356-05, page 18	14
11	SL-1/4 Dump Tape 361-03, page 5 & 6	15
12	SL-1/4 M487 Debriefing, page 10 & 11	17
13	SL-1/2 Dump Tape 151-09, page 1	19
14	SL-1/3 Dump Tape 250-07, page 2 & 3	20
15	SL-1/3 Dump Tape 259-05, page 20	22
16	SL-1/4 Dump Tape 022-03, page 5	23
17	SL-1/3 Dump Tape 229-13, page 11 & 12	24
18	SL-1/4 Dump Tape 344-06, page 3	26
19	SL-1/4 Dump Tape 353-07, page 14	27
20	SL-1/4 Dump Tape 361-03, page 1	28
21	SL-1/4 Technical Debriefing, page 12-81	29
22	SL-1/2 Systems Debriefing, page 118	30

<u>REFERENCE</u>	<u>SOURCE</u>	<u>PAGE</u>
23	SL-1/3 Systems Debriefing, page 61	31
24	SL-1/2 Air to Ground MC-114/4	32
25	SL-1/2 Air to Ground MC-416/1	33
26	SL-1/2 Technical Debriefing, page 12-7	34
27	SL-1/2 Systems Debriefing, page 24	35
28	SL-1/3 Air to Ground MC-1188/2	36
29	SL-1/3 Air to Ground MC-1279/1	37
30	SL-1/3 Dump Tape 259-05, page 22 & 23	38
31	SL-1/3 System Debriefing, page 57 & 58	40
32	SL-1/4 Dump Tape 332-08, page 19 & 20	42
33	SL-1/4 Dump Tape 356-06, page 16	44
34	SL-1/4 Crew System Debriefing, page 333 & 334	45
35	SL-1/4 Crew System Debriefing, page 425 & 426	47
36	SL-1/4 Technical Debriefing, page 12-80	49
37	SL-1/4 Dump Tape 356-06, page 8 & 9	50
38	SL-1/2 Systems Debriefing, page 34, 35 & 36	52
39	SL-1/3 Technical Debriefing, page 15-8, 9 & 10	55

Skylab Dump Tape 167-12
Time: 13:25 to 14:43
Date: 6/16/73
Page 2 of 5

SPT ... I haven't finished yet.

CDR Yes, and there are certain things that - in the workshop that - that ... are excellent design, but it first appeared that they might not be when we looked at them on the ground, but there's no way to evaluate them on the ground. I'm thinking of the water rate lockers ... blue ring underneath the edges. ... the blue ring ... you can get a hold of and stow the lockers. You can swing to anywhere in the workshop from the lockers, lock yourself in, do your job, close the door, unlock the ... turn around and take off to any place you want to go. Now, that's great. Mobility ... for us to get from one place to another other than the handhold ... As a point of departure, you know, you can depart from the wall ... go anywhere. You should be able to hold on.

13 55 48 PLT This means that ... I use that ... 194 ... mobility aids are ... OWS ... locker, airlock. Fireman's pole is great. You just grab hold of it ...

CDR Yes.

SPT That's the only thing I can think of that we have used and that is what I would consider a mobility aid.

CDR Yes. Yes, ...

SPT Oh, yes ... an example ... requirement.

13 56 23 CDR But now, mobility aids for, say a large retrieve really make kinda your own, like, taking an S073 out of the big box, I just hold on to S073 with one hand and pull myself across the floor. ... my hand. ... other hand where I want to go and I just ... - -

Skylab Dump Tape 167-12
Time: 13:25 to 14:43
Date: 6/16/73
Page 3 of 5

SPT That's right, but there's ... as well. You need mobility aids of some sort, and you usually invent some, right? If you ever take that big stowage box up to the dome locker. I don't think you - you ... problem going up the wall. I think you give a little flick and then you float - -

CDR Yes.

SPT - - And then you just go with it. You just go until you hit something and ... handhold. You've got to go across an open ... I think we all seem to get ... handhold and foot restraints, like the triangle grid.

CDR There's no doubt about it that - that in zero g we could have come up with really good places in our checklist and with some of the ... we did would have enabled ... put a little restraint strap here, a couple there, and ..., especially the small ... a lot of either items - -

SPT ... categories are equipment that need restraints, and there ...

13 57 55 CDR Okay, well that's enough for that one. Three is: How often have environmental factors, that is, noise, temperature, air flow, illumination, interferred with your ability to perform a task? Which tasks and where? Have any of these factors interferred with your ability to sleep? I would say, personally, no, on my ability to sleep. The biggest thing that I think I've noticed is I have to use my bloody flashlight all the time. Illumination is really poor.

SPT I was going to say that. Of course, in terms ..., personally. I think the bed-

SL-III MC479/2

Time: 18:48 CDT to 11:23:48 GMT
8/7/73

Reference 2

the Control Center either. So we occasionally send somebody outside to see if it's daylight out. Over.

CDR That's right. And I suspect if you're not careful, you can get your meal schedule fouled up and then you - you know, and then it just doesn't work right. You got to have something kind of timed so that the rest of it falls into place.

CDR I tell you another interesting thing. I think - I think I personally had more fun on this thing than the lunar mission. It's been a lot more fun. You're - you do things repetitively, and flying around inside this workshop is really a ball. The command module zero g is okay. But there's no where to go, and you can't zoom along. Here when you can zoom 40 feet and that's what you do normally, like when we were EVA prepping the other day, it - it's quite fascinating. And you get row where you don't - you don't ever go by handhold anywhere. You always grab and push off, kick off, or something like that. And you don't try to be too accurate I've noticed. You just tend to head in that direction and then if you don't quite make it you just kind of ricochet off, you don't bump into it but you use your hands or your feet to kind of give you a mid-course correction or two. And so you end up headed towards - head first sometimes and then feet first and then by the time by the time you get there you kind of belly towards it. And it seems to be very natural and it's a lot more fun, because you can sort of utilize all the space that's here. The whole three dimensions. You can cover and go to the top of the water tanks and then down to the wardroom and then back up to the MDA all in just a matter of 20 seconds. And it's easy and a lot of fun to do.

CC Roger; we copy that, Al. And it's really great to hear you guys talking like that as opposed to the way you were feeling a few days ago. Looks like we got a real fine mission coming up.

CDR Yeah, we think so. We were feeling awful poor for about three days here. But we knew that it's bound to get over with and it did. And, yes, we're having a ball. Okay, I got to get back to work.

CC Roger; out.

CC Skylab, this is Houston. Two minutes to LOS. We have completed dumping your voice data tape recorder. Next station contact is through Guam at 00:34 in approximately 36 minutes. Out.

CDR See you later then, Bruce.

CC Roger; Roger.

although what we have seems to be adequate. Having floor proximity is - uh - not applicable in the other compartments.

232 14 56 28 PLT

Ingress/Egress provision - uh - they're lousy in the MDA. Uh - just grab whatever - uh - seems to be sticking out. More often than not it's - uh - the - uh - table - uh - work table at the ATM. So ingress and egress in the MDA is - uh - not good. Uh come out of the command module - uh - the only thing you can do, just about, is push off at the hatch and - uh - float - uh - actually to the first thing you run into. And there's no hand over hand way to get around in the MDA to speak of. Putting in a little handrail the crew quarter's hatch - uh - getting into the - uh - going through the hatch, to grab onto when you come down from the dome and - uh - fling yourself into the - uh - lower compartment. Benn nice to have, but not required. Uh - getting in and out of the - uh - waste management compartment is - wh - sort of a stunt because - uh - once you get in there - getting in and out is okay, but getting in there is not too good because - uh - there's nothing to lock your feet in to. Your feet just slide all over the floor, you sort of bounce, ricochet from wall to wall. And - uh - you know the best way to restrain yourself in there is to - uh - you'll probably think to - uh - put your - uh - knee up against the little handrail there and your back against the tissue uh - wipe dispenser area and kind of wedge yourself to - uh - do what ever is necessary. Other than that, uh - you just drift around in there. and - uh - you have to wedge yourself with your feet and hands between the wall, in order to by yourself. So, it's wh - getting in and out is all right but once you get in there - uh - it's anybody's guess as to how you're

Reference 4

BEAN You couldn't tell the air was in motion all around the workshop unless you were standing in front of the outlets, or you released a piece of paper and saw where it went. You didn't float by anywhere where the air would blow on you. As long as you weren't concentrating, you never realized that there were any drafts in and around the workshop.

GARRIOTT It was pretty well designed.

BEAN It was uniform and had good flow.

LOUSMA It was breezy in the plenum. When you took the cellar door cover off to go down there, as soon as you removed that last screw, the cover would immediately float because of the air pressure beneath it. A big blast of air would come up.

QUERY When you went down to do the probe work, Al, you remarked that the mobility and workability was better than you had expected. Can you elaborate on that? Why you expected it not to be good, or how it turned out to be better?

BEAN

In the trainer, it always seemed to be a lot of trouble to call down, so that was eliminated; you just floated down there. Also, there were enough proturbances such as other probes or wires that were used to hold the plenum bags. But you always had a handhold. Also, the plenum has a crotch

BEAN
(CONT'D)

area so you can usually get your feet stuck in there. There were all sorts of places you could hold on or put your feet so you could work anywhere there or move around very simply. It was as easy to move around there as it was in any of the compartments that we designed with mobility in mind, mainly because the sides and the surface top were close to you therefore there was always something to hold on to.

QUERY

Were both hands free to do the job?

BEAN

Yes. You can work there and get much more stowed, and you can get in and out of there quite easily. That would provide some good area for SL-4 if they have to move something around.

QUERY

Was there an amount of background noise in the vehicle itself to be a problem?

BEAN

There's no noise; it was very quiet up there. I think that's why at night we heard a lot of noises. One thing we never did figure out to our satisfaction was why we could hear so many noises at night when we were all sleeping and it would go into the dark or out of the dark. In the daytime, we never heard them at all, going into the dark and out of the dark. All we could imagine was that the solar

Dump Tape 022-06
Page 20 of 24

talk around the subject; I hope I hit your - what you're asking.

022 19 03 25 SPT

When you push on something during a task - and you either have it braced between hands or you brace it yourself with triangle grids and a hand on the handrail and the object on a wall if you have to, although most of the time we don't have forces that require anything like that. Most of the stuff that we do is - is all internal, though, isometric, if you will. You're - you're pushing one hand against the other or - a good part of the time, or pulling. Torques - we don't have any high torques - well I guess so, with screws, for example. Course, now that's all - all - I've never had to work anything fixed that I was not holding my hand that I can think of. Oh, I guess I have. I guess what you do is just brace your body up against something. What the heck am I trying to think of - I've done that up in the MDA there was some darn thing that I had to take some bolts off. It was a long time ago in the beginning of the mission.

022 19 04 35 SPT

Really, what you do is just get your - oh, I know; another good example is opening up the windows in the MDA. Those windows are the highest torqued windows I've ever seen. Those - turning the cranks on those things. There what you do is just wedge your body in a position where you hold yourself down towards the window and then torque so that your legs or your hips or something else are reacting against something in the immediate vicinity. And

Dump Tape 022-06
 Page 21 of 24

you can then open or close the window. Now that' all improvised. If you ever needed a work station, it's right there, to open up those darn windows.

022 19 05 15 SPT

Number 6. Have you noted definite tendency to establish an IVA coordinate system as a frame of reference for locomoting and working within the various modules and compartments of Skylab? No, I don't think so. I think it depends upon what you're doing. By - if you're working that - the EREP, you got your own little coordinate system right in front of you; if you're working at the ATM, you got another one; if you're looking out the window, any of the STS windows, you got your own coordinate system; if you're working at the - the - -

CDR

Hey, Ed we're going to take the recorder, from you now. W'ere going to have to start the - the - ... logging.

SPT

Okay. I'll have to break this off here. I'm on question 6 and I'll pick it up later.

022 19 06 04 SPT

SPT out. You got it, Jerry.

022 19 06 40 CDR

This is the CDR at 0 - no, 19:06 and 45 seconds. At T2, which was 18:51, Delta 6 was reading 40 percent. And in a period of about 1 minute it sagged off to about 36 and then began a slow rise. And at this time, it's now reading 56 percent. Starting - let's see, the ready activation is complete. Now I'm going to start recording the monitor settings. Alpha 2 is 55; Alpha 3 is 86; Alpha 4 is 92, and htat is high; let's see, Alpha 4. Switch 3 is high - yeah.

QUERY Did you find the ^{THIGH} ~~side~~ restraints useful for the table?

GIBSON No, I tried them but they were more work than the foot restraints.

CARR I used them once in a while, too, but it was just as comfortable with foot restraints.

POGUE The only thing that I would try to use them for was to hold me down. I finally just gave up and I'd just take the food to me and bend over long enough to eat Japanese style.

GIBSON ^{THIGH} ~~Side~~ restraints required that you always be flexing some muscles to stay in there. With the foot restraints you could completely relax on any job you were doing and you stayed there automatically, without thinking about it.

QUERY

We noticed from video tapes and from comments that the attitude control of the lower part of the legs and feet sometimes was poor, particularly when you passed through openings or changed directions. When using the hands and arms for midcourse corrections, the feet would drift around and inadvertently bump against things.

POGUE

Sometimes painfully.

GIBSON

That's true. When we would move around in the workshop, we assumed a curled-up position and pulled our legs up like a duck, and we would pull ourselves around by our hands, but it was natural to pull our legs up to get our c.g. That's primarily what you did in the lower compartment or in the experiment compartment; once you got above in the larger open areas you ran into a problem. Your experience with swimming really does you in there. Because if you push off and go toward the hatch and start rotating you had the feeling that if you just spread out straight the water would keep you going straight. Well, you keep going straight, but you continue to rotate and when you get halfway through the hatch you'd realize that your back was that far from impinging on the edge and the next second you'd know for sure that you hadn't made it.

QUERY

We conclude from this that we definitely should avoid locating sensitive equipment along a mobility route.

GIBSON

We were lucky that we didn't hit the rate gyro package more often. We came close to it many times.

POGUE

One thing that you could direct your attention to is the protective devices. That type of device that was used in the command module for EVA for Apollo 9, only a little

Skylab Dump Tape 155-12
 Time: 22:15:46 to 22:50:46
 6-4-73
 Page 5 of 11

Reference 7

PLT ... if you wear the foot restraint instead of the triangles there are ...

22 36 46 PLT The triangle ... is a good idea. It's just that you need something to stick your feet in. The whole experiment compartment is kind of one-g oriented and a lot of people have 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, ... 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 slope. But once you get there and you want to be stabilized by the legs or the thighs or 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. ... the shower and it'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 - 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 some thing like the little handrails on the surface to grab hold of and torque your body or stop a pitch rate or whatever you have and if it's a flat surface, you tend to do some scrambling around. In the wardroom, I noticed that the edges of the locker extension 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 those compartment - those head - What are we talking about? Yes. We got carried away on that. Okay. Yes. ... most assistance is performing tasks. 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.

WEITZ Yes, the triangle shoes were extremely useful.

KERWIN ^{THIGH} The ~~side~~ restraints worked out better than I thought they would.

Handwritten: 77.00

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.

Handwritten: Thigh restraint
Handholds
Foot restraints

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.

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. Some of 'em use the handrail when we - seldom 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 inbetween the dome lockers and the hatch. So the workshop dome and wall handrails really aren't used very much. STS handrails, they are those I presume in front of the EPS ECS control panel. Oh, they're used when we there to stabilize ourselves. But they are not used for mobility. They're adequate; there's probably more of them than we need.

223 23 12 30 PLT

MDA handholds/handrails, there aren't many handrails in the MDA. Probably could use some. Not necessarily for hanging onto things, but in a stable position, but more - uh - 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 handrails in the airlock very much 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 on the ATM, and then grab whatever else happens to be sticking out or available. So, there aren't many good - hold - handrails in the ATM.

223 23 13 28 PLT

Triangular shoe cleats and grid. I give 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 ... 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 go into the next time. But the triangle shoe cleats - they're great and I haven't used the conical shoe cleats at all.

Dump Tape 356-05

Page 18 of 19

356 17 18 23 CDR Personal mobility aids, they're limited, you find yourself grabbing on to whatever handholds you can find up there. And I all ready mentioned the fact that I thought that there ought to be one handhold of some kind every four foot. At least one - if you grab one you should be able to look four feet in any direction and find a handhold. Thermal comfort, it's colder than the dickens up there.

356 17 18 47 CDR I understnad why it has to be that way, but it still is and you have to dress for that area. If your going to work in the airlock, you dress more warmly than you do if your going to work down in the experiment compartment or in the - the forward compartment. Noise levels in the air - in the MDISTS I think is unacceptably high.

356 17 19 09 CDR The biggest offender right now is the rate gyros and I realize that wasnt' a designed feature, that was something we had to add to survive and I understand that, but still you do have pump noises up there from the cooland system and all, and it's higher than it should be. Illumination in the airlock MDAISTS is - is more than adequate, qutie adequate.

356 17 19 31 CDR CDR out.

356 17 27 38 CDR This is the CDR at 17:30 Zulu; subject is M509 batteries. Terminate charge on M509 battery number 6 and initiate charge on battery number 7.

356 17 27 57 CDR CDR out.

PLT This is the PLT reporting the ATM debriefing JOP 18, that started at 17:12. JOP 6, step 2, building block 2 completed per pad, the Sun center exposure of 82A completed per pad. The corona was about the same as reported last orbit.

Dump Tape 361-03
 Page 5 of 7

everywhere we don't have a piece of gear. That would allow you to at least tie some gear down in a temporary way with some of these other personnel or temporary equipment restraints which I just talked about in OWS. I also find one thing that's very noticeable about this whole location - the whole thing is - that is, the spacestation is broken up into a hot spot. It was made by different people and it certainly shows. I think everything ought to be - become more standardized and uniform. The OWS and an airlock functionally should be different, but I think in terms of the types of equipment, restraint straps, the whole work - they ought to be uniform.

361 04 46 17 SPT

Personnel mobility aids - None.
 Personnel restraint devices - Well, mobility aids, you don't need. But personnel restraint devices, none, just flat zero. And I think in there you need triangles or some other - whatever we come up with in that future to - to work on. I think the triangles are pretty adequate. Matter of fact, I think they're more than adequate. I've learned to use them and I think they're super. But there's no handholds in there, just flat nothing, and the gear which I had to grab onto - I think in the - in the one-g layout that you have down here in the experiment compartment, you don't need handholds out in the center of the floor. Up there in the MDA, I think you at least need some handholds or something to grab onto move from one place to the other, sticking out a little above some of the equipment because that equipment - some of it's fragile - some of it's just flat barsided. One thing I have a deathly fear of is grabbing those rate gyros and setting us off on - rate gyros off on a wild goose

Dump Tape 361-03
Page 6 of 7

chase. Granted that we're not suppose to be in there to begin with, but now we shouldn't have that worry about delicate equipment.

361 04 47 51 SPT

Thermal comfort - It gets a little cold up there. I have to take a jacket up ther to work on the ATM or anything else. I come down to the OWS, I find I - taking the jacket off, sometimes the T-shirt. I know we got an inconsistency there. Noise level - Way too high. Aside from the pump which I mentioned, we've got rate gyros in there. And they're both making so much racket, I can't tell what noise level exists under either two of those. Granted the rate gyros were not a design feature, but the fact is, they're in there, and they do make a whale of a lot of noise. Gradually you tune it out after a little while; for example, when you're recording, it obscures the recording. I don't think you can think as clearly in there and you - you might be able to without all that racket right behind you. I think anything like that ought to be greatly reduced. Give them energy factors of 10 to 100 or so less than what it is right now - That noise energy.

SPT

Illumination - Again, it ge - it's a little dark in there. I think we got enough light scattered around to really get good photography. You have to take and bring in some high intensity lights. For some reason, the lights we have in there - Matter of fact, all throughout the whole spacecraft are just low illumination. I don't know why we can't get somthing that puts out a few watts. Scatter all these mediocre low-illumination lights all around the place, why don't we get a couple of good ones? You certainly need a reasonable number so you won't come up with a lot of shadows, but I think ... large number of

QUERY

It appeared that a chair, as we know a chair, is not a very useful device.

GIBSON

What a chair does for you down here is take the weight off your legs, but you don't need that up there.

QUERY

You said that it would actually be an effort to hold yourself in a chair, is that right?

CARR

Yes, the 131 chair is a case in point. We just actually had to strap ourselves into that thing because our body didn't naturally bend 90 degrees.

GIBSON

I think your previous observation is more important. You have a much wider range of reach. And we've found this true in working everything. For ATM we had checklists and cards all over the place which I could reach by bending one knee or the other. You could work around a whole sphere, essentially; the chair was very limited.

QUERY

We noticed that you tended to use any piece of equipment or projection as a mobility and restraint aid whether or not the designer had that in mind.

CARR

That's right and I imagine there were some designers that were a little worried about that, too.

QUERY

No, that's a good lesson; we might just as well face up to that.

CARR

That's right. If something is going to stick out and make a nice handhold, it's going to be used for a handhold.

QUERY

Particularly when there's not any other type of handhold?

CARR

That's right.

QUERY

From what has been said, we've concluded that the triangles and the grid form one of the best foot restraints we've run across.

GIBSON

They are good. We found that we could work those easily and it allows a lot of flexibility.

POGUE

We only had one pair of shoes, actually. I wanted to use those conical shoes more but you couldn't use them with the bicycle. But for general purposes, the triangle worked fine.

Skylab Dump Tape 151-09

Time: 1831 to 2011

Date: 5/31/73

Page 1 of 6

SPT Contamination observation on window S1 window 4. The window itself is clean. However, it has several leafy particulates on the outside. These come from the back that on - all MTF windows which I neglected to mention before this is one of the most audible - looking into the sun. As you open and close the window cover, it runs over that silver foil insulation and freezes and the backing material appears to be somekind of cloth and that causes some kind of lanting.

19 13 14 PLT Hello B channel this is the PLT with the 1487 3F. Going to repeat 3-3 on the restraint of the mobility aid the fireman's pole we have not used yet because we have not needed it. The CIS dome and wall hand rail have - on occasion been of some use primarily for stability. They are not used for transiting the dome or forward aeries. We do that by point by point translations free flooding. Same thing with the STS hand rail. And the ADA. We've generally found that you move about this vehicle - as I say - by pushing off the translating from point to point. You use these hand rails, but you use whatever is available. A surface that to mode fifth, surfaces to back of the ATM here, whatever you need just to give your self a little treat and to keepself trined up. The hand rails are not needed for translation. Hand holds and hand rails are needed for stability. And on ocasion - for example - yesterday when I vacuum cleaned the pointun infit screen at the top of the dome, I found the drops themselves very handy for foot holds. I'd wrap my legs around them and use that to stablize myself while I was vacuuming the sceen. The triangular shoes and a bed have come in very handy. The mode we've gotten into usually - most of the time - is the only hook in one shoe. Consequently we've been trying off and on - we'll coment on it later - two triangles as apposed to one triangle and one mushroom

Dump Tape 250-07

Page 2 of 7

Reference 14

hang onto some of the tools, and -
... velcro and the little pockets with
the - in the - uh - elastic. So the
tool caddy is kind of useful for when
you want to - uh - to - uh - to - uh -
retain lots of parts or lots of tools.

250 15 01 40 PLT

And I've never worn it around my waist
I've always just stuck it somewhere,
so really the waist belt hasn't done
me much good - uh - although, differ--
ent guys may use it different ways.
Mostly, fo me, a pocket - uh - is to
carry things to a certain - uh - loca-
tion in. And then I'll fasten them to
the wall or - uh - pick it up somehow.
so that - uh - it's - uh - within
reach but not on my - on my waist.
Some of the owrk sites we've used -
uh - other than those locations that
uh - the owrk needed to be done at,
were - uh - That is, some of the work
sites we've used which are other than
those at which your actual work is
being performed have been on the - uh -
food lockers for example - a nice big
flat surface - put springs (?) on
there, and - uh - hold things down and -
uh - work on them. Stand there on the
grid, support yourself, and - uh - so -
uh - found the food lockers was good
place to work.

250 15 02 37 PLT

And I worked in the tape recorder center.
Also - uh - at the top of the - uh -
waste management - uh - vent filter cover
is another reasonably good place to work
until we have better ways to hold things
down. But it's a nice flat surfact which
is about desk height. Set yourself down nes
to it and go to work there. Other work
... we've done has mostly all been done at
the site where the job needs to be done.
You just take what you get when you get
there. Figure out a way to wrap your legs
around something and go to work on it is

Dump Tap3 250-07
Page 3 of 7

about the only way to do it. But - uh - as far as performance half is concerned, there's - uh - not much difference in being able to do the job than there would be if you were at home.

250 15 03 17 PLT Adequacy of lighting for work tasks - uh - In some cases okay, and in most cases it's not. In most cases ... open or look at something closely or find out - uh - how the nuts and bolts come off in the preferential order and all that sort of thing you gotto get out a flashlight to take around.

250 15 03 38 PLT Adequacy of onboard data package - uh - toolwise - uh - I guess I don't know what that means. As for as the - uh - house-keeping-type items, where you replace components, I think the - uh - the adequacy of onboard data has been very good. The housekeeping - uh - maintenance tasks and the systems checklists are very explanatory and - uh - and - uh - if - if anything theyre conservative and telling you too many things as opposed to - uh - not telling you enough. So think they're good. It's better to be on that side than any other way.

250 15 04 18 PLT Preflight prep for maintenance tasks - uh - the - uh - tasks that we've per - been perfor - performing that - uh - where we were trained preflight for - uh - if preflight for - uh - if preflight training wasn't very adequate - very good - we haven't performed all those tasks that we've trained for - those which we have trained for - why uh - the preflight training was good. We performed maintenance tasks that we were trained for preflight and - uh - we need your help ... for the most part have been very explanatory in - in defining and outlining how to do those jobs. Training was good and - uh - data that we got on board then which we got teleprinted up is awful good. Mantience

bit more, I guess because a lot of times you're not in position to use your legs. Now when you are in a position to use your legs, then you'll use your legs differently. Mostly on the ground, you use them in tension or - or just compression. Here a lot of times, you wrap 'em around something, and squeeze down on them. A tank or you wedge your feet in a door. Like right now, I'm kinda floating up in my compartment, and to hold myself steady, I'm pushing back on one side of the door with my left he - heel - Achilles tendon, and I'm pushing forward with my right toe, and that keeps me nice and stable.

Now on Earth, I'd just be standing just on the floor. So you're tend to use a little different tricks. Takes you a while to learn to grab in different ways. You tend to want to stand up upright, and after a while you just look around for somewhere to put your feet. You may not be upright or upside down or just a better view but - a better visability. And what job you're doing. By the way, another thing you need, if its where the tool kit, is you need a good light. You need - we anin't - talk about work bench last time but you need a good light that you wear on your head. Now we have one over there that ought to have a little frosted glass on it; it would be adequate. I think it needs, maybe three more batteries, or needs to be made so that it fits the entertainment kit batteries so you don't just have one battery for it ... using one. That's what you need.

259 14 38 40 CDR

Would you offer any design recommendation for future vehicle based on these considerations? Yes. The main one is you gotta have a floor everywhere that you can grip to somehow, like this triangle grid.

Dump Tape 022-03/D-683
Page 5 of 19

is too large to fit by the OWS flapper valve that leads down to the heat exchanger. And what I'm leading up to is saying is that maybe we ought to give it a little bit more thought to more flexibility in our attachments on the vacuum cleaner, and also the fact that the vacuum cleaner itself turns into a maintenance device, other than just a cleanliness device. It's certainly satisfactory for cleaning off the diffuser and doing routine vacuuming in zero-g, but that thing is asked to do - fill many, many, many, more rolls than - than it was originally designed for. And I assume that the same thing is going to hold true of a vacuum cleaner in the shuttle. And I think we ought to have a lot more vacuuming capability. In other words, they ought to have a lot more power to it, and I know you've got problems because it's already on high power, and I don't know what the answer is. But that - that thing - that thing does turn out to be a maintenance tool, and that's the point I'm trying to make. And I think that we ought to have more flexibility in the attachments, and it ought to be a stronger vacuum.

022 12 19 38 PLT

What major muscle groups do you employ in zero-g as opposed to one-g? Well, of course, you use your arms and shoulders more, but what you do is you end up trying to use your legs as primary stabilizing devices and wrapping them around whatever is available in order to stabilize yourself and give yourself a - a work position which is satisfactory for the job at hand. And also, you - you end up an awful lot using your arms and - and your legs to wedge into places and it's a very - well sometimes it's painful. It's certainly not the - the - the way that you would - a good human factors, time and motion man would just throw up his hands if he saw a lot of things we have to do in order to perform the tasks that are more or less routine.

bering system that immediately tells you where things are. This would probably do it - probably all the 70's are on the floor, or something like that. No it isn't because here's one on the floor called 594, but probably all over - In any event, it's important that we ah, do something about volume; got plenty of volume. If your gonna do things like ah, evaluate the maneuvering, you - you're gonna need more. Ceiling/floor proximity, good. Ingress/Egress provisions, I don't like the fact we've only got one hole leading back to safety when you're in the command module. One of the funny designs we got here is, and we live in one end and our so call safety hatch is at the oether end, the command module. That isn't the way it ought to be. The experiment compartment ought to be the farther from the come home module. Sleet compartment ought to be next to it, and ah, everything else in between, there just is no reason to separate yourself so far from ah, safety, in the event of a - of failure - big failure of some sort. Ah, temporary equipment restraints, there aren't too many, except the floor and ceiling. Ah, they're not adequate, I don't think. Ah, personal re-straint devices, nothing except ah, ah, the floor and ceiling. I'd recommend ah, a little bit more in the way of restraints, and ah, mobility aids. Ther- mal comfort, satisfactory. Noise level, okay. Illumination, poor.

CREW ...

CDR 30 minute time limit!

CREW ...

229 22 27 11 CDR

He didn't say. Airlock, general arrange-
ment orientation of compartment, not
big enough. It's tubular when you'd
really like it square like a room, you

have to lay sideways in it, and as you lay sideways in it, you kick things. You don't have any good restraints. What ought to be in there, is some way to go in that lock compartment and secure yourself by the seat, some sort of foot restraint. Have your equipment all mounted around you, and that foot restraint be in such a position that you could open the hatch, and do all the other hatch and maneuvering and tricks or what you have to do. As it is, two of you get in there and float around, bang into one another. One guy flats up and down, tries to get cockeyed, brace his feet to do this, tries to stay out of the way of the cameras that are mounted on the wall; it just - it's sure a make shift operation. You need something, with a nice floor, a nice ah, way you can restraint something, being protected where you won't get bumped, where you'll be nice and stable, and you can get to all the items you need to get to without floating to them.

Volume, not enough. Ceiling/floor proximity, there ain't no ceiling/floor, it's a round tube and you're generally laying from hatch to hatch, it's not the way it ought to be built. Ah, trash collection, no provision, I don't - I think there's need not for trash collection provision but stowage provision that you can use EVA. Now we sit here and ... not because the handrails are tied to the handrails with straps, now that's a pretty poor way to do. We had some nice pocket springs and ah, restraints built in, where we could snap the stuff, or catch the stuff, and not have to put tethers and things all over them, unless you really needed them outside, it'd be much better, and it'd also be more organized, also you would ticket and then center it. There's just a lot that needs to be done to that lock compartment to make it type that you'd really want to use. Now I'd have to say that it's

Dump Tape 344-06
Page 3 of 36

little, tiny pins, that are used to hold the - I think, the attaching bracketry into [?] position and those roll pins vigrate out and if you snag your ... and cut your hands on those roll pins and that's the fireman's pole. But as far as the utility of it's concerned, it's - the - adequate to very good. OWS done and wall handrails: we don't work much up in that area but they're good when

we use them. STS handrails: well, the STS and the MDA probably are between poor and unacceptable or unacceptable to poor as far as all restraints. They don't - they don't seem very well-positioned for much of anything. I know - it seems to me that probably for - if you're just thinking about nands, they're not

too bad; but in the STS and MDA when you're using handrails, you toss yourself around. And we are continuously bumping our feet into sophisticated equipment, namely, the rate gyros. 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 that I would give the handrail. And as far as the MDA and STS as a working area as far as restraints are concerned, I'd say it's unexceptable. Real short-comings all over the place and the MDA is just a lousy place to work. 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 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. Is no - not much good for working water tanks. I'd say

Dump Tape 353-07/D-340
 Page 14 of 16

Lake Titicaca. That's just about it. I took - I tried to take a look at Antofagasta but realized too late that that was one of our 101 targets as well and just missed a chance to look at that and say a few words because it was clear down in that area, but it was too far away when I finally got a chance to look at it.

353 23 32 19 CDR CDR out.

353 23 35 24 CDR This is the CDR at 23:36 with a note for the PI of the ED76. The neutron - neutron gathering devices that are around the - the spacecraft. I'm afraid that we have poorly

placed Bravo 3. I in the last 30 days have inadvertently touched that thing about five times. It's in a natural place as you come through the hole from the forward compartment to the experiment compartment. It's a very natural place to grab, and I reached through the hole and - and - and grab and doggone it I've got that darn slide underneath it my fingers. So I personally have touched it no less than five times. I'm sure the other guys have touched it several themselves, and I'm afraid the data on that one - is touching degrades it, it is definitely degraded.

353 23 36 20 CDR CDR out.

TIME SKIP

353 23 47 16 SPT SPT at 23:47. Handheld photo observations for 149-3 Perth Australia. Okay, when I got directly over the target we had just run into a line of clouds, but shortly before that time we were looking at some fairly

Dump Tape 361-03
Time: 361:04:36 to 361:04:51 GMT
12/27/73
Page 1 of 7

361 04 36 32 SPT - photography or for better v
for one reason or another. I think
they can do it in the airlock
what can you say about it? A
si an airlock. The tube - th
is a tube. There's not much
can do with it.

SPT General arrangement and orien
the compartment for EVA none
Volume - Well, I think it could be a
little bit larger. Run into a few
instances where we had though
planning for an EVA, and - ar
of gear just because we don't
enough room in there. I'm af
of these days we're gonna kid
of those pie - delicate piece
gear while we're in ther and
mess it up. I think the volu
could at least be 50 per - s
at least 50 percent larger for
that kind of operation. GE
yourself in there with all
umbilical and - in a situat
may require that you have a volume
available to you for crew safety. I
don't think it could - it could
a good design in terms of volume; you
just flat need more.

361 04 37 43 SPT Ceiling/floor proximity - Yeah that's
not applicable. Ingress/e
Great, one ... the other. Think
collection provisions. There are none,
but you don't need it in there. You're
always passing through wh
in the mode of making or generating trash.

SPT Stowage volume and access. I think we need
a little more stowage vol
that fits in with the who
question of volume.

Handwritten:
INGRESS
EGRESS
VS. VOLUME

POGUE That's just for high traffic areas. Other places, it may be very impractical. One other crew safety item is the location of the airlock relative to the other volumes in the spacecraft.

CARR Another crew safety area that bothered me was the radial hatch in the MDA. I worried all the time about kicking or disturbing some of the wiring, or something like that, around that hatch. It's too bad we didn't have some sort of a shroud or something that went over that hatch, a lightweight cover that kept us from sticking a foot in there, or getting it under the equalization valve. It always made me feel uncomfortable to work around that thing. During EREP, we had to do that a lot. You could see that it also made Bean and his guys uncomfortable because they did some taping jobs there and taped the handle shut.

POGUE Another crew safety item is the handle cranks for the STS windows. You could guillotine a finger right off with those if you weren't watching it. Boy, that was a very bad design.

CARR You had very, very poor mechanical advantage, so you ended up leaning into that handle to turn it hard, and there wasn't finger clearance all the way for full throw of that crank. You could really lose a finger or a bone there very easily.

Reference 22

28

SP: Did you encounter any suddelties during the EVA that were overlooked or were treated lightly during the training.

CDR: No

SP: Lighting contrast at the work stations, both day and night how did that work out?

CDR: The lighting was excellent night or day. The night light was excellent.

SP: Did you have any scattering from the suit and from the adjacent structure during the day to provide more shadow detail, could you see this or anything like that?

CDR: You, you mean you're still hanging on to the old theory that in space you get dead shadows, is that what you--I thought we shot that down. You don't have any trouble seeing the shadows.

SP: Ok, it isn't that, the contrast is not that high generally

SP: Were there any mechanisms or stowage locations that had an accessibility problem?

PLT: Yeah, film vault

SP: OWS film vault?

PLT: Yes, because of the way the doors open. You had to have one closed to get the other one open.

CDR: Plus this moving I you know, they have those cam-locks on them and the doors always had a tendency to be open a little bit and they were always against the cam-locks and you had to push to get the dial latches or whatever, to get them open.

SP: Ok, the rest of those have been answered. Was there any bumping that you noticed, particularly head, elbows or otherwise due to the cluster layout and installation?

PLT: No.

CDR Never missed it though. I don't think we held onto the little books, the book racks either.

PLT

Well, I frequently, in coming up through the airlock and going to forward to the EREP, I would touch that thing to make sure I didn't hit the ATM panel. Cause it was kind of protruding out into the traffic pattern. I guess that's another point. If you're going to have a working station, right there and a delicate panel, you want to make sure the traffic pattern doesn't pass right over or through it or anywhere near that you could kick it. I noticed that in the MDA, if you got to whirling around in there and, as I mentioned before, you can lose your orientation in there very readily. Before you know it, you could be sitting on the ATM panel and not have even noticed that you were there.

SPEAKER O.K. I guess that's got all of the general spacecraft layout things. On stowage and hardware restraints, did you experience any problems with any of the stowage restraints that you would like to comment on? Any particular things that you can identify?

CDR

Too complicated. Once more, we've overdone it. Spent too much money, etc. A lot of it is our office's fault, by the way, so we're not casting stones at Marshall or anybody else. A lot of it is our own doing. But, for example, the way we stowed the filters for the Waste Management Compartment, odor filters. You ended up having to take a tool up there to release them. It looked like a cheap, simple, structurally good way, seemed okay. Some of the things like the restraint for the tapes? It was okay too, except somehow it had marmon clamps, it had little levers so you could do it without tools. It was better. The one without tools was better, but if we paid a penny more for it, we cheated ourselves. We should have had them mounted in there the cheapest possible way because they were only used once, then go get a tool, unscrew them and take them out of there. We over-optimized a lot of this stowage. We used it once and we had folding hinges. All this fancy stuff. It was nice, but I don't think we want to do it. Also, there was a lot of padding in there, and a lot of bags within bags it would be nice to eliminate. Stowage was overdone. One of the nice things about coming home, or launching the command module this time was all those brackets and fittings and everything that was in there to put every little piece in its place that someone said you had to have to make it work right, we'd just end up with more stuff that wouldn't fit on them. So you essentially opened the door, shoved the stuff around in there and closed the door. It worked great; the thing didn't sink; none of the stuff got broken; and it was just great.

Reference 24

SL-II MC-114/4

Time: 21:36 CDT 01:13:36 GET

5/26/73

CDR

Roger

CC

We're about 30 seconds from LOS, Skylab.

We'll be coming up on Vanguard, as I said, at - it'll be about 09 now, and we'd like to say, you guys did a tremendous job down there. We've got everybody smiling here, now that we've got that parasol out.

~~PLT SP~~ Okay. Thank you. And tell those people that I'm awful sorry about that breaker. I thrashed it around (garbled) in that heat exchanger break, but I just flipped it up with my toe.

CC

And if you still read us, we'd like to get that (garble) system activated.

CDR

Roger, you got a page number for that, Hank?

SC

Okay, that's page 2-137.

PAO

This is Skylab Control. The Skylab cluster has gone over the hill from Hawaii tracking station. It is now just north of the equator in the Central Pacific. Twenty minutes to Vanguard. The trend in temperatures as shown on the numerous different measurement points throughout the workshop is definitely downward. And as mentioned by spacecraft communicator Jack Hartsfield, it's likely that the workshop atmospheric temperatures will be below 100 degrees Fahrenheit by tomorrow morning. They're now around 120 to 125. We're still estimating around 10:30 for the change of shift press conference in the Johnson Space Center news room. Participants again. Skylab Program Director, William C. Schneider. Flight Director Neil Hutchinson, and Jack Kinzler, Chief of the Johnson Space Center Technical Services Division, who will discuss his invention. Eighteen minutes to Vanguard where there will be a medical consultation on a private loop. And at 2 hours 50 minutes Greenwich mean time, this is Skylab Control.

END OF TAPE

SL-II MC416/1
 Time: 07:05 CDT
 6/2/73

Reference 25

CC Skylab, Houston. We're 1 minute until LOS. We'll see you again over Madrid at 12:16, 12:16.
 PAO This is Skylab Control, 12:12 Greenwich mean time. About 2 minutes 50 seconds across to Madrid. Canary Island overlapping passes. We'll leave the circuit up across that gap in the North Atlantic. At 12:13 Greenwich mean time, Skylab Control.
 CC Skylab, Houston. We're AOS over Madrid for the next 9 minutes.
 SC Hey, Houston, CDR on that odds and ends message. That heater circuit breaker is in fact OPEN.
 CC Understand the circuit breaker is open.

SC That's right.

CC Thank you.

SC You know Crip, we're not sure any of these switches; any of these switch breakers on the STS panel. There's always a potential for inadvertently opening those darn things, and I was thinking about that last night, and we probably ought to pass on to the 487 people. I guess I'll put it on B channel. But if you got exposed breaker panels with the switch breakers on, you got to cover them. The guard is not enough. You got to flat cover them with something.

CC Roger. Do you think there's a chance that you might accidentally pop that one open?

SC That's what - That's my message really. Any breaker on panel 200, 201 or 202, always has a potential for having been inadvertently opened by one of three or four people up here.

CC Okay, Paul. We copy, thank you.

SC May I add: We've been running with the lights out up there a lot and I've made a lot of trips to the command module yesterday, plus changing that tape recorder paper and around there and it's very easy - you get to hanging on with one hand, you get floating around on the (garble) to get in there and knock something off and you'd never know it.

CC Okay. We copy.

SC Ask EGIL, I already (garble) integrated to zero for them that way.

CC Skylab, Houston. We just sent you one more pad and it was one concerning that M151 and 183 we were talking about earlier. And what it is is changing of the lighting slightly, to handle reduce lighting power due to the powerdown considerations we got.

END OF TAPE

CONRAD
(CONT'D)

so that worked real well. We had a couple of spurious fire alarms in the beginning that used a little of our adrenalin. Especially the one in the OWS heat exchanger package, which is the one place we could really have a serious fire. That was the one that went off twice. After the vehicle started to cool down, or maybe the system just got on the line for a while, we didn't have anymore spurious fire alarms. We had another one down in the crew quarters early in the game, too. I think we had three spurious fire alarms. We got in a good test on a rapid Delta-P whenever we repressed the airlock on EVAs. That always caused a rapid Delta-P. You're aware of the one where we had to secure the fire system in the aft lock for EVA because they were getting something in there that would cause a rapid Delta-P if we'd opened the hatch. I thought the rest of the controls and displays worked great throughout. We did have

one problem in the beginning. I guess we got a little careless working around that STS section and we inadvertently turned off a fair amount of switches in the beginning, mostly with our feet. Those guards on the STS panel really wouldn't keep your toe from getting in circuit breaker panels or something. After we got a little better about managing our feet, we didn't turn too many of these things off.

Reference 27

24

CDR: Pretty buried. You know, they got MOL sieves around them, and teleprinter paper boxes or whatever all that stuff was. I'll tell you the thing that wasn't vulnerable to that was the 200 panels and those guards cause we apparently turned off a lot of circuit breakers and switches in the beginning of the business until we got very conscious of our feet being down around there.

SPEAKER: Do you have any comments on the fiber glass stowage containers that are used in the airlock as far as being sufficiently rigid? Did you find any problems with the lids flexing or any problem like that?

PLT: Well, the only one that, I think, that we had problems, with and we've had problems with it in the simulator, in the trainer, is that 202 box. Isn't it 202? When you move the whole box, you know. It's got a cover on it plus it's got the two calfax so you can swing it down and get at the ATM C&D loop, right? And it's a real pistol to get it hooked back up just like it is in the trainer.

SPEAKER: Calfaxes don't align properly, is that it?

PLT: That's right.

CDR: Other than that, we didn't have any fit and function problems with any of those hatches that I can think of.

Reference 28

SL-III MC-1188/2

Time: 20:22 CDT, 30/01:22 GMT
8/25/73

CC Okay. Thank you very much. Let's move on to another question, Al, and get back to the business of the guards on the switches for the rate gyro packs. First of all, we flew up a guard in the rate gyro pack tool kit which was a little u-shaped aluminum dealy, and it was intended to go over the high-power accessory circuit breaker on panel 202. Did you find that guard, and is it now on that circuit breaker?

CDR The answer is yes. I even taped the base of the guard down. It's completely, to my mind, doesn't do the job, considering the criticality of that circuit breaker staying closed all the time. Now it's taped there and somebody will have to go to great effort to knock it off. But I'll guarantee you when you getting in the coolant trying to hunt around for the coolant, or you're trying to get some of those screws off, like we've been doing lately to hunt the leaks or hunt the vacuum, then sometimes your feet flail around. They don't usually, but once in a while they do. And you'd sure hate to knock that circuit breaker off. So it's on now, and taped down. But I think we ought to come up with a design that we can put on there, and screw it on so if somebody gives it a good kick, it still doesn't move. Right now, if you give it a kick it just kind of flies off its snap and the circuit breaker's exposed.

CC Okay, Al. Let me go on to another couple of suggestions that we had. First of all on all these switches, for you flight, the high-powered accessory outlet switch that's over there, we think it's be okay just to get a piece of gray tape, and actually tape that switch to the on position. In the case of the circuit breakers, we obviously want some kind of guard that will allow the circuit breakers to pop open. And the best idea that we've come up with, would be to get maybe one of the backs off one of the books that, maybe you can find, that Pete was using, or a piece of cardboard or something and just form a little U-shaped cover over it. One that could be taken off in a hurry if you needed to. And also, one that would allow the circuit breaker to do its job, but would hopefully prevent, you know, you from getting your finger or foot in there. And then for Jerry's mission, of course, we can do something a little more scientific.

CDR Okay. That's not a bad idea. We've got tape over them now, that'll still allow them to throw, but protect them somewhat. Before we launched, I thought those things were acceptable. And I don't think so anymore. The circuit breaker we've discussed is fixed the problem there is, that's a rather narrow area of the space ship and you end up going by there and sometimes you're not in complete control. You know, your feet are dangling and it's just

SL-III MC1279/1

Reference 29

Time: 10:47 CDT, 32/15:47 GMT
8/28/73

PAO This is Skylab Control; 15:47 Greenwich mean time. One minute, 50 seconds away from acquisition at tracking station Guam. Skylab space station just over the main island of Honshu in the Japanese Island group. Midway through revolution 1530, Commander Al Bean should be winding up his first run on the ATM, Apollo Telescope Mount's solar observatory at this time, while Pilot Jack Lousma should be in midrun as subject on the M031 vestibular function experiment, while Science Pilot Garriott observes. Acquisition at Guam upcoming momentarily. Standing by at 15:48.

CC Skylab, we're AOS Guam for 8 minutes.

CDR They gave me housekeeping 7K today, and I can't even find it in the book. Ah, there it is, down at the bottom. I got it.

CC Okay. If the M131 troops or not getting ready to do a voice record. We need about 2 to 3 minutes of dump here.

CDR Okay. They're not voice recording, they're whirling - whirling slowly in the chair. Okay?

CC Okay and we need the DAS for a couple of minutes.

CDR Got it.

CC And while I've got you Al, I got a couple questions on the switches that go to the 6-pack.

CDR Go ahead.

CC Have you done anything to protect the - the high power accessory outlet number 2, that's panel 139 or the rate gyro control distributor panel 1 - 141?

CDR That's affirm. We put good protective tape between the two guards on the high power outlets. Looked like that was strong enough and rigid enough to do the job. Now, for the circuit breakers - we put tape over all the circuit breakers where you'd have to - where they wouldn't bump. And then I got a couple of pieces of cardboard taped over the structure nearby with a little caution on it and it tends to protect them also. So I think they're both protected, so that a foot kick or something will not turn them off. I hope that's true, but of course, we need a more permanent place for chair.

CC Okay. We didn't know you'd done that, and we were going to suggest taping the food can over the high power accessory outlet switch and maybe a blister patch over the panel 141. But it sounds like you've taken care of it pretty well.

CDR I don't know. Those ideas are maybe better. I'll go up and look and may do - I like that food can idea too. I'll go up and look at it - we may change them.

CC Okay.

You need a work bench with a vice, some electrical power, some way to hold it. You got your volt low meter there, and grippers from the experimets, so whatever is bolted you take over and strap down on the table and work on it. Now, you have to strap it to the floor and you don't have any lights, bring your flashlight, a lot of other problems to solve. Yes, we do. Just like a - no difference up here and on Earth. You wouldn't think of working on precision electronic gear on the floor, on Earth. You'd have a nice bench for it.

259 14 41 18 CDR

What is prime method of removing reactive forces when you must exert limear push or pull forces during a task? I think somehow get the feet down, torque gently with the other hand. I haven't had problems with these unless you're in a place where you can't get your legs ... into position. Have you noted a tendency to established an IVA coordinate system. Yes, because it goes just like you did on Earth. In fact, I think it end to hold the back up here, somewhat, to get generally move to a station that way. It allows you to reach things; it allows you to move into position. But it - you have to remember and say; hey I could work out this thing the other way; it'd be easier. So you have to be careful or you fall into the trap of trying to always do it with that reference frame, whatever it is. It's hasseled and then it allows you to orient yourself easily into space.

259 14 42 13 CDR

The application you feel it should have: I think you should design it with a definite orientation in mind. Uh - because that makes everything uniform; it makes you, when you some - into a site, know how you got to operate, without having to figure it out. Now, if you get - let's say your gonna go up and work on the water tank. When you get there, you spend a quite a while flipping around to different places. And when you flip around, you'll find that sometimes you're working with your foot, in a switch that shouldn't be in. Uh, going up and looking

out the STS window, we've turned off the switches up there two or three times. It's a ridiculous thing to do. There ought to be a way to operate at those windows where switches are out of the way, yet you have the ability to see out the windows in all directions you want to go. So, you ought have design with one orientation in mind that - but you, yourself be flexible enough to change, have things protect realizing that people may change.

259 14 43 11 CDR

What is your opinion concerning the - ed visibility of exerting design influence to standardize the multiple type of snaps? Every snap ought to be the same. I agree with that. Latches: as good as possible. Retainers: I don't think you ought to do it after the - think is - is uh - built except in areas where - like - uh - trash bags and utility bags, things like that. Uh - these little holders for clothes. All of that ought to be standardized and not try to assess something better than we got. Springs on the door. the ought to be standardized. A lot of that ought to be standardized. But once a piece - once you go buy a piece of gear, you shouldn't change it over. You should try take it like it is, cause we do have a lot of flexibility. We haven't - one thing I've noticed is we overkill the personal problems. We work with a lot less human engineering than we have pass. Now we could do away with almost everything we have and still survive up here which gives me the feeling we spent a lot of money to get these things standardized to just perfect. I suspicion what we ought to do next time is factor that. Let's pot out some specs to begin with for all experiments.

259 14 44 22 CDR

Before I had to say, excuse me, pass me this and this and here's where you get them. If we get it off the shelf itme, take it like it is. But have the spers in plenty of time to give the other correct. One of the biggest complaints I've about stowage around here, is we got all this stowage so neatly placed to wast. Particularly in the command module.

Reference 31

TAPE 3, SIDE 1

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.

TAPE 3, SIDE 1

PLT I think the fact that they were toggles, like switches, instead of the old kind of circuit breakers was really what made the difference. They were easy to flip, inadvertantly. Anytime you grab the little ---- in fact, anytime you grab one of those little switch guard covers, use it as a handhold, it was very easy to trip a switch or a circuit breaker.

CDR Tripped a master alarm one time, grabbing the guard.

SPEAKER Did you have any electrical discharges occur during any activities or equipment operation?

SPEAKER Yeah, they covered that this morning, I forgot to mention it. But let me ask.

CDR With close, only. As far as I know.

SPEAKER We probably spent a lot of money grounding everything, except those ----- just because of the nature of it, we really didn't go overboard on that. But did we probably overdo that? The impression I got this morning, was, somebody, Owen thought on one occasion he developed some static electricity, but other than that there was nothing.

PLT I didn't notice any at all.

CDR When I took off my clothes, sometimes I could get a little static electricity on the arms, you know, but none, nothing ever visible and you're right. We shouldn't do, bother doing that unless there's a need for it. I don't know how you do in airplanes, but I'd say about the same as in airplanes. Never had any problem, and probably spent millions doing it. Got to cut the cost of this thing.

SPEAKER Maybe the reason you didn't have any trouble was because you had everything well grounded.

SPEAKER Yeah, I think thats true with respect to basic structure and everything, but all the add-on items-- Most of them just didn't lend themselves to it.

SPEAKER Went through a considerable program to make sure you had grounding straps, and when things were withdrawn, they were grounded until they came apart and things of that nature. I would be hesitant to eliminate grounding just because you didn't have any trouble with it.

Dump Tape 332-08
Page 19 of 25

332 17 53 23 PLT

Now there were a lot of house-keeping tasks that I had never done before, and again the first time through required more time than was allotted. Some of the medical stuff that we got, the stereo photos we had never - that's right, the stereo photos we had never done, some of the IR photos, we had never done and yet we were given, you know, like, just added on a couple of minutes here and there to do this sort of thing; it's extremely difficult. What - I would like to give an example of what happens when you add on a task like the IR photos, and this is a case where we were given the task of taking IR photos of each other, and the instructions, although it sounded rather glib, were pretty difficult to follow. Man lay down on the grid floor in front of the film locker, another man is supposed to float up around the fireman's pole, and of course that's ridiculous; you don't float when you're taking photographs. So what I - what I ended up doing was going up by putting one triangle in by water tank 3 and sticking one leg back in between the water tanks. And what I did, I had activated water tank 3 and pressurized it, and I had - then I kicked the valve off. Now I didn't know this until last night; we has some trouble with - started having trouble with the water tank. I still have not reported this to ground. But I would just like to give this as a good example of what happens when you throw stuff on the last minute without having proper training on it.

Dumpt Tape 332-08
Page 20 of 25

332 17 54 53 PLT

And what I did - I actually could have damaged the pressurization valve to water tank 3. There I was, fat dumb and happy, one foot restraint and the other foot sticking back between a water tanks, and I kicked the valve off - PRESSURIZATION valve OFF which started the water pressure, and I didn't - I wasn't smart enough to figure this out till last night after we'd al - after Hosuton had already solved the problem. The question you asked here in the book, is what unanticipated problems have occurred in performing vaious activation ... you know experiment activity to date, ... and that's the answer. That is - that is a kind of thing that happens when you start throwing things on at the last minute. And we're very - we're quite happy to do this, but we've got to have the time, the first time period to get familiar with it, and also you can expect glitches like me kicking of that PRESSURIZATION valve on water tank 3. Now I consider that to be my fault; I should have know better than that, because exactly what happens - This is - a very good question you've asked, and I was just giving that as a good example of how not to fly a spacecraft and how not to schedule operations. Somebody thinks something up in an office, it sounds good, and then all of a sudden you find yourself trying to do it the first time, never having done it before, it's - it's gonna take probably 4 or 5 times as much time to do the task. Than the man who is needling the FAO types. Have 'em do my experiment, it only takes 5 minutes, and you end up taking an hour to do it.

Dump Tape 356-06
Page 16 of 17

they want me to close the circuit breaker, and they put in parentheses UP. And, of course, you close circuit breakers by turning them DOWN when you're looking at the printing right side up on the panel. But anyway, I just say they - it's also the guides. The guards on the switches and everything conceal an awful lot of nomenclature and make it pretty difficult to find the switch. But the 200, 201, and 202 are so bad that, you know, it just leaves a bad taste in my mouth every-time I try to work in the area because you're moving - trying to move your head to a bad angle. You get your head where you are in a good angle and you can't read the numbers, you are looking upside down at the nomenclature. Bad scene, all the way around, STS: I can't over emphasize the fact that that is extremely poor lay out, as far as the control display panel is concerned. And that has to do with the more or less paradoxical conventions that are used - conventions that are used as far as up/down and throwing the switches. And the major problem in the area is the switch guards, which are absolutely essential in that area; you are really kicking around in there a lot of time when you are moving. - And you have to have good switch guards control guards.

356 19 35 48 PLT But there's gotta be a better way of doing it, because they conceal too much nomenclature with the big rods and so forth. This is the PLT completion of M487-3, Subjection Evaluation Guide 2; and that's 3-5, and then the Eval Checklist. PLT, out.

356 19 44 00 CDR This is the CDR at 19:44 Zulu with a debrief of the AT24 Zulu ATM pass. The JOP 6, building block 32 was no sweat. Then we did a branch of 2-A, building block 10; again no sweat. The only thing of significance was the - in active region 00 the scan spots had; in the

POGUE No.

CARR No, the - either one. It was the either RF or - -

POGUE Yes, that's right; it would throw it off. We didn't set that up too much either, because that thing again - that would go off on the nightside for some reason or the other. You got an awful lot of RF on nightside of the Earth.

QUERY

Did you - I guess I don't remember it - I got a question here on inadvertent operation of the switches and circuit breakers in reference to the guards. Were the guards - proper?

CARR

Sometimes if you succumbed to the temptation of using a guard for a handrail, you were in danger flicking one of those little breakers. We did have a couple of instances of inadvertent switch operation in the STS area. One was the - what was the one you threw one time?

POGUE

The timer, I advanced the day one flick.

CARR

Yes, that's right.

POGUE

I was up there doing something, working with the condensate system and I reached over and advanced the day of the year one.

CARR Also the guards restricted your visibility of the nomenclature on the switch or breaker and you find yourself playing this game, trying to check circuit breakers to see if any one was open or something like that.

POGUE It was hard to read the - -

QUERY We can understand that after looking at the closeout photographs.

CARR Yes.

QUERY For proper position.

CARR Yes, it was tough, but you've got to protect those dog-gone things and that looks like something you just kind of have to buy.

QUERY Were there any failures when lamp tests were performed?

CARR No.

POGUE No, I don't recall any.

CARR We did that; that was a periodic thing; it was a house-keeping task, I think. And - you go around and test all the lamps and report - report the anomalies and I don't remember reporting an anomaly when I did it, nor do I remember anybody else reporting anything.

CARR (CONT'D) kind of creative. And Ed's ATM was designed for creative use, and he got to use it creatively later; so that was very satisfying to him to be able to do it. The - -

POGUE The science demos too.

CARR The science demos were satisfying because we could be a little creative there. The stuff where you just followed the clock and threw the switch was not very satisfying at all, as one would expect. Being the observer in a medical thing was not very satisfying. It got very boring.

QUERY I'm going to scratch out some of these I think we've covered. Did you all - Well, you mentioned in the electrical portion that you had some bumping of those airlock circuit breakers and switching them off occasionally. And that was partially due to the switch and was that - the traffic area and the bar guard design, did that anything to do with it?

POGUE Yes, because you're tempted to grab the bar guard; that's how I got trapped in this, I think, when I reached over to grab ahold of it and it flipped the circuit breaker.

QUERY Do you think that the wicket type of guarding would have been better than the type of guarding they had on, or would it have made much difference?

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

POGUE Panel 217, that access area where you had to remove the gas separator from the coolant lines, I thought was a poor design. It was also a crew-safety consideration in that there wasn't any way to get in there and do that operation without endangering your hands from hand cuts. I noticed this during training and, of course, I was very dissatisfied with the operation. There was no way around it; that hardware had already been built. There was a tool fashioned that could have simplified that operation, but for some reason, we did not get it. I ended up using connector pliers to help myself, but I always had hand cuts. When you have a chance of cutting your hands, then you increase the chance of a deeper cut. I was very careful and used the optical gloves for the EREP when I worked on that.

Around high traffic areas, like going down to the aft compartment through the hatch in the hexagonal hatch in the forward floor, we never hurt ourselves, but there was a possibility. I caught my finger a couple of times, but fortunately, I was not moving too fast. Any time you have a high traffic area, you ought to make a positive effort to avoid small apertures through which you can put a finger and get it caught.

CARR

Good point.

Dump Tape 356-06
Page 8 of 17

forget it. Because there is just too much noise. There is no noise control in the vehicle. And that propagates right into the sleep compartment. Illumination is fine.

356 19 21 01 PLT

Experiment compartment: general arrangement and orientation of compartment. Well, that's sort of a hodgepodge. Hard to get back into that one corner over there where the tool - tools are kept, because we have to get back there quite often. And when anybody's riding the bicycle, you're taking a chance of hurting them or you when you go sliding past them, cause they'll be pumping on the bike. That ought to have a special volume all its own, because it does occupy that, tied it up. And there is a small safety problem there when you start trying to go by somebody with a - the bike, while they're operating the bike. The corner over there where the - it was 131 chair; well, that's a good place for the 131 chair. It's sort of out of the way, and sort of useless area in there, anyway. Ceiling/floor proximity's fine.

356 19 21 43 PLT

Ingress/egress provisions. Well, here's a small point. They put those neutron detectors in the - around the ring where - the ha - the hole that we come into when we come in straight down the X-axis into the experiment compartment. And several times we've touched the neutron detector, which is not supposed to be touched. Well, forget it' I mean, if you're coming down through there and you got to get a hold of something, you're going to grab; you're going to grab for the lightning hole or anything else. And this is what's happened; that's why that particular experiment's been possibly contaminated. Now, that - that - that's a consideration. You should not locate sensitive devices anywhere around a high-traffic area because, man, a guy's

going to - going to grab, and eventually he's going to get a hold of it. Ingress/egress provisions, no

356 19 22 28 PLT

Trash collection provision; there is none out there. I think there was one, but we - but Pete moved it here in the - the wardroom. But there ought to be some, and that's - by the way - oh, yes. I know what I want to talk about. Disposing of that - of the myriad of little tiny bits and pieces you get when you're putting sensors on for the M092 or whatever. When you put biosensors on, you've got overtapes and those little 3la - I jsut suppose adhesive - caps on the - or rings on the sensors themselves. And then when you get through, you've got to get - pull them off, and you've got to take the electrolyte sponge out. And those things are floating all over the spacecraft. There ought to be a special way, and the medics ought to bear the brunt of the responsibility of designing it, of getting rid of the small sponges and overtapes and ring tapes, because those are - are really - they're messy, they're - it takes time - it's time consuming to clean those and clean the harness up. And we have to use the regular trash pr - trash provision, and the mouth on that thing is - the slit on it's too long. And those things, you can put them in there and they'll just chase you right out. They'll follow your finger right back out. And they're always covering the diffuser section up above.

356 19 23 42 PLT

So, I suppose - going back to the WMC, since that's what we put our sensors on, that that would be a - a complaint against it, although it's not a complaint again WMC because that's not its designed function. But it's against an area wherever medical preparations - preparation for medical experiments is performed.

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 couldn't. 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

7

as it appears. I think the other thing too, was the doctors you know, were saying "how much exercise do you think you are getting running around the water ring locker" You aren't expending a couple of ounces worth running around those things. If you ever got going fast enough to really pull g's, you'd never get your feet out in front of yourself, you'd be going in face first every time, so there very low energy, although it looked like we were putting out a lot more than we were.

SPEAKER Yeah, it looked like slow motion

CDR Well, thats essentially what it is

SPEAKER Yeah

SPEAKER Was the padding in the equipment sufficient or do you have any comments on that? In some areas padding on sharp edges that you may have hit, was that covered pretty well?

CDR Well, anything that protrudes thats narrow in area, if you know, now you are absorbing that on a point. The one thing that I really clobbered myself on one time and for which I had a great deal of respect for was the metal ring up in the dome that goes around the air vents.

PLT ducts

CDR The cloth ducts you know, you got a machined metal ring thats about 3/8 ths of an inch wide and that son of a bitch is flat sharp and I really clouted myself on the pelvic one day sliding into that thing backwards, and I gave them a wide berth after that. But that was the only-everything else was, we didn't have too many sharp projections sticking out anywhere.

PLT Some fire sensors were padded, I think. What else was padded?

CDR Yeah, the two

SPT A lot of care was taken pre-flight to round off sharp corners. I think that was appropriate and I think it had ought to be done on any vehicle.

CDR Yeah

SPEAKER Say, over on the OWS hatch, when you went EVA on that OWS hatch, did you actually put something over that equalization value in there?

PLT Yes

SPEAKER Was there something over that?

PLT Yes, but I'm not convinced there doing any good. I cut out two pieces of mosite, theres some sheet mosite that was filler in the ESS drawers. I cut out two pieces and put it over the inside and taped them on with two pieces of gray tape each. Such that I think that they wont resist airflow into the workshop but more than 3 or 4 inches of water. Theres a row of bolts that holds it on from that side. It looks to me its awful close, it looks like the bolt heads protrude above the flat milled sufrace there. I think they may be getting airflow by there. We got the word that we had zero leak rate during EVA's and I would almost have to think that it fixed itself, but, we didn't change anything anyway. They are still there.

SPEAKER Did you notice anything wrong with the seal around the hatch?

PLT Nothing, There is nothing wrong with that hatch at all that you can tell by visual inspection.

SPEAKER I see we got some questions on liquid dumps. Did you dump any urine at all through the urine dump system into the waste tank.

PLT No

LOUSMA
(CONT'D)

that happened a lot up there. Things seem to just disappear very easy. Usually they show up in a day or two but sometimes that isn't soon enough.

BEAN

One other thing that I think gives a slightly different feel is how easy it is to move around in that total forward/lower compartment. For example, during EVA prep, we always practiced carrying our TSBs up and attaching them to the food locker. Then, loading the TSBs there, I think, that is unnecessary. You should leave your own TSBs in your sleep compartment and then when the guy gets the UTCA, he can float down to the sleep compartment and stick them into the TSBs just as fast as he could ever go up there to find them on the wall. You've got to be careful because you're working one g, stashing things here and there for convenience. My opinion on most things is to just leave them right where they are at the moment and whenever you find something, you can float from one end of the cluster to the other in 15 seconds, or from the forward compartment to the sleep compartment in 2, 3, or 4 seconds, go ahead and put the gear right where it is. You probably should leave things stashed or stowed where they are and not worry about the. That's one thing that is a pleasure compared to trainer. It's just super easy to get everywhere.

LOUSMA

It's super easy to get everywhere in there. It's so easy to get things out of the dome locker and it's just so easy to go anywhere in a flash to set things up. I think the trainer is misleading in that respect, sometimes.

SPEAKER

Okay, how about the AM/MDA?

LOUSMA

I never felt a tendency to try to orient myself as I would in one g. I never tried to get EREP at 6 o'clock like you do in the trainer. The fact that it's oriented one particular direction on the ground doesn't really make any difference.

BEAN

IMPT

I found that it was more convenient after being up there for about 4 or 5 days. Anytime I entered the MDA compartment, I'd rotate so that I was essentially head up in respect to the ATM panel. Then I knew where everything was located. If I went in there and didn't do that, it was kind of mystifying where all the objects were. So you got to where you would roll a certain direction as you went in the MDA and then the same thing occurred when you returned to the OWS. If you rolled a certain direction as you went through the lock compartment, then you come out through the overhead hatch, and you knew whether to break right or left or forward or backwards to end up over near the dome lockers or wherever you wanted to go. Otherwise, sometimes you end up in a part of the compartment where you didn't want to be.

LOUSMA

I know often when you'd come back in the OWS, you'd stop and look to see where the minus-Z SAL was or wherever you wanted to go, you just didn't automatically come through the hatch and zig in one direction or the other unless you came through at the same orientation all the time.

BEAN

I think it would be worthwhile over there when they're running EREP to give them a short EREP pass where they never did anything over at the SLS but did it all right there. Have the clock running and I can't remember if the C&D runs in the trainer. Just put a clock there and have them run through the complete load; simulate how to get in their foot restraints and kind of stand there and run the whole thing in the AM/MDA including putting the film back without ever getting out of there, without going over to the other simulators, realizing the lights and things don't come on. But I noticed that you don't use the lights. You throw the switches on time, and hardly any of the EREP things give you any indication except maybe the 191 CAL. Stay right there and work in that one portion of the simulator through the whole pass. Someone might say, it looks like we're wasting time here. We've got 30 minutes set aside to throw switches. We know the switches don't do anything. Switches don't do anything over there the other simulator either, but yet you would get the feel of doing it all and working side by side. The guys in

I know often when you'd come back in the CME, you'd stop and
 look to see where the minus-3 BAL was or wherever you wanted
 to go, you just didn't automatically come through the hatch
 and rig in one direction or the other unless you came through
 at the same orientation all the time.

LOUISIANA

I think it would be worthwhile over there when they're training
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BEAR