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SKYLAB EXPERIENCE BULLETIN NO. 11

PERSONAL MOBILITY AIDS

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

BULLETIN NO. 11

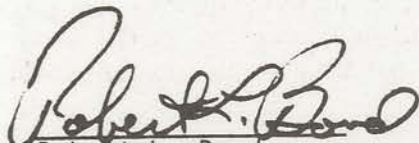
PERSONNEL MOBILITY AIDS (IVA)


This document is the eleventh 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.

Prepared by:

  
Maynard C. Dalton

REVIEWED AND APPROVED BY:

  
Robert L. Bond  
Head, Man-Machine  
Engineering Section

  
G. C. Franklin  
Asst. Chief for Crew Station  
Spacecraft Design Division

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## INTRODUCTION

This is the final document in the four-document series concerning personnel restraints mentioned in Skylab Experience Bulletin No. 7. The Skylab IVA Mobility Aids are the subject of this bulletin.

## SUMMARY

The fireman's pole, the portable handholds, and the preinstalled handrails have been evaluated as to their usefulness.

The fireman's pole and the long strap which was sometimes used to replace it were both useful during the early portion of each mission. However, once the crewmen learned to move around in zero-g, neither one was needed.

The preinstalled handrails were used frequently and to good effect as both mobility and stability aids. It is recommended that such aids be installed along all traffic routes and around hatches of future vehicles.

The portable handholds were not used. They could only be attached to the open triangle grid and the grid itself was adequate as a handhold. A portable handhold would have been useful if it could have been attached to various surfaces in the spacecraft at the crew's discretion.

## PRE-SKYLAB EXPERIENCE

Prior to the Skylab missions, mobility aids were not really required. The Mercury and the Gemini spacecraft were too small to move around in.

The Apollo Command Module was somewhat larger and did allow IVA mobility, however, the interior had sufficient structure readily available to function as grab-bars so that handrails were not an extensive requirement for zero-g operations.

The Lunar Module (LM) had few zero-g handholds. One such is shown on Figure 1 in Skylab Experience Bulletin No. 10. It was a grab-bar mounted on the control panel and functioned in conjunction with the Lunar Module Restraint Assembly. However, most of the handrails or handholds in the LM were for use by a pressure suited crewman during ingressing and egressing the LM on the lunar surface and were specialized aids for that activity rather than being necessary for zero-g use.

## SKYLAB DESIGN

Mobility aids were provided throughout the Skylab to assist the crews in translating to and from work locations. These devices included the fireman's pole, fixed handrails and portable handholds.



### Fireman's Pole

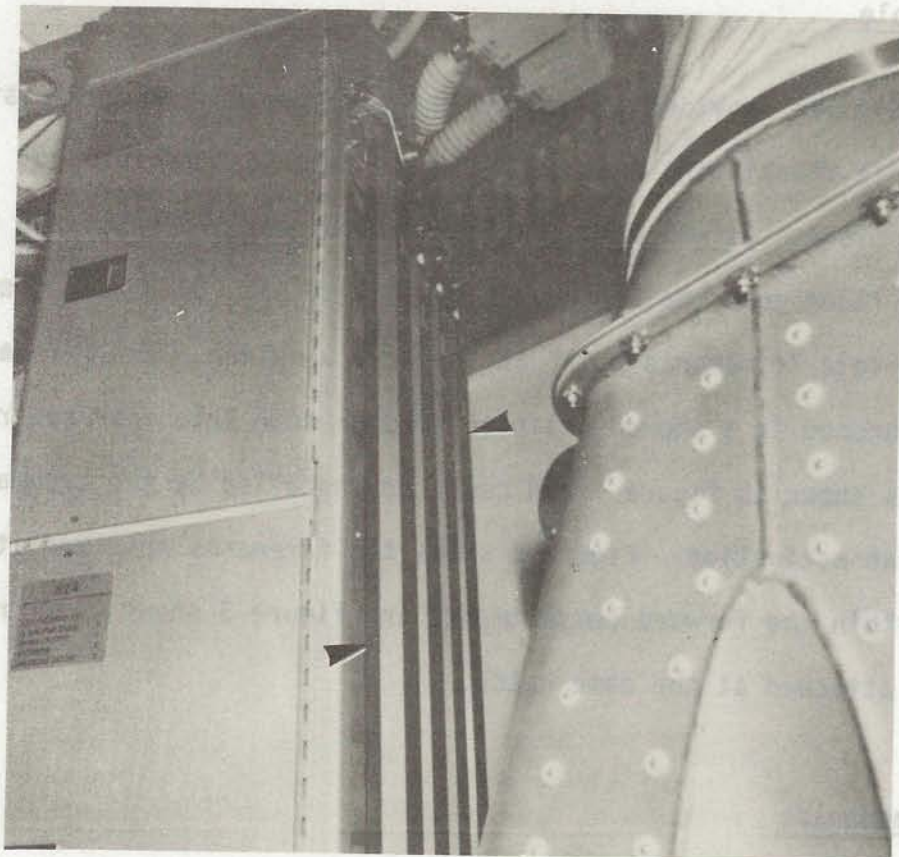
A mobility aid was provided in the OWS forward compartment to assist the crewmen in translating from the OWS dome hatch to the forward compartment floor. It was attached to the dome near the hatch and the compartment floor near the hatch. This mobility aid could be a flexible strap or a rigid "fireman's pole" at the crew's option. The fireman's pole was launched in a stowed position (broken down into four separate segments) as shown in Figure 1 and could be installed by the crewman during Skylab activation. Figure 2 shows the fireman's pole and its location within the forward compartment, and Figure 3 shows the fireman's pole attached at the dome hatch.

### Portable Handholds

Six portable handholds were provided to enable the crewmen to install handholds as required, in areas where open grid was available. Figure 4 illustrates these handholds. The attach point to the grid was the astro-pin located at the center of the base of the handhold. Figure 5 shows the six handholds at their stowage location aboard Skylab on the exterior wall of the sleep station.

### Fixed Handrails

Fixed handrails and handholds were installed throughout Skylab to assist the crewmen in translation and in maintaining temporary body stability



STOWAGE LOCATION OF FIREMAN'S POLE

FIGURE 1

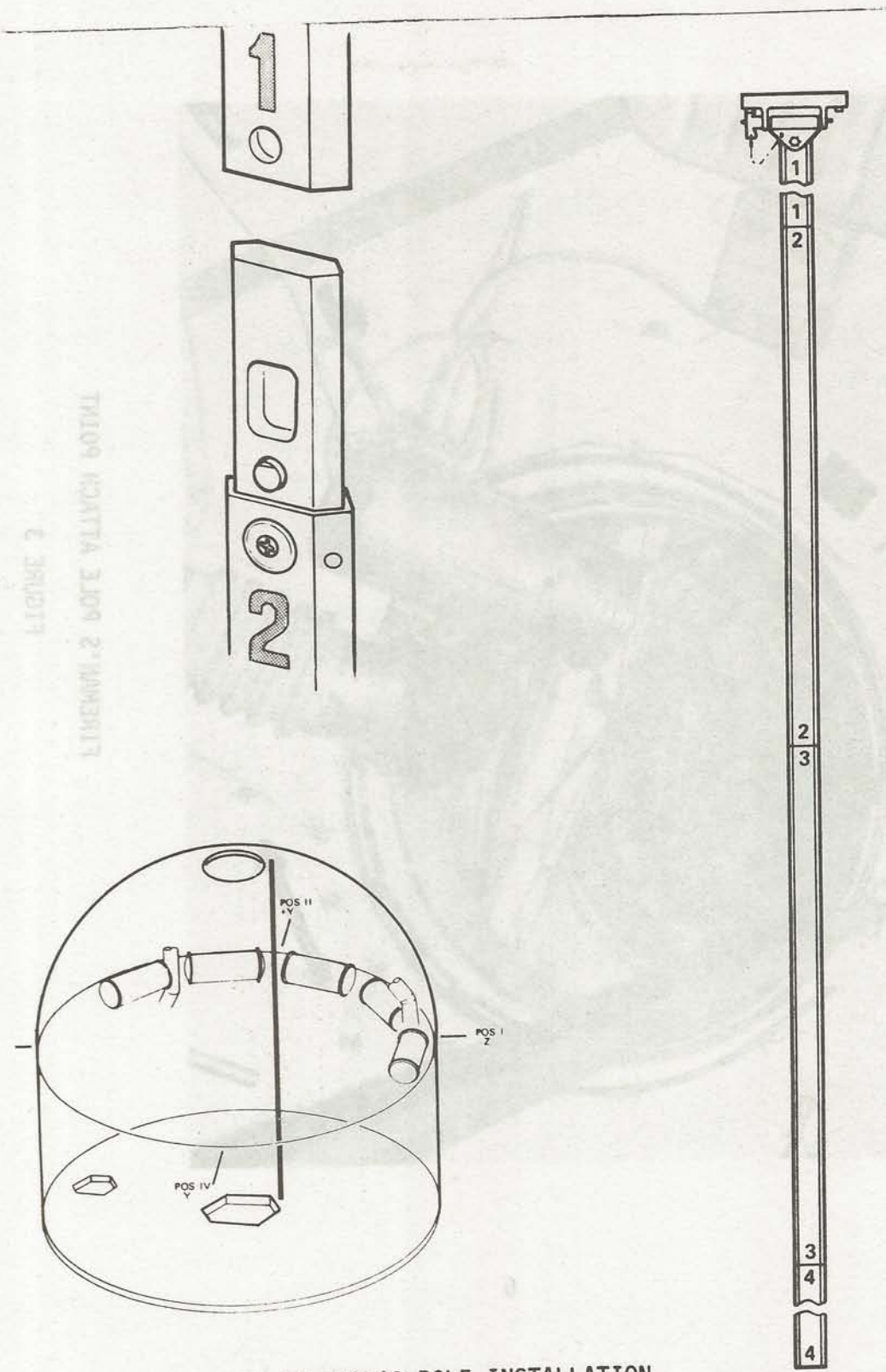
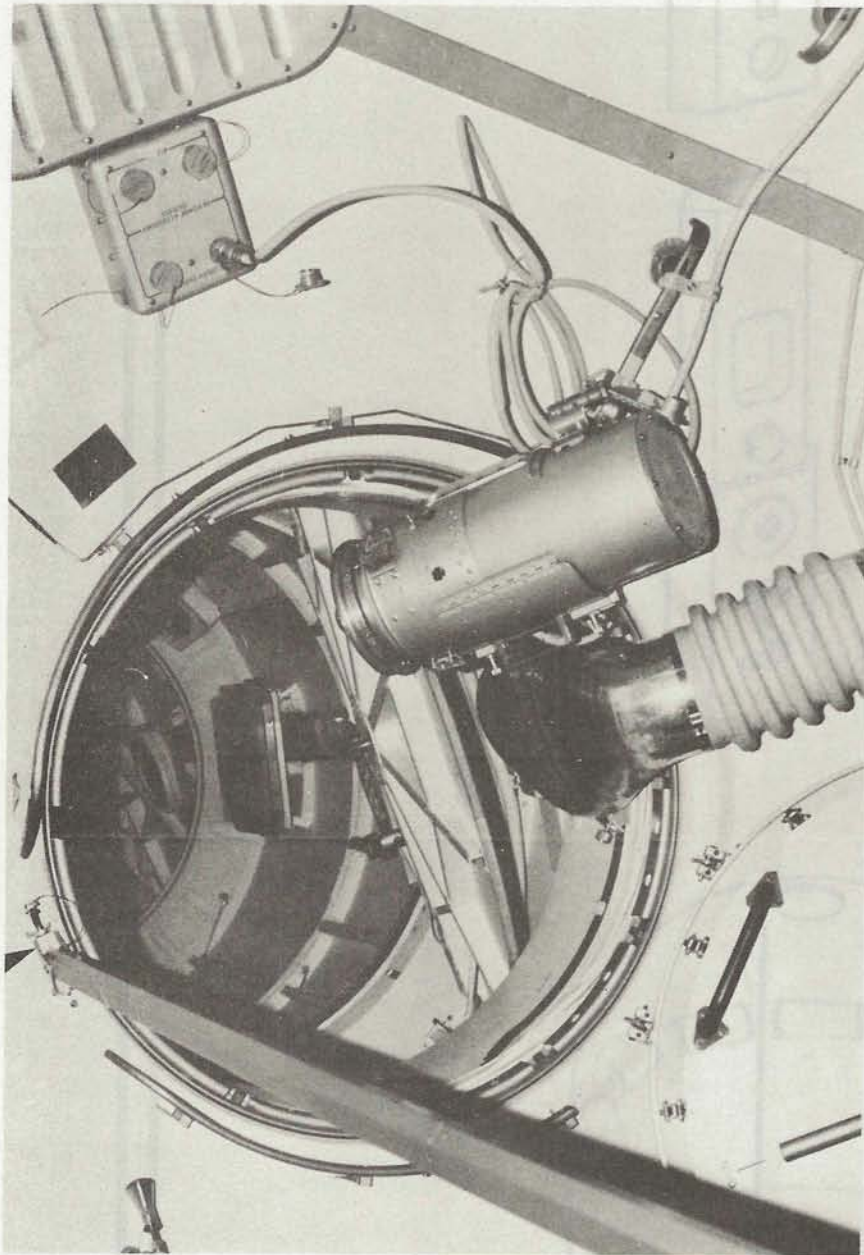


FIGURE 2  
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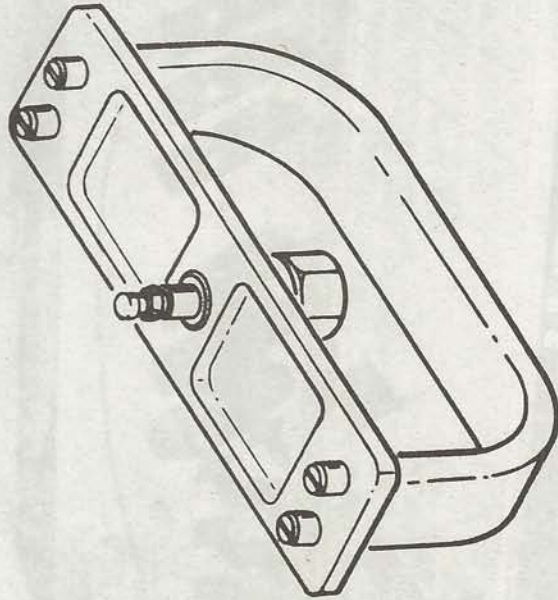
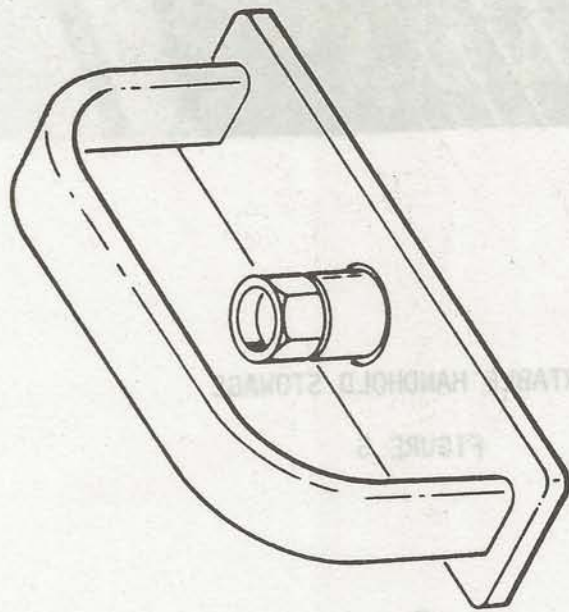
FIREMAN'S POLE INSTALLATION

FIGURE 2



FIREMAN'S POLE ATTACH POINT

FIGURE 3

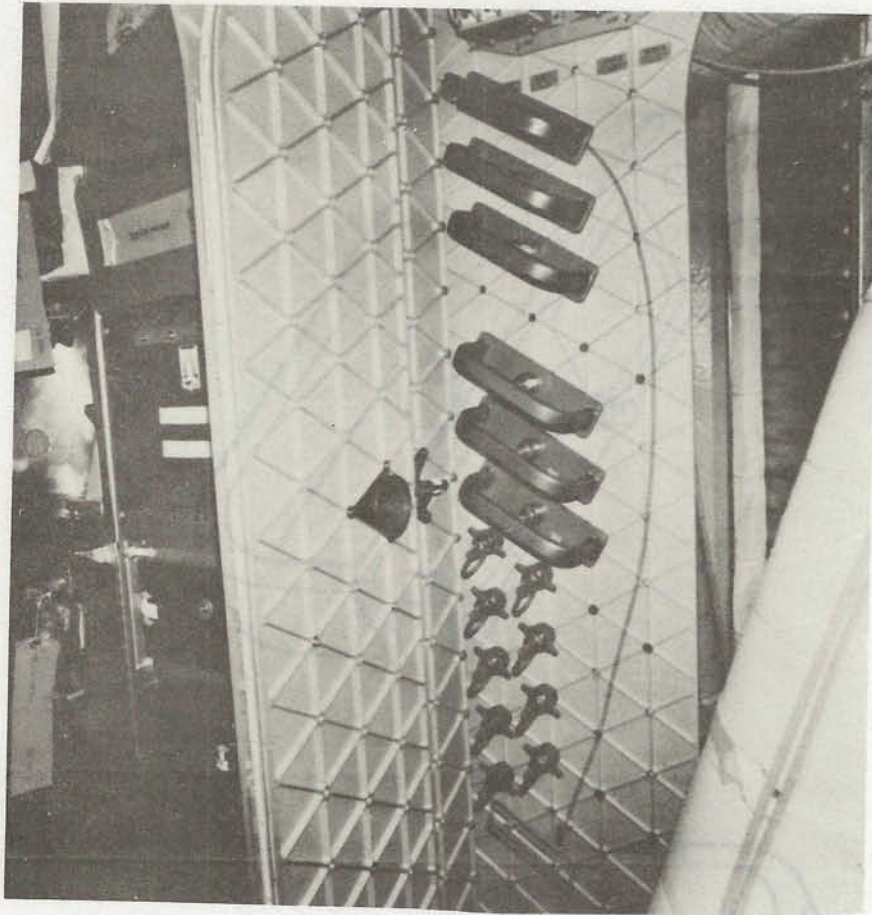


PORTABLE HANDHOLDS

FIGURE 4

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LOKLEITE HVASHOFTIC



PORTABLE HANDHOLD STOWAGE

FIGURE 5

in activity areas. Figure 6 shows the location of fixed hand restraints in Skylab.

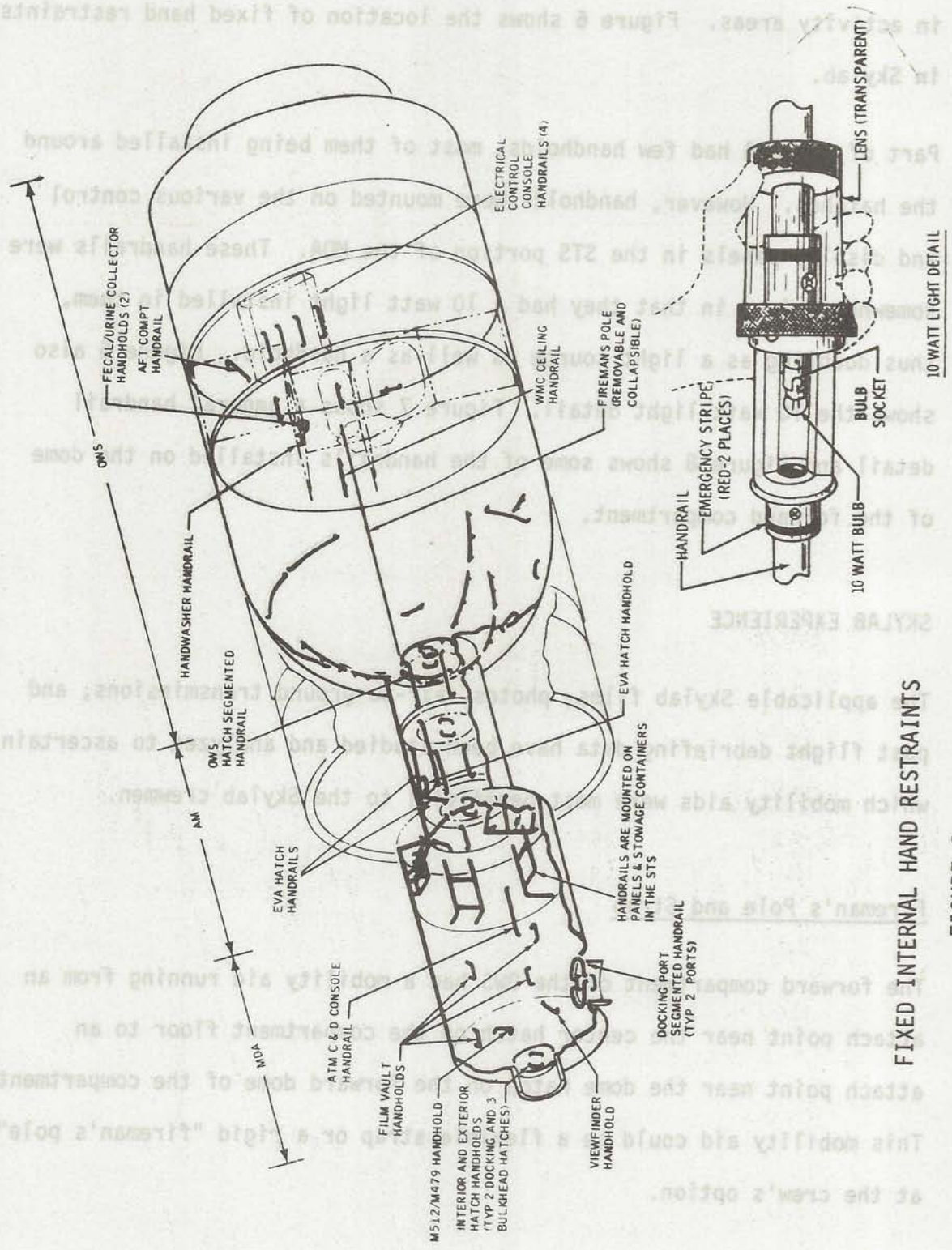
Part of the MDA had few handholds, most of them being installed around the hatches. However, handholds were mounted on the various control and display panels in the STS portion of the MDA. These handrails were somewhat unique in that they had a 10 watt light installed in them, thus doubling as a light source as well as a handhold. Figure 6 also shows the 10 watt light detail. Figure 7 shows a general handrail detail and Figure 8 shows some of the handrails installed on the dome of the forward compartment.

#### SKYLAB EXPERIENCE

The applicable Skylab films, photos, air-to-ground transmissions, and post flight debriefing data have been studied and analyzed to ascertain which mobility aids were most beneficial to the Skylab crewmen.

#### Fireman's Pole and Strap

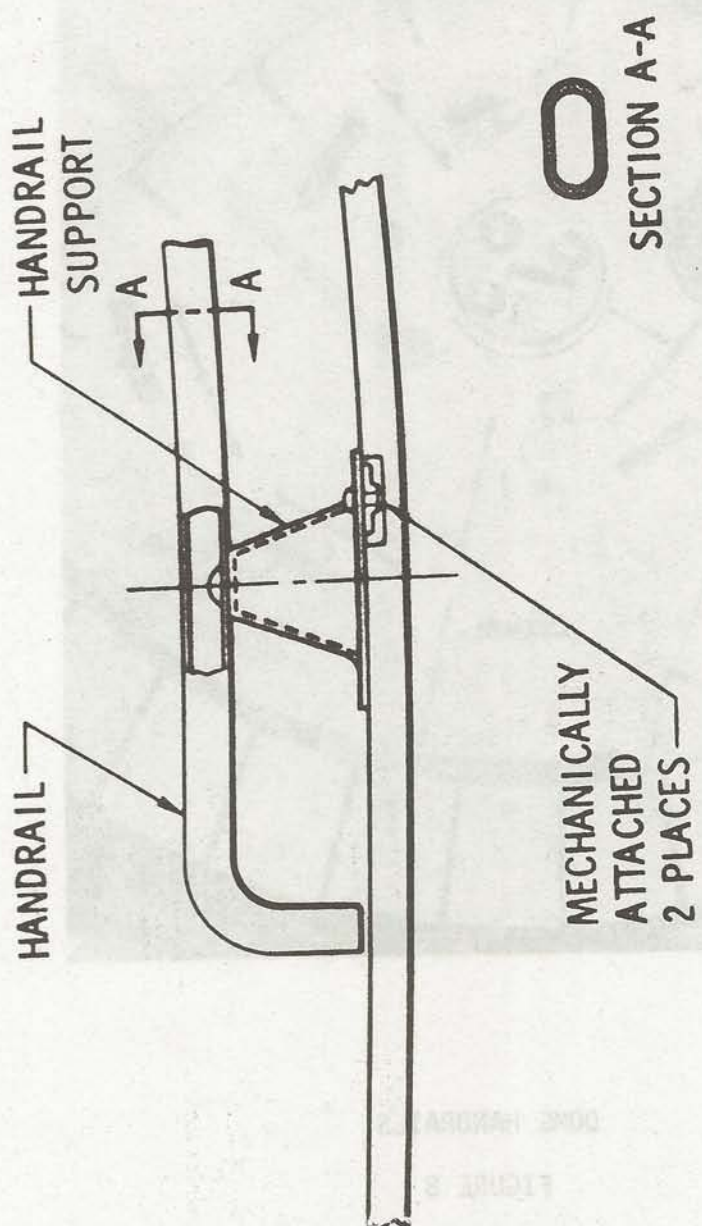
The forward compartment of the OWS had a mobility aid running from an attach point near the center hatch on the compartment floor to an attach point near the dome hatch on the forward dome of the compartment. This mobility aid could be a flexible strap or a rigid "fireman's pole" at the crew's option.



FIXED INTERNAL HAND RESTRAINTS

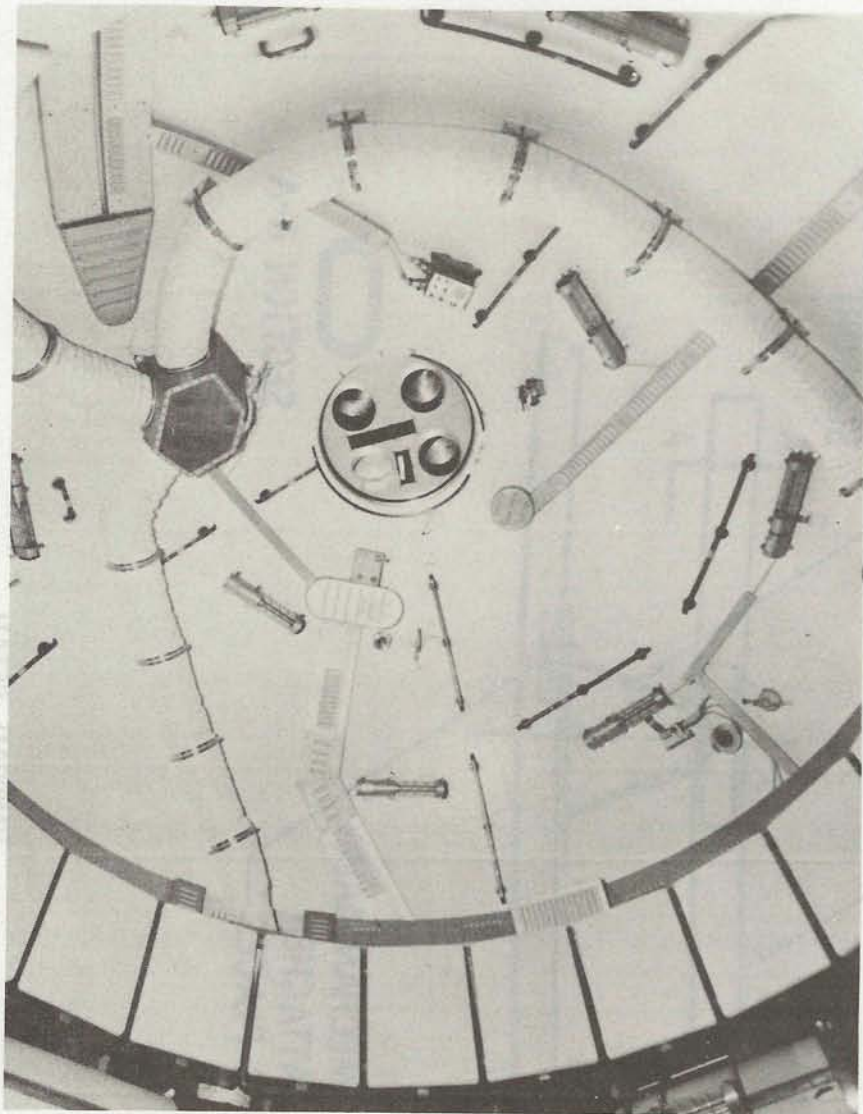
FIGURE 6





HANDRAIL DETAIL

FIGURE 7



DOVE HANDRAILS

FIGURE 8

The SL-2 crew started their mission with the strap installed as the mobility aid. It apparently was satisfactory for use, because they didn't rig the pole until approximately 18 days into their mission. They then commented that the rigid pole was probably better than the flexible strap, but that neither one was really needed. The fireman's pole did prevent mid-air collisions between two crewmen moving in opposite directions through the compartment, due to its noisy rattling when someone was using it. However, its prime use seemed to be for mid-course corrections when the crewmen were translating across or longitudinally through the dome area.

The SL-3 crew started their mission with the fireman's pole installed. After about a week, the crewmen indicated that they were going to try the strap, but that it was no big problem to just push off and go to where they wanted to go without using the pole. They later indicated that the stiff pole was a much better mobility aid than the limber strap, but that they really didn't need either one.

The SL-4 crew had similar reactions to the fireman's pole. They commented that it was very handy and convenient for the first couple of weeks of the mission, but then they were quite comfortable without it. It was quite useful during the "get acquainted phase" of the mission.

The fireman's pole was a great aid in helping the crewmen learn to translate across a large open compartment, and in moving large, massive

items very carefully. After the initial "moving in," and once the crewmen learned how to translate in the zero-g environment, it was no longer needed.

Figure 9 shows the fireman's pole being used for stability. The strap can be seen at the left side of the floor hatch in Figure 10.

The following references contain comments referring to the fireman's pole and the strap.

<u>Reference</u>	<u>Appendix Page Number</u>
1	1
2	3
3	5
4	7
5	8
6	9
8	13
10	19
11	21
13	26
16	31
17	35

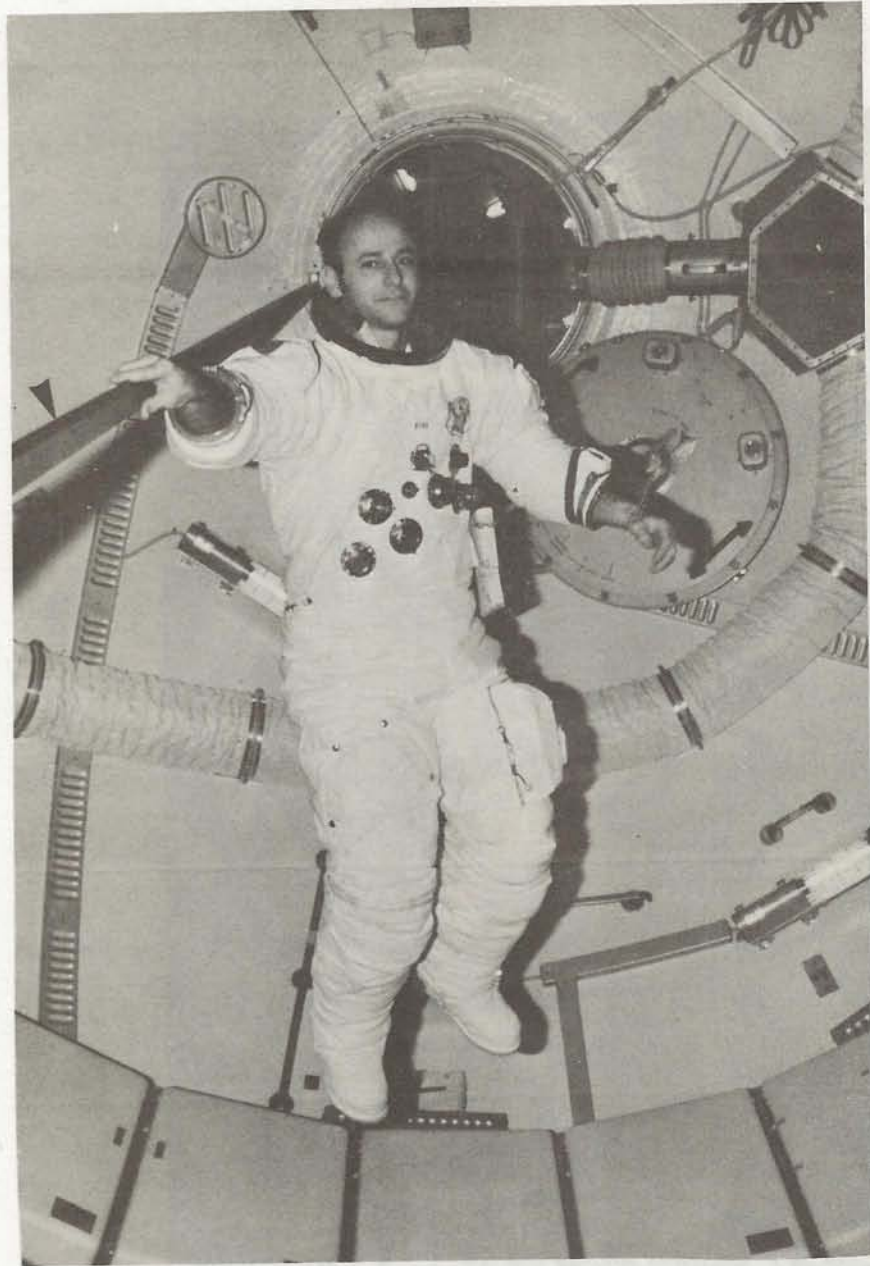
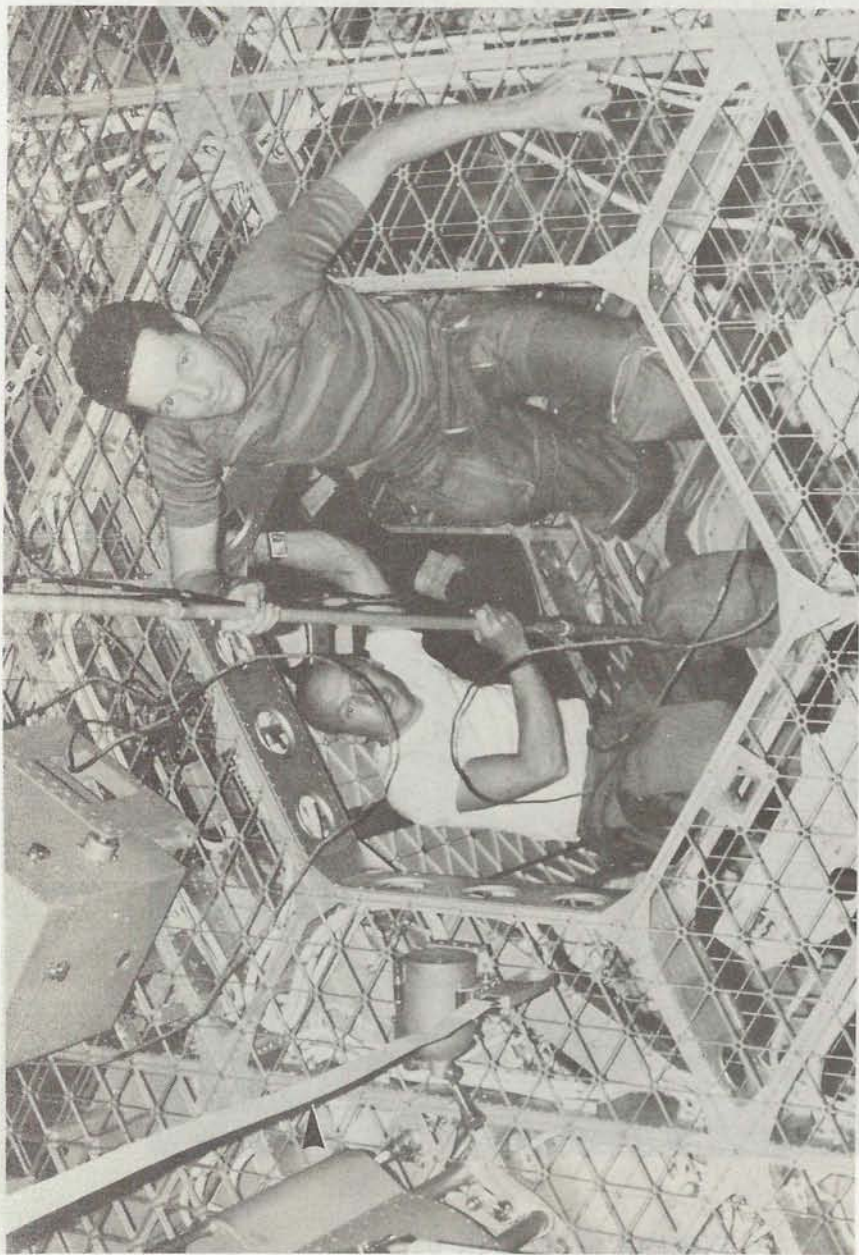


FIGURE 10

FIREMAN'S POLE IN USE

FIGURE 9



FIREMAN'S STRAP

FIGURE 10

## Portable Handholds

The portable handholds, designed to be used in the triangle grid, proved to be of little use. The only places they could be installed were in the equipment holes in the triangle grid, and the grid itself was adequate as a handhold. Had the crewmen been able to install the handholds in other locations, they may have been used more. As it was, they were not used to any extent.

The following references contain comments pertaining to the portable handholds.

<u>Reference</u>	<u>Appendix Page Number</u>
1	2
2	4
3	6
5	8
6	10
11	23
16	33
17	36
19	42
20	44

## Handrails

Handrails and handholds were preinstalled at many locations throughout Skylab. In general, they were readily utilized by the crewmen. The IVA handrails were not used for hand-over-hand translation as the EVA handrails were. They were used as grab bars about which the crewmen could torque their bodies or for controlling body pitch rates, or as hardpoints for stopping translation. As such, handrails might be more properly considered stability aids rather than mobility aids only. However, they were sufficiently utilized as mobility aids that the crewmen recommended handrails be installed around hatches and along main traffic routes within future spacecraft. Figure 11 shows a crewman utilizing the forward dome hatch rail to stabilize himself.

The crewmen unanimously felt that the forward compartment had a sufficient number of handrails. They had no problem in stabilizing themselves any place in the area. The handrails were even used as "knee gripper" restraints on occasion.

One of the crewmen commented favorably on the color of the handrails. They were dark blue, which contrasted well with the lighter background colors. This made the handrails much easier to see, thus making them more readily usable when needed.

Some areas were deficient in handrails or grabable objects. The crews specifically mentioned the area around the film vault and the food lockers as having too few places to hang on to for stabilization.





DOMES HANDRAIL USAGE

FIGURE 11

Another area deficient in handrails was the Multiple Docking Adapter (MDA). All three crews commented on the difficulty of moving around in the MDA and the constant hazard of bumping some item of sensitive equipment. Handrails more plentifully distributed would have aided their translations.

An interesting contrast to the MDA was the experiment compartment. Although not too many handrails were installed on the experiment deck, the floor and ceiling were in rather close proximity (78 inches or 2 meters). The orientation of the two areas was totally different also. The experiment deck was arranged as a one-g compartment with a definite floor and ceiling while the MDA was arranged as a zero-g compartment within an open cylinder. The crewmen had no difficulty moving about on the experiment deck even though there were few handrails. This was not true of the MDA.

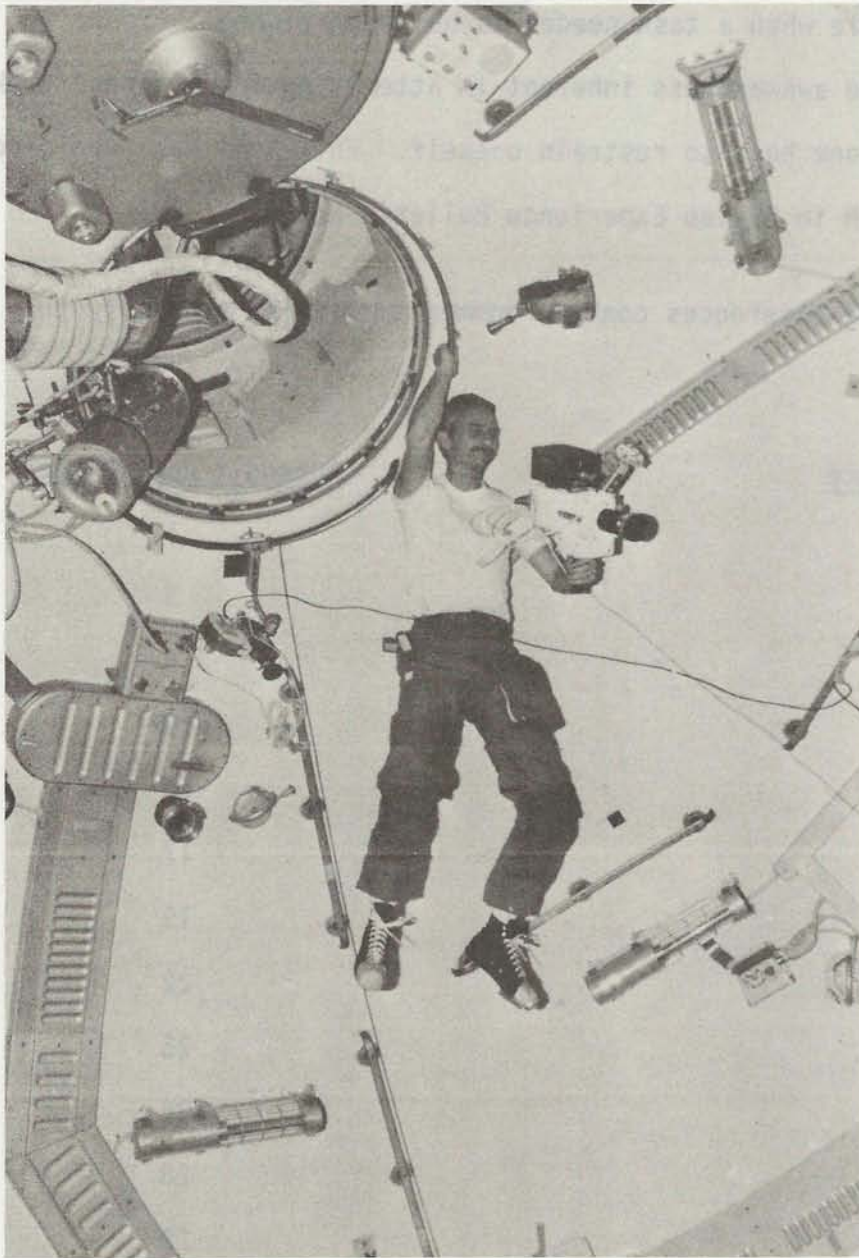
Actually, handrails as such were not an absolute necessity. A rim around a hatch, or a lip under a surface would be adequate to grab and would serve as well as a complete handrail. Many of the areas had no handrails, per se, but the crews had no difficulty functioning in those areas because sufficient protrusions of equipment were available to hold on to.

The crews did comment on the undesirability of handrails as restraints when doing tasks. Handrails were necessary for stabilization while the crewmen were restraining themselves with the foot restraints, but were

not acceptable when a task needed to be accomplished. Figure 12 indicates the awkwardness inherent in attempting a two-handed task while using one hand to restrain oneself. This area has been discussed in more depth in Skylab Experience Bulletin No. 7.

The following references contain comments relating generally to handrails.

<u>Reference</u>	<u>Appendix Page Number</u>
1	1
2	3
3	5
6	9
7	11
9	17
10	19
11	22
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13	26
14	28
15	29
16	32
17	35
18	40
19	41
20	43



HANDHOLDS AS WORK RESTRAINT

FIGURE 12

## CONCLUSIONS AND RECOMMENDATIONS

1. The fireman's pole or the strap were quite useful to the crewmen while they were learning to move about the spacecraft and to handle large masses in zero-g. After that period, they were no longer needed.
2. Since the portable handholds could only be installed in the open triangle grid, and the grid proved to be an adequate handhold, they were not used. Such a device appears to be needed, but it needs to be installable on nearly any surface in the spacecraft.
3. Handrails are needed generally along traffic paths and for use in controlling body orientation and stability. They are not used for IVA hand-over-hand translation.
4. There should be a strong color contrast between handrails and the background.
5. Handrails, per se, are not absolutely necessary. Anything gripable could and did suffice as a handrail. Equipment designers need to be constantly aware of this use of available protrusions and recesses for mobility and stability aids.

CONCLUSIONS AND RECOMMENDATIONS

RAW DATA APPENDIX

<u>Number</u>	<u>Source</u>	<u>Page</u>
1	SL-2 Dump Tape 151-09	1
2	SL-2 Dump Tape 154-03	3
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4	SL-2 TAG Tape 163-01	7
5	SL-2 Dump Tape 167-10	8
6	SL-2 Dump Tape 167-12	9
7	SL-2 Systems Debriefing	11
8	SL-2 Corollary Experiment Debriefing JSC-08082-3	13
9	SL-3 Dump Tape 222-01	16
10	SL-3 Dump Tape 223-03	19
11	SL-3 Dump Tape 223-08	21
12	SL-3 Dump Tape 231-08	25
13	SL-3 Dump Tape 232-07	26
14	SL-3 Dump Tape 245-08	28
15	SL-4 Dump Tape 333-02	29
16	SL-4 Dump Tape 338-02	31
17	SL-4 Dump Tape 344-06	35
18	SL-4 Dump Tape 361-03	39
19	SL-4 Dump Tape 003-01	41
20	SL-4 Earth Resources Experiments Debriefing, JSC-08813	43

Final

Dump Tape 151-09

Time: 18:33:24 to 20:04:08

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- 18 33 24 SPT Contamination observation on window - STS window 4. The window itself is clean. However, it has several linty particles on the outside. These come from the fact that on all STS windows, which I neglected to mention before, this is one of the most noticeable looking into the Sun, is that as you open and close the window cover, it rubs over that silver foil insulation and frays it. And the backing material appears to be some kind of cloth, and that causes linting.
- 19 13 14 PLT Hello, B channel. This is the PLT with the M487-3 Alfa. Going to page 3-3 on restraints and mobility aids. The fireman's pole we have not used yet because we have not needed it. The OWS dome and wall handrails have, on occasion, been of some use primarily for stability. They are not used for transiting the dome or forward areas. We do that by point-to-point translations free floating. Same thing with the STS handrails and the MDA. We've generally found that you just move about this vehicle by, as I say, just pushing off and translating from point to point. You use these handrails, but you use whatever is available; a surface - The mol sieve surface, the back of the ATM chair; whatever you need just to give yourself a little tweaks to keep yourself trimmed up. The handrails are not needed for translation. Handholds and handrails are needed for stability. And on occasion, for example, yesterday when I vacuum cleaned the plenum inlet screen at the top of the dome, I found the ducts themselves very handy for footholds. I'd wrap my legs around them and use that to stabilize myself while I was vacuuming the screen. The triangular shoes in the grid have come in very handy. The mode we've gotten into usually, most of the time, is you only hook in one shoe. Consequently, we've been trying off and on, we'll comment on it later, on two triangles as opposed to one triangle and one mushroom.
- 19 15 03 PLT The water tank foot platform has been used on occasion when working in a dome locker. I think it's been necessary and useful. Again, the usual use for myself has been to hook one foot in one of the triangular cutouts.
- 19 15 21 PLT The ATM foot platform has been used so far only to hold the captain's chair. We have been using the captain's chair almost exclusively at the ATM.

Final

Dump Tape 151-09

Time: 18:33:24 to 20:04:08

Page 2 of 5

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

19 19 37 PLT

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



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

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

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

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

Final

Dump Tape 154-03

Time: 13:44:09 to 14:18:19

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triangle is quite helpful when you want to concentrate on something else for a few too many minutes - want to lock yourself in and stay locked. However, it's a lot of trouble getting it in, and a little trouble getting it out. With two triangles on my shoe, it drives me up the wall, because it takes me 30 to 45 seconds to get locked in at a spot, which is a waste of time. Between the mushrooms, I've evaluated the medium and the large. I thought the medium mushrooms were adequate, but they were too easy to slip out with, and you had to concentrate too much on keeping your foot pressed against one corner of the triangle so that the mushroom wouldn't pop out. With the large mushroom - this is not nearly so bad. They're fairly easy to slip in and they hold very well. Sometimes they're a little trouble getting out of. Trying to get it out in a hurry, you have to sometimes look down and figure out which direction you have to go. I think, for that reason, Paul prefers small ones. I prefer big ones. In summary, triangle shoes are mandatory. If I had to make an improvement, I would have loaded two pairs of shoes on board for each crewman, so that I might leave the triangles in one of them to ride the bike with and put mushrooms in the other.

13 49 55 SPT

The water tank foot platform is handy but not required. If you're working at a dome locker for a period of time, it is very pleasant to be able to stick one foot into a mushroom or a triangle into one of the holes in the - in the foot platform. So, if you're just going there to get loose item of equipment, you can steady yourself on your hands, then open the locker, steady yourself with your hands again, reach in and get what you want, and steady yourself again, and close the locker on the way down. The portable EREP foot platform, I have not used. The portable PGA foot restraint, we have not yet used. The portable handholds have not been used. The portable tether hooks, I am currently using to try and rig ropes with handles to hold myself down on the bicycle seat while peddling the bike. The portable tether hooks hook you to the floor grid and the ropes are attached to them, and

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

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

16 34 13 CDR Hi there, friendly tape recorder, this is the CDR, on day 154 and 16:35; for an M487-3 Alfa, subjective evaluation, guide 1. Work

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

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

SPT Wilco.

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

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

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

16 37 30 CDR

The water tank foot - foot platforms, for myself, works out extremely well. I find it quite comfortable to lock my feet in the water tank foot platform to work out the dome lockers. I've had no trouble with any of the tasks that have been involved. And I rate those as excellent. The ATM foot platform has worked well. We had the chair located at the center of it for the person that's working at the chair, another person can lock in at - either end and can talk over the SIA or to get into the 126-M126 checklist box; which we have to on occasion, and you don't bother the person who is working the ATM. So that has been good to work at. I rate that as excellent.

CREW (Music)

SPT You copy those, Paul?

PLT No, I didn't.

CDR Now the portable M512/M479/EREP foot platform: We have only used it in the EREP station so far, and I have used that at the EREP station to operate the C&D console. And I also rate that one excellent. The portable PGA foot restraints - I have not had an opportunity to evaluate yet - we have not done any suited exercise, and so we have not used them. We have found that we have not used any of the portable handholds. ... no reason to have portable handrails; and therefore,

Final  
TAG Tape 163-01  
Time: 01:41:05 to 01:55:05  
Page 6 of 8

CC We - -

CDR We've also gotten to where we can turn the vehicle right side up or upside down, depending on how we want to do it. If you want to stand on the ceiling for a while, after a while everything looks perfectly natural that way.

01 49 49 CC Copy that. And we gathered that you had some pretty efficient ways of hanging on, some of which left us mystified down here as how you seemed to be stabilizing with feet, with a no apparent way of doing it. You didn't appear to be in triangle shoes or anything, yet you seemed to be hanging on some way.

SPT Don't tell, don't tell.

CDR No, I won't. Well, it's like I'm talking to you right now. I mean you asked, you know, how we adapt. I'm in the wardroom and my feet are up in the ceiling, and my head is over the SIA with my back to the window. And - and I'm just resting over here, with, you know, just free floating up in the air with my feet in the ceiling.

CDR Oh, one thing - Are you still there, Houston?

CC Say again, Pete?

CDR We did rig the fireman's pole. You know we've been using the strap, and we rigged the fireman's pole the other day. And the only thing about it is as I went up and did a couple of little windings around it, and I discovered even moreso than you've seen on some of the other things, that you've got to watch the old conservation of momentum, because I started circling it, stretched fully out at arm's length and went and pulled myself into the pole. And I really got wrapped up. And I - That's the - that's the one device I think that you can get yourself going on where you can get flung off and get hurt if you weren't careful.

CC We copy that. Ballerinas probably could have made some comment on that one.

01 51 47 CC And, Pete, those details are on board for your Flight Plan.

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around a little bit to see what would happen. We used ... about three or four times. The dart set we concluded did not work up here, so we only used it the one time, ... concluded that. Exer-gym - I don't use one on the ground; I don't use one up here. I use the bicycle to exercise my arms. Binocular I use daily at the windows, and the windows I use daily during off duty; and I wish we had more windows that covered more of the outside. It turns out the high Beta angle we're at now, our one ... window is looking mostly at the horizon and the sky. That's the end of the CDR's 487-3 Charlie.

12 42 51 CDR

Hello, friendly tape recorder. Here's some further comment from the CDR on M487-3 Charlie. The equipment items: My comments of the ones that I've already

talked about have not changed. The ones that I didn't talk about that we hadn't used - there's a couple that we've now rigged and used. One of them is the OWS fireman's pole, and find that quite handy. And it's probably a little better than the strap, but it's difficult to say. And it really doesn't make any difference. We really don't need anything at all, but it's nice to have. We still haven't used the portable handholds. We have no reason to use them. Really don't ever use restraints to speak of, except in the most obvious of places. And I think we discussed that at length.

12 44 20 CDR

That's the only addition on the group 1 items I had on what I said originally on subjective evaluation guide 1.

END OF TAPE

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

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

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

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

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

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

14 08 39 PLT Yea!

14 09 16 PLT Hello, tape recorder. Here's the PLT with the rest of his M487-4 Charlie, which is the subjective evaluation guide 1. I just realized that I was remiss, negligent in not filling out for you verbally before.

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

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

14 11 25 PLT ATM seat I just discussed. The conical shoe cleats, I don't like them. I haven't used them since I evaluated them the first couple of days because - for two reasons: One is, you have to keep changing back to the triangles to get on the bicycle ergometer anyway, and we have been riding the bicycle ergometer everyday, if not for experimental purposes, then for PT and general conditioning. So you have to change it. The second being that with those cones on there, you tend to catch them in the grids.

14 12 01 PLT Under the waste management area, the fecal collection equipment and the urine collection equipment have turned out to work quite well. We, again, had a discussion of this on the two Charlies just a few minutes ago. It worked well. I - I can't say anymore about it. The urine flush water dispenser, we haven't used. The hand washer is a requirement - It's an absolute necessity. It worked well, except we yesterday changed out the valve. The valve has gradually become more and more plugged until we were hardly getting any flow through it, and we changed out the only dispenser valve on board yesterday. The fecal collector lap set and hand holes are a requirement. They are well designed. I give them a "very good" using your gage. The belt tends to hold me a little far back on the seat. I'd prefer to have something that, if you could, - that pulls more straight down, but other than that, it's been very good. The handwasher handrail is a requirement when using the washrag squeezer, and that's about the only time I use it. I may subconsciously - or unconsciously use it other times. The ceiling handrail comes in handy on occasion. Again, that - it's occasionally and without thinking. The light-duty foot restraints, we have griped. You've responded to these. Essentially, they're unsatisfactory.



PLT: Well, how about the lids on the stowage spheres, they are fiberglass, right?

CDR: Stowage spheres? In the airlock?

PLT: The LSU stowage spheres.

CDR: The 310-311

SPT: They are OK if they are not loaded by the connectors.

CDR: Yeah, it's the LSU's that are loading those things.

SPEAKER: OK. We had a lot of back and forth on color, on the handrails. Did you give us an evaluation of the contrast between handrails and the background structure? Was the blue anodized color acceptable, or would it have been better some other color?

CDR: I think that was good and I think it was good that you had them a different color.

PLT: Yeah

CDR: I think that worked well.

SPEAKER: OK. Blue, in other words, would be preferable over dark gray or--

CDR: Yeah, I think so. Esthetically, the blue was very pretty (laughter).

SPEAKER: The message is the contrasting handrails the color is whatever is necessary.

PLT: It's relatively unimportant really, I think, Dick.

CDR: Yeah, but we do appreciate the fact that that worked well, that they were a different color. I think that we appreciated that outside too. You know, not just inside.

PLT: Yeah.

SPEAKER: OK. Next one is kind of a loaded question but it has to do with mobility. In light of your experience on Skylab, with respect to the need to move about on the exterior of the vehicle in an unplanned mode, do you recommend incorporation of a universal type portable mobility aid like handholds or little portable gimmicks that you would carry along? This is advanced planning.

CDR: Yeah, I'd-- There's no doubt in my mind--there's no way you can think of what happened to the OWS happening and preplan that. In the first place, had you preplanned it, all that stuff would have been gone anyhow, cause it would have all been mounted in the meteoroid shield, right. So you get down to the meteoroid shield, which you never planned on leaving. But, I think, in future design the message is that if you know that you may have to go someplace and perform any kind of a task, like changing out black boxes that are exterior equipment or anything, as long as you preplan this, these are relatively simple tasks, and the EVA operation speaks for itself on changing film out. That was well thought out,

CONRAD (CONT'D) obvious to you when you've got things completely under control and you're going right with it, and you just continue to make corrections.

WEITZ It does mean you need something at the other end to either grab hold of with your hand or stick your foot into to slow you down.

CONRAD Yes. But there are plenty of those things laying around on the floor up there.

WEITZ And we had the fireman's pole to change directions on, either from coming down through the hatch and bouncing off to the side, or going from one side to the other. You could make midcourse corrections using the fireman's pole.

CONRAD Yes, you got pretty good at doing this while you were moving. You'd come down and you want to go to the water ring locker, you'd come down and as you were approaching the level of the water ring lockers, you just sprang up the fireman's pole and then towards the locker you wanted to go to, and you get pretty good at intercepting the right place at the other end.

SPEAKER Joe, did you find the straps and handles on 190B to be useful?

SPEAKER You didn't have to use that crooked tool to go under the grid?

WEITZ That's one tool I think we never used. That and the vise.

CONRAD We debated about using the vise for something. You and I talked about whether we should use the vice or not and we decided not to because we were trying to apply a lot of force to something.

SPEAKER You mentioned that you put up the fireman's pole, and tried that out. I haven't seen any comments on it.

CONRAD What kind? It rattled a lot. Always prevented a lot of mid-air collisions that we had on the strap when somebody was coming down looking up, and somebody was going up looking down, because you could always tell when somebody was coming.

KERWIN The strap wasn't bad either, though. I swear I could take out torques on that strap and don't know how I was doing it.

WEITZ Yes, that's how he broke it.

WEITZ

We used the launch-installed strap until it was broken. And then we mended that and we were making do with it, but we were having trouble keeping it tight enough.

CONRAD

Yes. It used to work its way loose and get looser and looser and that's when finally one day we said let's put up the fireman's pole and see what it's like and we did and we just left it. I can do just as well on the strap, I think I'd say.

WEITZ

I think you'd want something.

CONRAD

Yes, you wanted something mainly to make corrections on the way down. You could still make it all the way down all right, and that was always a great game to see how accurately you could make it from one end to the other without touching the strap or the fireman's pole on the way down. But if you're really in a hurry, you'd really whistle up the fireman's pole and you'd put the brakes on at the other end.

KERWIN

I can't say enough for how pleasant and convenient it was to work in that large volume of the forward compartment. If you have a choice in future design between a larger and smaller volume, use the big one.

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here that you can see anything out of that's worth looking at. And I think we need to have more of them, because we sure cover a lot of ground and a lot of interesting features on the ground, not too scenicwise, but geologically; and then the weather - in the area of weather.

222 02 18 56 PLT

And if we could see more in the different directions, I think it would be a great asset to collecting data as well as providing something to do that's enjoyable. So the one window is really not enough, and if we could have some more windows somewhere, we need to have them. What else is ...?

222 02 19 19 SPT

Yes, I was going to comment on the coloring. It may be a little different viewpoint than Al just had, but it seems to me that the color arrangement that we've got in here might very well have been designed by a Navy supply department or something with about as little imagination as anybody I can imagine! All we've got in here are about two tones of brown, and that's it for the whole blinking spacecraft interior.

PLT Yes.

SPT Yes, with ...

CDR ... got a ...

222 02 19 42 SPT

And it would seem to me that a better study by an interior decorator, not only of our instrument panels, which are equally bad if not worse, but also just the interior decoration of our living quarters would make it a much more pleasant environment - some pastels and some other things that

certainly help make it better. The other thing that I think that - I would feel would be helpful is, as I see ourselves move around through the spacecraft, 85 percent of our motion is by arm. We pull ourselves everywhere are going - we're - everywhere we go. The exception here being when we jump off from one side of the dome to the other.

We spring forward, of course, from the hatch opening between the trash airlock and the MDA hatch, and we do that with our legs and arms. But, basically, we move around with our arms. There are essentially no handholds around anywhere. There are a few over on our electrical panel, which we can use occasionally to stabilize ourselves.

But we really tie ourselves into our feet whenever we go in front of the electrical panel. So as far as practical handholds, there is very close to zero around the whole spacecraft. I guess that's our principal means of locomotion. So I just think we had ought to have a better arrangement of handholds the way they do for EVA to get around inside the spacecraft. And I've thought about where they should go, some place so that they don't stick out and reduce the amount of volume available for moving but still are accessible to the hands. I think that would be a significant design improvement.

Owen, are you trying to say that we - We have handholds around expanses where we thought we were going to work. You're suggesting that we ought to have handholds positioned in traffic areas - -

SPT Yes.

- - to use to pull and direct and remaneuver. Yes - not in so much for - for stabilization for work but to get from one place to another, sort of a switch-off/pull-off thing.

Yes, because once we get to the place where we're going to work, we than want to tie our feet in so that we can use our hands to do the work. We don't need the handholds there. Like this example that I just gave at the electrical panel 613 and so on - five handholds, but we don't need them there.

PLT Yes, I think ...

222 02 21 45 CDR

Wait, wait. One other thing. We got handholds up here on the dome. And we put them there so a guy could come in and sort of follow those handles and get down to the floor. Well, we know now that nobody ever follows handholds around. They shoot up in the air to the next spot, and the only time that they need to grab by their hands is when they're going through small openings like doors or openings in the ceilings or things like that. And that's where the handholds should be and not against walls where nothing's going on or where you've got - nothing to do. Because like Owen points out, you want to stabilize yourself some other way, and that some other way is usually with your feet. It's more desirable, and it frees your hands to work. Here you are, Jack. Why don't we move on to the next one.

222 02 22 28 PLT

Okay, one of the other questions that we ought to discuss is the the effectiveness of - of verbal communications throughout the workshop without the use of the intercom box. And we find it isn't very good because you have to holler pretty loud to be heard even from the lower crew quarters area up into the dome. And, - -

CDR

... the door.

222 02 22 51 PLT

And sound does not - Voices don't transmit up through the airlock at all. We have to use the intercom box to talk to anybody in the MDA. It's not because of the external noise within the spacecraft either. The spacecraft is relatively quiet, more so than I had thought it would be with - even with fans and other electrical equipment running. It is very quiet and - and, - even when our - we burnt the rod, I didn't notice that there were any loud noises which I was not used to. So verbal communications throughout the assembly without the use of sound equipment is not very good.

222 02 23 28 PLT

The intercom boxes must be used and - and on that score you probably have already heard that they keep



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223 14 31 45 CDR

Okay, this is the CDR and I'm doing 487-3A. I'm going to cover each of the items as stated here and give it a rating and then talk about it a

little bit. OWS fireman's pole - Incidentally, this is for the 487 PI. Fireman's pole - OWS fireman's pole - fireman's pole is an excellent device. We used it for a while; it seems to have an advantage over - I can - Wait a minute, let me give it a rating. I would give it an excellent rating. I don't think any improvements are needed. I've noticed that the stiff fireman's pole is much better than the limber strap one, because it allows you to, at any moment, push off in a direction you want to go. When you're on the strap, there's really no easy way to push off, and a lot of times you have to kind of move back and forth and get some momentum up across the strap, much like a bow string, and then let go. Further, the strap does not have the ability to allow you to rotate around it to point the direction you want. Let's say your feet are facing the plus-Z and you really would like to face the minus-Z. Now the fireman's pole does do that.

223 14 33 00 CDR

The fireman's pole aids you also in taking big packages up and down and certainly to be - to learn. We do not have the fireman's pole or the strap in at the moment, haven't had it in since the first week and we found it no trouble to launch through just the space there from one place to the other. In fact, we find it more convenient than the pole. So we have not reinstalled the pole. My guess is that a fireman's pole should be carried on a flight; however, it probably should not be launched installed and only used as a temporary device in the somebody wanted to move items very, very carefully. Big items, heavy items of a moderate nature: 100, 200 pounds; doesn't seem to be any trouble to just fly them across.

223 14 33 47 CDR

OWS dome and wall handrails. I would give them a poor. Not because the handrails themselves are not good; their design is probably excellent. It's the problem that we've put them in the wrong place. Handrails, in a station like this, look to me like they're going to be used merely in traffic areas to - get something to grab on to change your direction. For example, a handrail near a hatch

opening, near the ceiling in the experiment compartment or the floor in the forward compartment would be perfect. It would allow you to grab them and zip in. Presently, we're just using the edge of the hatch, which works okay. But it's perhaps conceivable that, if we didn't have this triangular grid where our fingers grab real good, we would be at a loss there.

223 14 34 35 CDR

Having handholds at workstations are a little bit wasteful, mainly because it turns out that, when you go to a workstation, you want to anchor your feet and do some work there. Now if you're coming up to a squawk box, such as I'm holding onto right now, you definitely need - definitely need these little bitty - standoff switch guards and handholds to react your forces against. So they're useful things and very good to have, but you certainly don't need a handhold near this box, if I were - And the handholds running around the dome that essentially we thought would lead you hand over hand down the dome are never used sometimes people fly up in the dome to do something and they grab one, but it's not needed. We should not have put them there. Definitely should not use handholds as a pathway. The technique for moving in the space station is more of a flyaround where you're at one position, you fly to the next and fly to the next. So that would be my comment there.

223 14 35 34 CDR

STS handrails. They're good things, the reason being you don't do any work in the STS. You merely stop there and read some gages and the like. You don't need to put your feet in anything firm, and that's exactly what they allow you to do. Now there may be a - an excess of those handrails, but they're not noticeable, like most excess.

223 14 35 57 CDR

MDA handholds and handrails. There are not a lot of them there. I'll have to look at them later and give you an evaluation of them but I can't say that I've used very many of them. There's plenty of objects and boxes and small containers - EREP - that allow you to use them as sort of handholds when you need to.

223 14 36 20 CDR

Triangular shoe cleats and grids - excellent. Those are excellent things. The only suggestion I could make would someone try to come up with a triangular

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223 23 06 21 PLT

Okay, space fans; this is Jack, channel A. The subject is T002, visual navigation sightings for Bob Nute and Bob Randle. Just took my second set of star-to-star sightings, run number 2 of day 223, from approximately 22:30 to 23:00 GMT. At the beginning of the run, the temperature was 71; diopter, minus 1.25. The stars are Formalhaut and Enif. The first of five zero-bias settings as follows: 0.005, 0.001, 0.001, 0.005, 0.003. Now the 10 star-to-star sightings are as follows: 43.276, 43.267, 43.271, 43.271, 43.271 43.271, 43.277, 43.271, 43.271, 43.271. Temperature at end of run, 75 degrees. You notice there are a number of readings all the same there. That was done each time by separating the stars and then projecting the line of sight, so that I could get the stars lined up again and now they're coming out pretty consistent. It turns out that you can't hold the - the instrument - sextant steady all the time. It still wiggles around and the stars appear as snakes - kind of snaking around on there but it's - apparently - (cough) apparently we can line up the stars well enough to get some pretty good readings. I lean the front of the sextant up against the window and view out - pretty much out of the center of the window. That'll be all the runs for today. I can't think of any more to add to this conversation at the present time. We'll try to get some more in the near future.

223 23 09 31 PLT

Good night.

223 23 10 16 PLT

Hello, space fans; this is Jack, on channel A. The subject is M487-3 and probably my friend and professional golfer, Robert Bond, would like this information. This is subjective evaluation guide number 1.

223 23 10 39 PLT

First subject is work restraints and mobility aids. The workshop fireman's pole I rated excellent, at the time that you need it. We used it when we first came here and we use it - we could use it to handle large loads, but just from my - Getting from the workshop hatch down to the hole on the deck it's not necessary. We don't have it up any more. We don't use it and - However, I think it was used to good advantage the first few days while we were here,

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

223 23 11 32 PLT

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

223 23 12 30 PLT

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

223 23 13 28 PLT

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

frequently have to reach down and twist them around to line them up so they'll go in the next time.

223 23 14 26 PLT

But the triangle shoe cleats are great and I haven't used the conical shoe cleats at all. I haven't tried them. I might mention that one place you really need some handholds is right around the film vault. There's nothing there to hang on to. That film vault is just a big square object and you just can't grab on. You don't have any triangular shoes on and you're pretty much out of luck in that film-vault area. Frequently go up there with our socks on late at night and put cameras away early in the morning, before you get your triangle shoes on, and it's a real unhandy place to be without handholds or - or foot restraints.

223 23 15 13 PLT

Portable PGA foot restraints - correction - ATM foot platform is very good. I use it all the time when I'm at the ATM, but don't use the chair. And I always have myself anchored by one foot at the ATM.

223 23 15 31 PLT

Portable PGA foot restraints are - I tried forgetting this. I'd rate them excellent. The extra little pins that were put in there to keep the feet in there, the PGAs down there by themselves were a very good position. And the portable foot restraints worked very well in suiting up, and they also worked very well on the EVA the other day when we carried a set outdoors to put up the sail.

223 23 16 03 PLT

Portable handholds. I haven't used any of them yet. Portable equipment restraints, tethers, bungees, universal mounts and so forth I would rate them as adequate to very good. The tethers - they're really not used very much except for the tether that we strap onto the arm of the suit to use for EVA. Be nice if there was a way to fasten the EVA tether down to your arm with some sort of elastic or something. One wasn't any use because otherwise it flops around and catches on things. The bungees we've got, we've used them all. We've got them all over. I don't like the ones with the sharp hooks on them because there's

223 23 19 36 PLT

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

223 23 20 21 PLT

Fecal/urine collector lapstrap and handholds. First day or two I used the lap - lapstrap, and it was very handy. I don't use it anymore.

I do use the handholds. They're in a good location and I use the footholds on the fecal collection position as well. Most for stabilization. Triangular shoes fit quite well-not to be confused with the foot restraints on the floor.

223 23 20 53 PLT

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

223 23 21 12 PLT

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

223 23 21 21 PLT

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

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231 21 27 18 PLT MARK. Cameras off. Okay, that's got two successful translation maneuvers. Okay, now let me look in the book and see what's next.

CDR ... translation ...

PLT Yes.

231 21 27 35 PLT Okay, and the pressure is 1500. Okay, now facing the forward - forward in this area. Has to go back to his translation. It's over here by -

CDR ... the same place. It always starts here and goes to - -

PLT Oops! That is right. You're correct. MMD.

CDR ...

PLT

Yes, okay. Then you rotate to - I thought you said you wanted to go over there. You grab on to that because I'm floating. One gripe I got about this food locker here; there's nothing to hang on to. Got to remember to put that in the habitability. If Lou Ramon will pass that along to the habitability guys. There's nothing to grab on to in the food locker or the film vault area.

..., I don't want to do that. Okay, I'm going to position your feet toward the plus- or minus-Z SAL and then you're going to pitch - pitch up and thrust downward. Pitch up, thrust down, and pitch down. Okay, I'd say your feet are pretty well pointed. How do you like that? Okay, let's get the cameras on.

231 21 29 22 PLT MARK. Cameras on. This is number 1. Okay, let me stabilize you again. Okay, let go. Let go and let me - stabilize you.

231 21 29 39 PLT MARK. He's pitching up; starting to pitch up, moving very slowly. I'd say his feet are pretty much pointed at the FMU. He's translated only about foot and a half. Now he's going toward the FMU. He's got himself a left roll going and a right yaw. He's actually moving up toward the water tank. Now he's bringing that down. Now he's pitching down. He's got a little right yaw in yet. Looks like in that translation he might have got a little attitude maneuver in there

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and I'd be interested in any comments you might have. First of all, I would like to know the amount of weight lost in pounds that corresponds to those two different BMD readings, to the nearest 0.1 of a pound, please. And any other comments you might have about it would be appreciated.

232 18 38 53 SPT The message goes to Doctors Buchanan, Michel, Rummel, Mike Whittle, and anyone else interested in the exercise or water-balance studies.

232 18 39 11 SPT SPT, end of message.

232 18 40 08 SPT SPT again, on channel A. That last message, relative to exercise and weight loss should also go to Dr. Bill Thornton; Bill Thornton, also.

232 18 40 18 SPT End of addition.

232 18 51 24 PLT Okay, space fans. This is the PLT, on channel A, continuing M487-3 for Bob Bond; Subjective Evaluation Guide number 2. The subject is, continuing on, personnel mobility aids, I think the - there aren't very many personnel mobility aids in the wardroom. It's just - you sort of grab on to the table and ceiling to get around there. That seems to do the job pretty well; although we could have a handlebar here and there, which would help some. Waste management compartment, I think we've got adequate handholds around the sink area, but there are not enough handholds back in the fecal dryer area. Sleep compartment, you've got to use the ceiling to get in and out and that should be adequate in there. Experiment compartment, there aren't any handholds in there, but we do use the ceiling a lot and whatever's available. I think that the mobility aids there are adequate. The forward dome, we don't have the fireman's pole coming up any more. The handholds - there are no handholds around the food lockers and the film vault, where you need some, and we have an inadequacy in that area. We have a number of handrails in the upper dome which seldom get used because we're seldom in that area. In the airlock, we have adequate mobility aids; probably about the



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

- 232 18 53 27 PLT Personnel restraint devices - Stand by 1.
- 232 18 54 41 PLT Okay, here we go again on personnel restraint devices, M487. The best restraint devices we've got are the triangle shoes and the more of them you've got located around, the better we do. We have quite a bit of it down in the experiment compartment, and so that's the best restraint device there is. We're not using any tethers at all, except to - to hang on to things and go EVA. But then we're not hanging on to body, we're hanging on to equipment against the ri - rip tethers.
- 232 18 55 19 PLT So the best personnel restraint device we've had is the triangle shoes. I used the leg restraints, along with the triangle shoes or the toestraps in the wardroom. And I think they do a very good job. Personnel restraint devices not employed much in the sleep compartment. You just sort of drift in there, out without fastening yourself down. The worst place - one of the worst places is in the head. The restraint devices are inadequate there. You always hoist yourself between the walls to do the job, to - to restrain yourself. There should be some cutouts in the floor for your triangle shoes. The toestraps are inadequate because they don't fit over the triangle shoes, even the lengthened ones. Even though you can get your feet under them why the bottoms of the triangle are so slippery that if you put any force at all, your feet slip out. So we have inadequate restraint devices in the head.
- 232 18 56 24 PLT The only one that's adequate is the handholds and the feet restraints that keep you down when you're on the - on the one-holer. The - it's a - in fact, a very annoying thing to go in there and try to

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in the proper orientation and so forth. So the workshop orientation is much preferable to that of the MDA. Obviously the tasks to be performed do influence your preference of orientation because you won't want to look at the ATM panel upside down. You got to look at it the way the writing is. Same way with all the other panels. You got to face them the way you did in training. And it's - it's - it's - not vertigo producing sensation to - to operate in different orientations in the MDA, but it's simply less desirable than the way we operate in the workshop.

245 22 35 31 PLT

How adequate are the restraints and mobility aids in the orbital assembly? We discussed this many times. It's a repeated question. And - basically, there aren't enough mobility aids in the MDA. The restraints in front of - the foot restraints with a grid in front of the ATM control panel and the - also in front of the EREP C&D are good. We also needed one like that in front of the EREP VTS in my opinion, because there are times when you want to take your hands off that panel and - and shuffle your papers and - and that kind of thing and you'd like to be restrained, but you're not. I think we needed some sort of foot restraints on that VTS to make it better. But the mobility aids are zero as far as I'm concerned on the MDA, that's an oversight. I like the built-in rails inside the orbital workshop right around the dome because we often whistle up there and if we pushed off at an odd - odd attitude, and we - you need something to grab onto. The ones around the hatch are great. The ones leading down the dome from the hatch aren't really too necessary; we use them once in a while. The - There are - There's also a deficiency of - of restraints - or mobility aids near the film vault and food lockers. I've discussed that before. There's just nothing to grab onto there and needs to be something.

245 22 37 04 PLT

The - There's also a deficiency in the - in the waste management compartment. We've discussed that before as well.

245 22 37 14 PLT

How often have environmental factors and so forth interfered with your ability to perform a task?

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333 03 08 47 CDR

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

333 03 09 59 CDR

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

333 03 10 49 CDR

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

that all of the - The items that are in the hygiene kit, I - I think we'll probably get a chance to hit later; so I'll drop that for now and hope that I'll get a chance to brief - debrief on that at some later time.

333 03 17 04 CDR

Getting back to restraint devices and handholds and the like. I've pretty much given a good bill of health to the workshop section. Moving on up into the airlock module and STS and the MDA, we begin to find that handles become few and far between or leg - correction - foot restraints become rather few and far between. There really isn't much requirement in the airlock module for foot restraints during the non-EVA situation, but it would give crewmen a thrashing around there in a EVA situation. It certainly would be helpful if you could lock yourself into some sort of a position. I suspect that some sort of a bracket that would have held the universal foot restraints might have been a very valuable thing in there, so that the - each man could lock them into the airlock module much the same as we lock the VS and VC trees. And then the crewman can go in there and lock his feet in and be stable and be much more efficient in the way he works in the airlock module.

333 03 18 12 CDR

In the MDA, I think the EREP foot restraints and the ATM foot restraints are very good. Unfortunately, I think we need a few more. I think we could use a few more handholds in there, too. It would seem to be that the handholds could be placed just kind of randomly in there but no handholds more than 4 feet from another handhold.

333 03 18 40 CDR

And a handhold could be designed in such a manner that a leg can be - or a knee - that back of a knee or something like that could be hooked into it. And that way, the hold - the restraint could be both a foot restraint or a leg restraint and a hand restraint. Okay. I guess I've indicated all of the deficiencies and what I consider to be the restraints.

333 03 19 12 CDR

How effective is the nonequipment-assisted verbal communication throughout the OA? The intercom boxes have been quite satisfactory with the exception

338 03 12 17 CDR

Okay, break, break. This is a - a new message and this one is for the visual observations people. I had two - two assignments tonight at 03:03 and 03:04 Zulu. One was HH101-1 of the Manila area. The clouds over Manila were essentially broken - scattered to broken deck. I took a - a Hasselblad shot of it. I'm not sure that you'll be able to get much out of it in the way of metropolitan study, but I went ahead and took it anyway.

CDR

Then we - as we moved on down to the south, the clouds remained pretty much scattered to broken and I got a picture of Leyte, Samar, and Mindonao Island, and I don't know if you're going to be able to get very good fault information out of it or not because of the clouds. The settings - Because of the cloud cover, the settings were f/16, 1/250 with a 100-millimeter lens on the Hasselblad. And stand by and I'll give you the frame numbers. The frame count on the Hasselblad right now is 42. So that means that number 41 was Mindonao; number 40 was Samar, number 39 was Leyte; and number 38 was Manila.

338 03 13 47 CDR

CDR out.

338 03 15 17 SPT

Okay, this is the SPT at 1 - correction, make that 05:15.

338 03 15 31 SPT

Okay, try that again. Let's make it 03:15. Subject is M487-3, 3A. Work restraints and mobility aids -

Okay, fireman's pole: I guess it's kind of tough to give it a rating as I really don't - really didn't want it in there, and we have since taken it down. I think it you're - It was really not anything which I could not have - did not provide any function which I could not have done without.

338 03 16 16 SPT

Stand by.

338 03 19 21 SPT

Okay, this is the SPT picking up again on M487-3. Okay, on fireman's pole: Again I thought I was able to get along without it. And I think I was finally able to wean the other guys from it. That large open space I find kind of fun to move around in, and also I think you can push off one wall to the other of the - one entrance to another and get

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

338 03 20 38 SPT

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

338 03 21 17 SPT

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

SPT

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

338 03 22 12 SPT

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

SPT

ATM foot platform: I'd call that adequate. What I'd like to do is to have that foot-pad moved down a lot more than it is. We find ourselves really hunching up over the panel, trying to get our heads in the same position they were in one g. And we can't move that thing down any more. Useful to have much more, greater range to travel on. Portable PGA foot restraints: Okay, very useful. I give them an excellent.

338 03 23 03 SPT

Portable handholds; specify where and how used. I guess - I guess the problem is - they're probably adequate, but the problem is, for me, I don't have time to run one - run one up and then try to figure out where to put it. I'm interested in getting the job done and I sure don't have time to construct things in order to do it. If I used footpads many many times, I might do that, but I have not run into that situation yet.

SPT

Portable equipment restraints, tethers, bungees, universal mounts, et cetera: Okay, most of that - heck, let's go at it. Tethers: I've - I've not used any inside except for the small lanyards that we put on our checklists, and I'd say those are very good. The bungees are - If you're talking about the spring ones, they're lousy. They - they stretch out too easily, and I give those a poor.

338 03 24 05 SPT

Universal mounts: I guess for the job they're going to do, they're very good. ATM seat/back rest restraints: I haven't tried it. I have the feeling it would be very much - way too confining. When I'm working on the ATM, I have material mounted all around there. And I swing my body completely back, to the right side, to the left side, straight up, in order to get to the material which I have posted for cue cards and one thing or another. Sitting in that chair would really tie me down. So that's why I haven't even attempted - I may drag it out one of these days when I get a chance.

I think we ought to retain that. Drying: Okay.  
Light-duty foot restraints: Well, here I - hold  
on; I'm moving on.

338 03 27 24 SPT

WMC Ceiling handrail: Don't use it very much. I  
guess it's adequate for - but I just flat don't use  
it very much at all. I guess when you ever need it,  
you might - you might find it convenient, but I'm  
usually using the walls. WMC light-duty foot re-  
straints: Okay, going back to that ceiling handrail,  
I'd give it a inadequate also because it really  
doesn't have that much job to perform.

SPT

Okay, the light-duty foot restraints: I'd give  
those - I'd give those inadequate also. The prob-  
lem is they're - they're not big enough or they're  
not small enough. They ought to be smaller if  
you're going to use your stocking feet in them, and  
they ought to be bigger if you're going to use  
triangle shoes in them.

338 03 28 16 SPT

Drying stations: I think they're too crowded to-  
gether, so I - I'd give them - inadequate. They  
do the job, but it's just, I guess, too - too packed  
together.

SPT

Shower: have not used it yet. I use sponge baths,  
and what's the difference. I guess I really can't  
give you a rating; I guess I'd give it an adequate,  
but what scares me off is all the frapping time it  
takes just in order to get the - the thing set up  
and to clean up after it. I find I can go on in  
and give myself a good sponge bath and can do the  
job just about as well as that shower in about half  
the time. We've been pushed for time up here, so  
I just haven't had the - haven't had the time to -  
the luxury to go on in there and try that. Looks  
like fun and I'll probably - I'm sure I will try it  
quite a few times.

338 03 29 11 SPT

Personal hygiene kit: It's all right, except the  
place that they have it stowed is inside a small  
locker. I'd much rather find a place that we could  
stow it permanently outside so you wouldn't have to  
dig into a small locker and fiddle with it all the



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complete steps 3 and 4. Well, step 3 is to inhibit both - or to inhibit the secondary door motor, which you sure want to do, and step 4 says operate 82A per pad. And I didn't think that was right with the white staring at us; so I held up and was glad I did. So, apparently, you also thought it was not best to chance wasting the film, not knowing what the situation was on the doors. So I'll try and get that clarified once more on the air-to-ground to make sure that we don't ever have that happen to us and end up taking data from a closed door or partially closed. Also, at the conclusion there, 56 got a - put a frame SINGLE FRAME, 5 exposure of just about 7 minutes. And again, I cut that off at ESS. I know 8 is roughly the minimum useful, but I figured we were close enough to go ahead and see what we can find anyway.

344 21 37 47 SPT

SPT out.

344 21 39 23 PLT

Okay, this is the PLT recording at 1 - 21:40 Zulu. Subject is M487-3 Alfa. It is subjective evaluation

guide 1. OWS fireman's pole is adequate to very good. It vibrates quite a lot when you use it. And one fairly important point is that it has roll pins along it - little - little, tiny pins that are used to hold the - I think, the attaching bracketry into position. And those roll pins vibrate out, and they'll - You'll snag your head and cut your hands on those roll pins. And that's the fireman's pole. But as far as the utility of it is concerned, it's the - adequate to very good. OWS dome and wall handrails: We don't work much up - up in that area, but they're good when we use them.

344 21 40 18 PLT

STS handrails: Well, the STS and the MDA probably are between poor and unacceptable or unacceptable to poor as far as all restraints. They just - They don't seem very well positioned for much of anything. I know I should - Seems to me that probably for - if you're just thinking about hands, 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 I would give the handrails. And as far as the MDA and STS as a working area, as far as restraints are concerned, I'd say it's unacceptable. Real shortcomings all over the place, and the MDA is just a lousy place to work.

344 21 41 22 PLT

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

344 21 42 22 PLT

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

344 22 04 54 PLT

Privacy curtain: I've no problem with that. That's certainly, say, - Give it very adequate to very good on the light baffle and privacy curtain. Air diffusers: They're - I would say there's - they're completely adequate. And I - I know we have not gone around screwing them in or out or anything like that because apparently we're getting enough flow and it - it doesn't bother us that much. Air vents in the sleeping compartment: I've adjusted mine several times and they're excellent. I have no question about those. And that ends the debriefing on 3 Alfa for the PLT, pages 3-3 and 3-4 in the mal [sic] checklist.

344 22 05 39 PLT

PLT out.

TIME SKIP

344 22 15 19 CDR

This is the CDR at 22:15 Zulu with a 487-3 Alpha, a subjective evaluation guide, number 1. And we'll just get right - right off with the top

one here. OWS fireman's pole: I rate that very good. We found that it was a very, very convenient and handy thing to have in the beginning, after we got here, and we kept it up for about 2 weeks. And finally, after about 2 weeks, we felt that we could make it quite comfortably from one part of the spacecraft to the other without the need of a fireman's pole; so we've taken it down. And we have nothing installed now, not even the strap. We find that that particular piece of equipment, though, was quite useful during the, you might say, get-acquainted phase, when we were getting use to the - to the workshop and how to get around, to get myself positioned away so that I don't get that feedback.

344 22 16 41 CDR

Okay, OWS dome and wall handrails: I would rate them very good. I think that, particularly in the area of the dome the handrails are quite - quite good. There's really not much action going on up on the dome; so there's not a whole lot of requirement for a great many handrails up there.

to be doing anything up there. If we had more equipment up there, it would be exceptionally useful. The ones that are on the OWS wall are - are used to a degree, depending upon how much equipment there is right next to it.

003 02 45 04 SPT

The ones by the airlocks are used - the ones - Well, I guess most of them on the wall are used, just about all of them. The only points which are relatively nonused - unused are the ones to the left of the 509, between that and the 505 which is just because we don't do many things over there.

SPT

The movable handholds, I have just not found a use for those things. They are probably good to have around. Maybe some day we will come up with a use for them, but so far in 48 days, I have not found anything to do with them.

SPT

Portable foot restraints are great for the EVA prep and post. Are some unnecessary? No, I just - I would think so. I don't think there's a handhold around here that I have not used at one time or another. I find them exceptionally useful. I think if you made your - your inner surface out of traingle and kept it free wherever possible, you could have yourself a good combination handhold and - and foot restraints. You won't have to worry about putting these blue - handholds all over the place. They still would have to have them somewhere sticking out from equipment which would preclude you from getting close to the floor.

But other than that, I'd go triangle all the way. But just for visual appearance, you want - may want to put something in back of the triangle like, oh, something with a reasonable color into it, not this vanilla white or whatever it is. It's very nonappealing; something with a light blue or something like blue or light green or something, maybe a couple inches or so behind the triangle so you can still get a foot in there or get in anything else you need to, but not have the whole place look like a maze.

003 02 47 19 SPT

How often have environmental factors, for example, noise, temperature, airflow, illumination, interfered with your ability to perform a task? Noise

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.

POGUE  
(CONT'D)

more flexible, should be used for protecting equipment in Shuttle. It should be easily insertable into the triangle grid because I'm sure you're going to need a bundle of that stuff in different sizes.

QUERY

Were the portable handholds found to be very useful?

CARR

We didn't use them very much at all. There weren't many good places to put them except in the floor and you already had great restraint on the floor with your feet. There weren't many other places that were of much value for those things. We used three of the astropins, the small ones with the eyes, to hold down the treadmill and we were scared to death that we were going to break a toe on those things because they stuck up so much.

POGUE

It took too much time to position the astropins.

GIBSON

The only place in which they would really be useful is in a flat area where you can't grab with your hands. With a triangle you can always grab it with your hands; it's much easier to do that.

CARR

A pip pin sort of thing would have been just as good.

POGUE

The dog leash clips and the snap clips that we used all around fit so few things that there ought to be attention