JSC-09544

SKYLAB EXPERIENCE BULLETIN NO. 10

BODY RESTRAINT SYSTEMS

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National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

DECEMBER 1974

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December 1974

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

BULLETIN NO. 10

BODY RESTRAINT SYSTEMS

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

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December 1974

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BODY RESTRAINT SYSTEMS

INTRODUCTION

This document is the third of the four-document series on personal restraints identified in Skylab Experience Bulletin No. 7. The various types of body restraints developed and flown on Skylab are the subject of this document.

SUMMARY

In general, chair-type body restraints proved to be unnecessary for zero-g activities. The ATM chair was not used by the SL-3 and SL-4 crews and the thigh restraints were not used by the SL-4 crew.

The ergometer restraint harness was found to be unnecessary when the handlebars were lengthened to provide handholds in the proper relationship with the user's body posture.

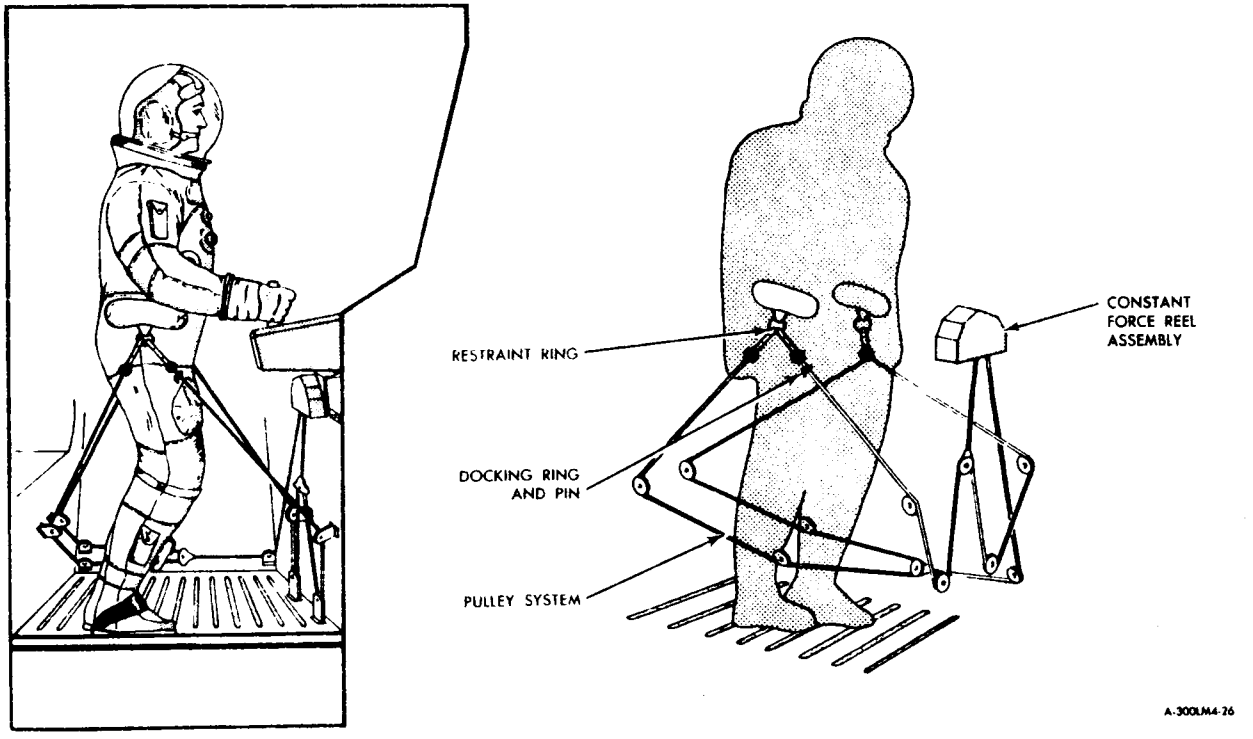
Lap belts and body restraint belts should be provided with a positive, adjustable aircraft-type buckle that permits the user to force himself firmly against the restraining surface.

PRE-SKYLAB EXPERIENCE

Prior to the Skylab missions, very few body restraint devices, other than couch restraints, were necessary. The Mercury and Gemini spacecraft and the Apollo Command Module all relied upon couch restraints as the only IVA whole-body restraint necessary for such mission functions as launch, orbital maneuvers, and reentry.

Since the Apollo Lunar Module (LM) had no couches (the crewmen flew it while standing) an IVA body restraint was needed for the lunar landing and take-off portions of the mission. The crew support and restraint equipment included armrests, handholds (grips), Velcro on the floor to interface with the crewman's boots, and a restraint assembly operated by a tensioned rope-and-pulley arrangement that secured the astronauts in an upright position under varying-g conditions. Each astronaut station had a set of this equipment shown on Figure 1.

The armrests provided stability for operation of the thrust/translation controller and the attitude controller and restrained the astronaut laterally. They were adjustable to four positions to accommodate different sized astronauts and had a stowed as well as a docking position. The armrests were held in position by spring-loaded detents and could be moved from the stowed position by grasping them and applying downward force. The adjustment positions were selected by pressing latch buttons on the armrest forward area. Shock attenuators were built into the armrests for protection against positive-g forces (lunar landing). The maximum energy absorption



LUNAR MODULE RESTRAINT SYSTEM

FIGURE 1

of the armrest assembly was a 300-pound force which would cause a 4 inch armrest deflection.

The handholds provided support for the upper torso when the crewman's activity involved turning, reaching or bending; they attenuated movement in any direction. The handholds, mounted on the forward panel directly ahead of the astronauts are single, upright, peg-type metal grips, one for each hand.

The restraint assembly consisted of cables, restraint rings, and a constant-force reel system. The cables attached to D-rings on the sides of the pressure garment at the waist. The constant-force reel control provided a downward force of approximately 30 pounds and was locked during landing and docking operations. When the constant-force reel was locked the cables were free to reel in. A ratchet stop prevented paying out of the cables and thus provided lunar landing restraint. Docking pins on the commander's restraint cables were to be used during docking maneuvers. Inserted into the forward panel, they enabled the commander to maintain his equilibrium while leaning backwards to use the optical alignment sight at the overhead (docking window).

The Velcro patches on the crewmen's boots and the Velcro strips on the floor of the LM provided the needed friction surfaces to prevent the crewmen's feet from sliding on the metal deck.

The LM restraint system presents an example of a specialized body restraint required for the variable-g forces encountered in flying and landing the LM on the lunar surface.

SKYLAB DESIGN

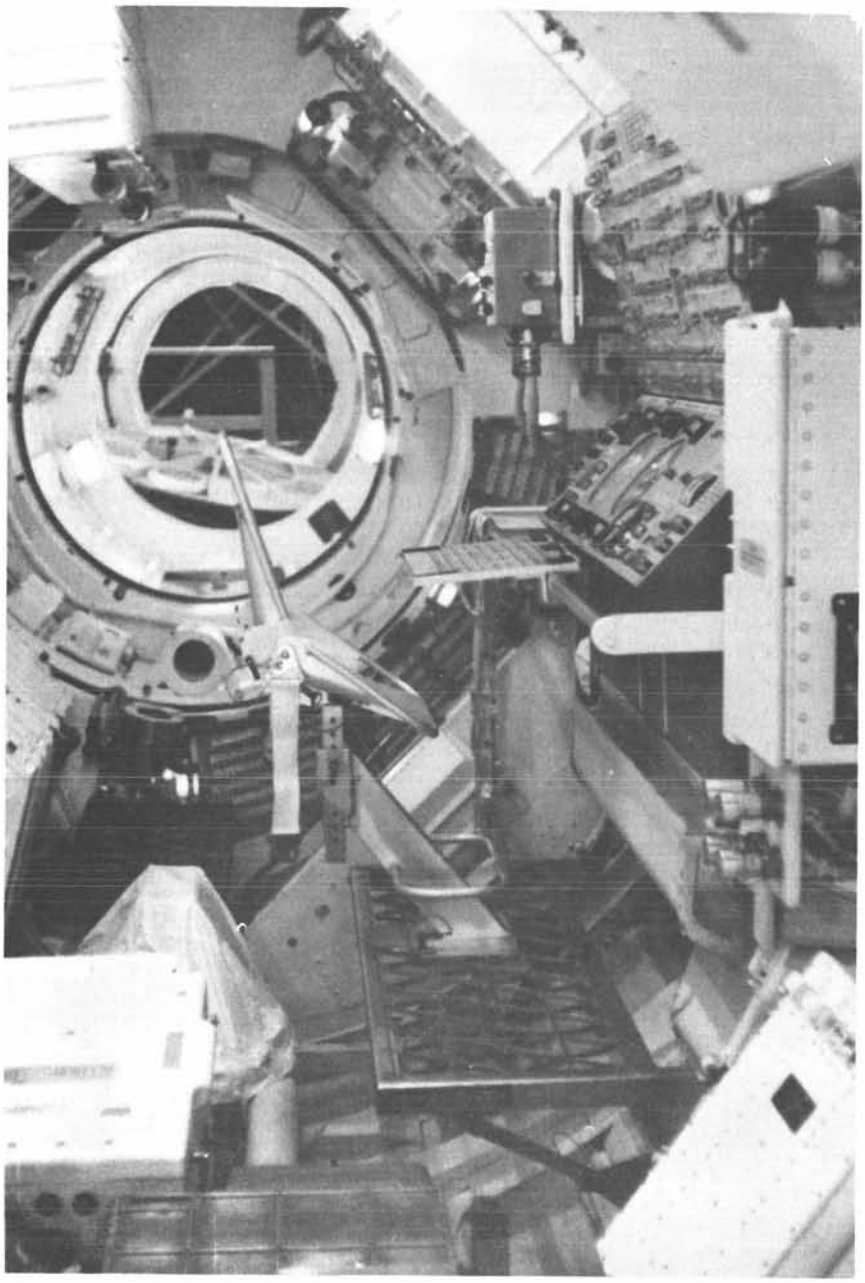
Skylab Restraint Assembly

The Skylab Restraint Assembly (commonly called the ATM chair) was one of the more controversial restraints installed on Skylab. Early in the program, a rather elaborate chair was developed for use at the ATM panel. It appeared to be much too complex and complicated and was discarded. Later, just prior to the SL-1 launch, another chair was proposed for use on the mission.

The ATM chair, designed to attach anywhere along the ATM foot restraint platform, was intended to provide the crew with a chair-type body restraint while working at the ATM control and display console. It had eleven height adjustment positions above the ATM foot restraint platform, and the back of the chair was adjustable to nine positions of tilt. The seat also had five tilt adjustment positions relative to the foot restraint platform. A tubular foot restraint rail, which could be employed as a foot reaction point, was also provided at the base of the chair. Figure 2 illustrates the ATM chair installed at the ATM panel.

Thigh Restraint

Three thigh restraints were located on the wardroom table, one at each eating station. They were supposed to provide, in conjunction with the



ATM CHAIR

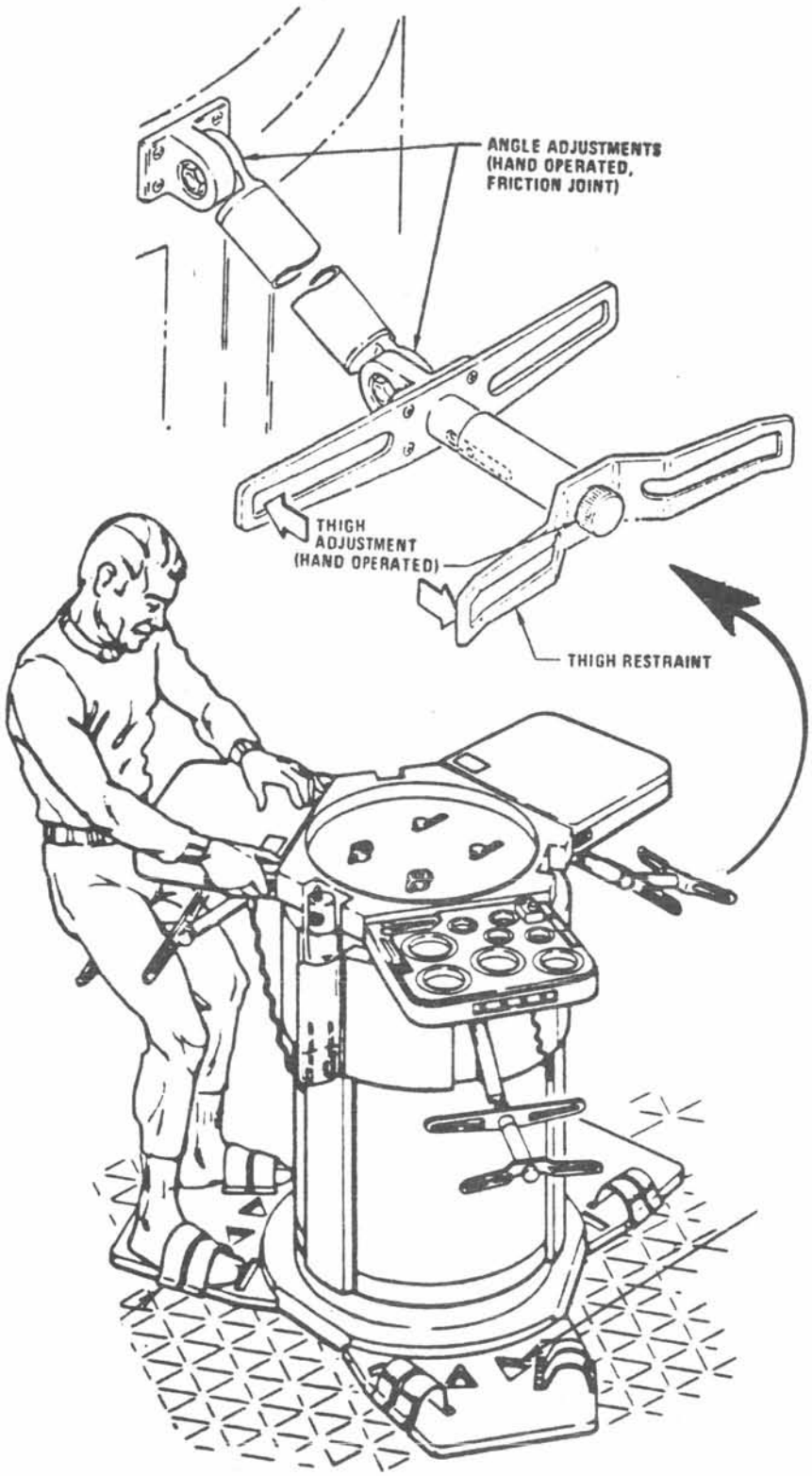
FIGURE 2

foot restraints, a comfortable means of stabilizing the crewmen in a semi-seated position at the wardroom table. The thigh restraint was friction-hinged in two places--at the table to permit the desired elevation or for out-of-the-way stowage, and at the mid-point of the restraint to provide a selection of the desired seating position. The cross-rails were fitted with a slide adjustment to permit their conformation to the size of the crewman's thighs. Figure 3 provides an illustration of the wardroom table thigh restraints and how they were to be used.

M-171 Ergometer Restraints (Bicycle)

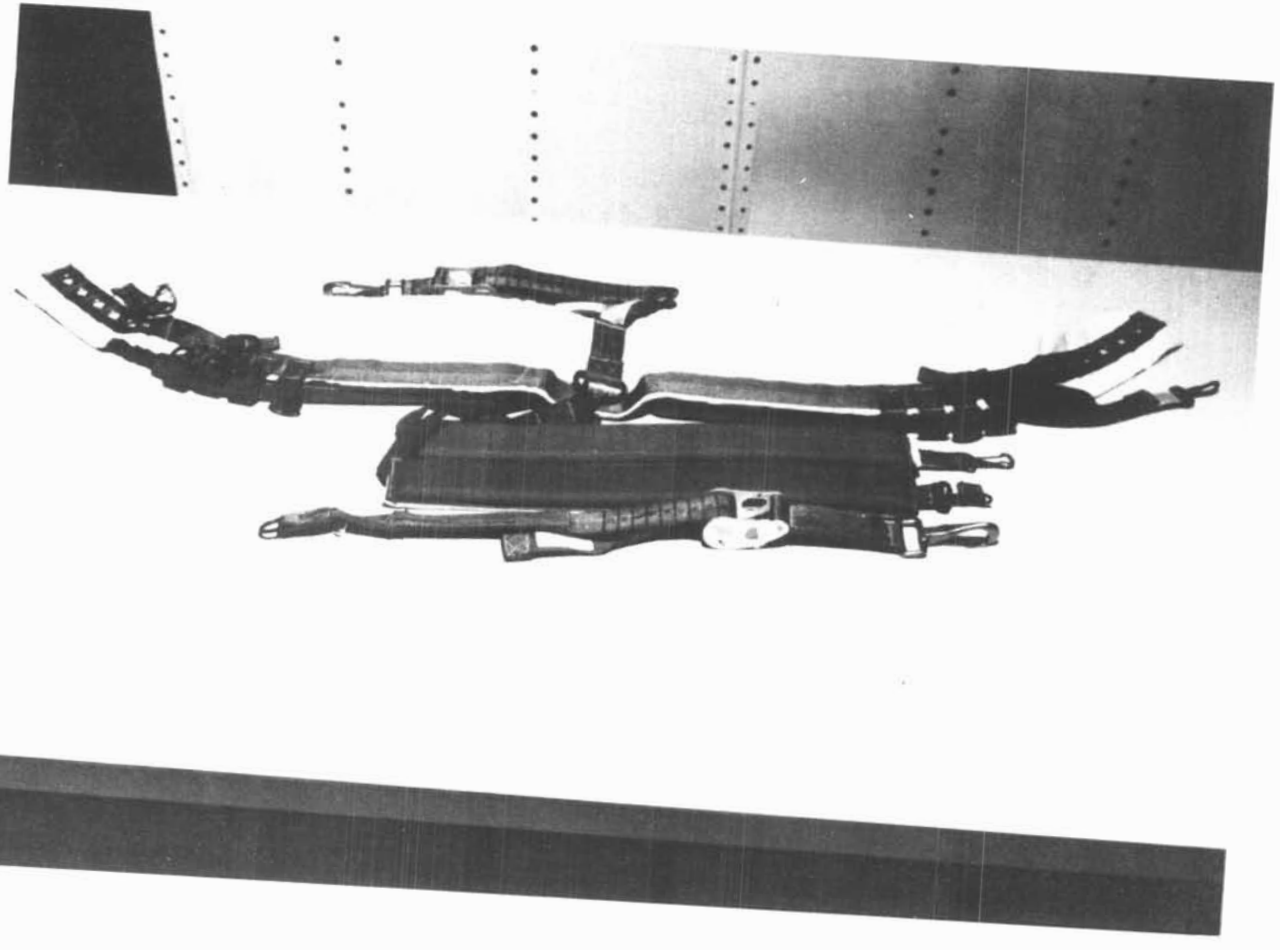
An ergometer was installed on the experiment deck of the OWS as a part of the equipment for experiment M-171. Since it utilized a bicycle pedaling action for operation, it was also utilized as an exercise device to help the crewmen maintain their body muscle tone.

A rather elaborate set of restraint straps was devised to permit the crewmen to remain in the proper position while pedaling the bicycle. Figure 4 shows the restraint assembly and Figure 5 shows an operator on the bicycle with the restraints in place on his body. This harness, in conjunction with triangle shoe cutouts on the pedals, was supposed to provide total restraint for the crewman.



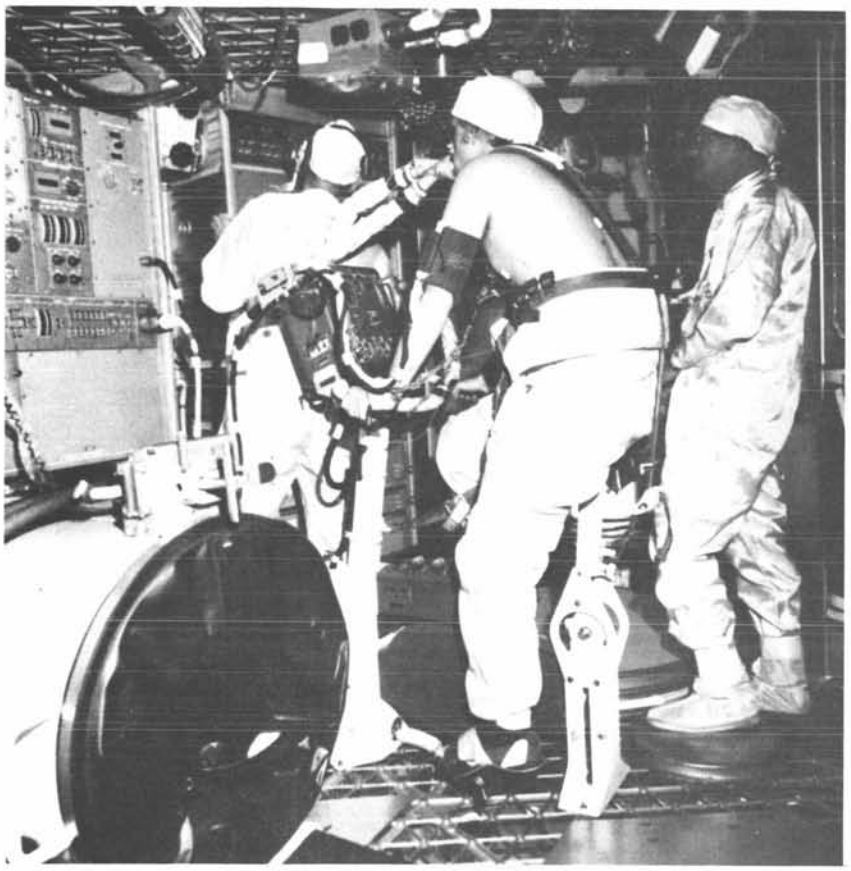
THIGH RESTRAINTS

FIGURE 3



ERGOMETER RESTRAINT STRAPS

FIGURE 4



ERGOMETER IN OPERATION

FIGURE 5

Body Restraint Straps

Several kinds of body restraint straps were utilized for various tasks aboard Skylab.

One of these was the ATM chair belt. This lap belt had an aircraft type of belt buckle that permitted the crewman to cinch himself firmly into the ATM chair. It was adjustable to any size of crewman and would hold anyone equally well. Figure 6 shows the belt in use in the trainer while Figure 7 shows the belt in the stowed position.

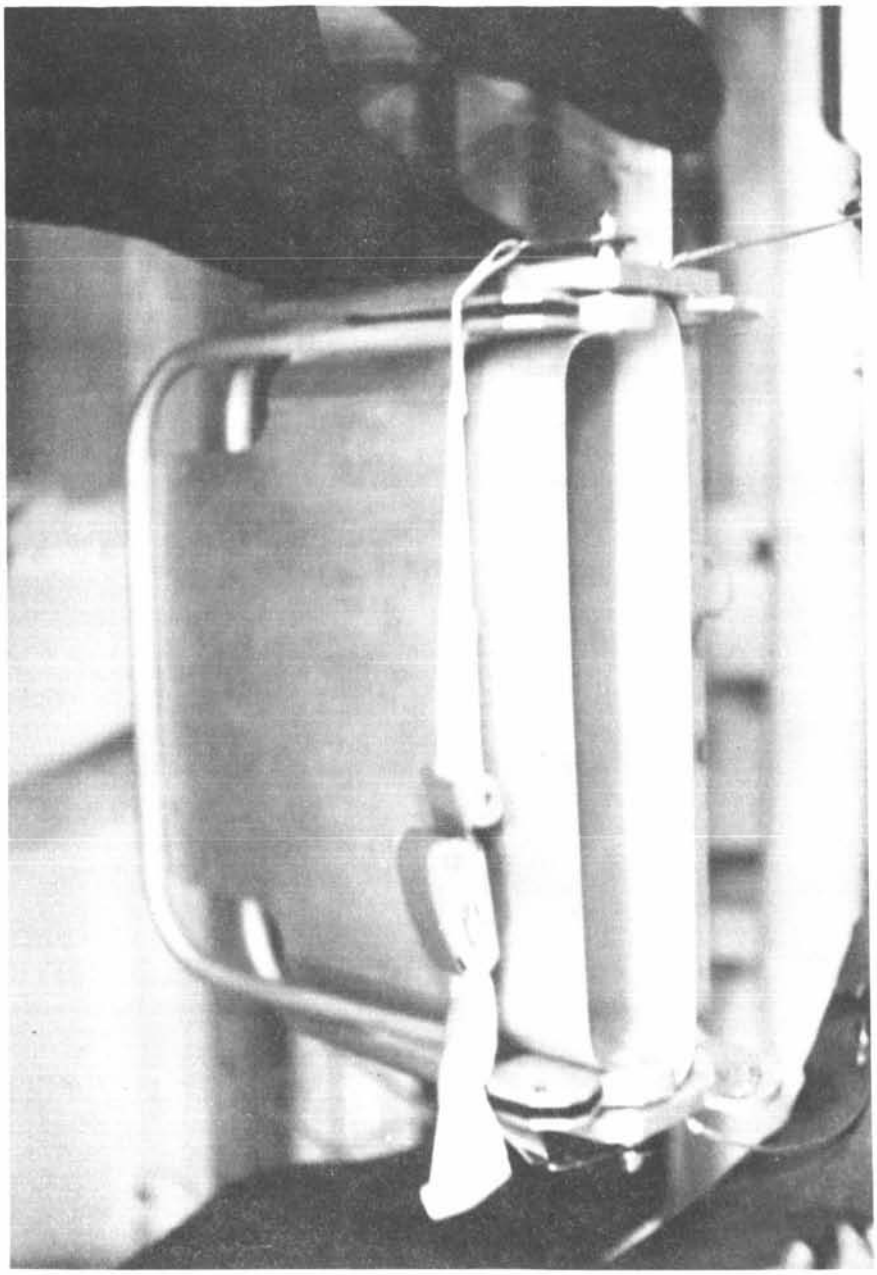
The M-131 litter chair had a strap that had a dual restraining function. It was a lap belt to restrain the user while in the vertical or seated position as shown on Figure 8. While in this position, the litter chair would be rotated at various speeds. The strap also served as a chest strap to restrain the user to the litter chair in the horizontal mode. Figure 9 indicates this configuration.

Figure 10 shows a good view of the strap installed on the litter chair. It was a simple, two piece fabric strap with a large strip of velcro sewed on each piece to provide the fastening mechanism. The small patch of velcro, also seen in the picture, was for use in stowing the strap in launch position.

The fecal collection unit had a fabric strap designed to hold the crewman in the proper position on the unit. It was designed to provide a certain amount of "cinching down" action on the user and had a large velcro patch for a fastener.

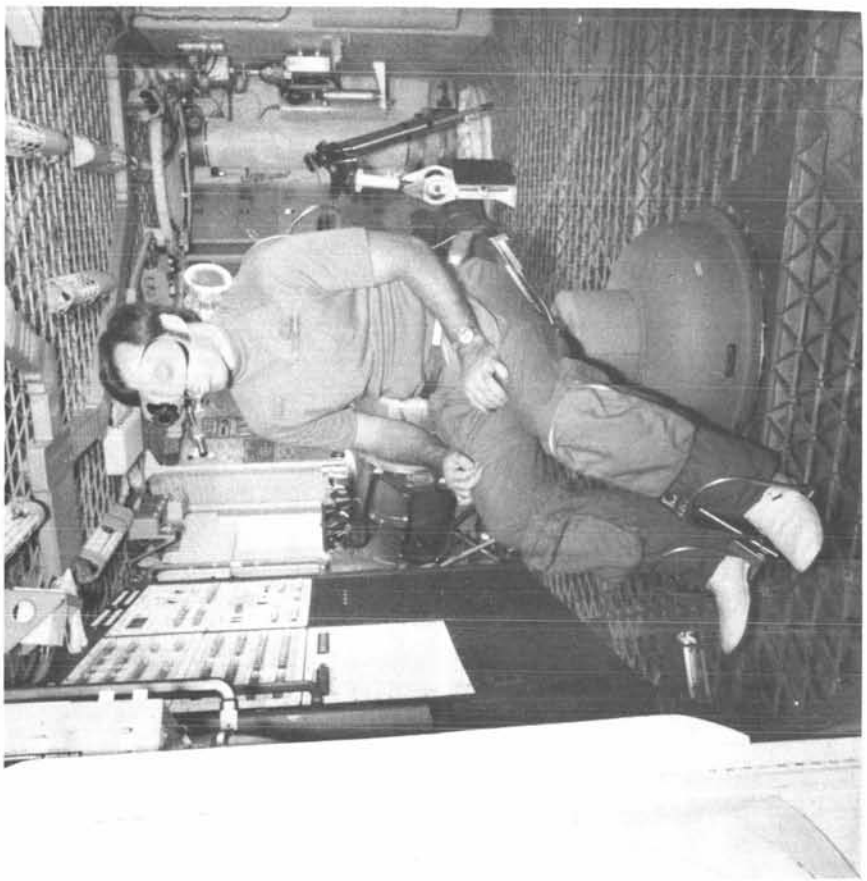
ATM CHAIR

FIGURE 6



ATM CHAIR LAP BELT

FIGURE 7

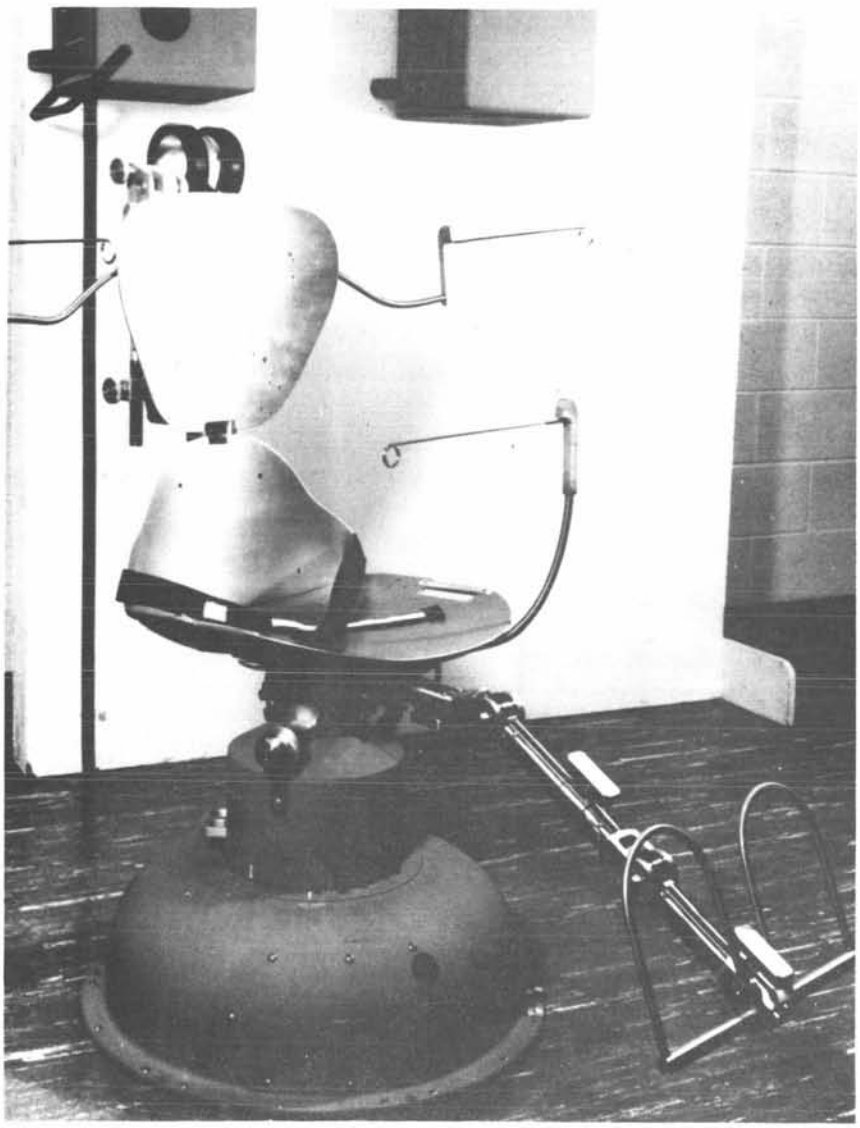


M-131 LITTER CHAIR

FIGURE 8

M-131 LITTER CHAIR - HORIZONTAL MODE

FIGURE 9



M-131 LITTER CHAIR BELT

FIGURE 10

The Body Mass Measuring Device had a fabric harness to hold the crewmen immobile in the mass measuring device. Figure 11 shows the BMMD and its restraint harness.

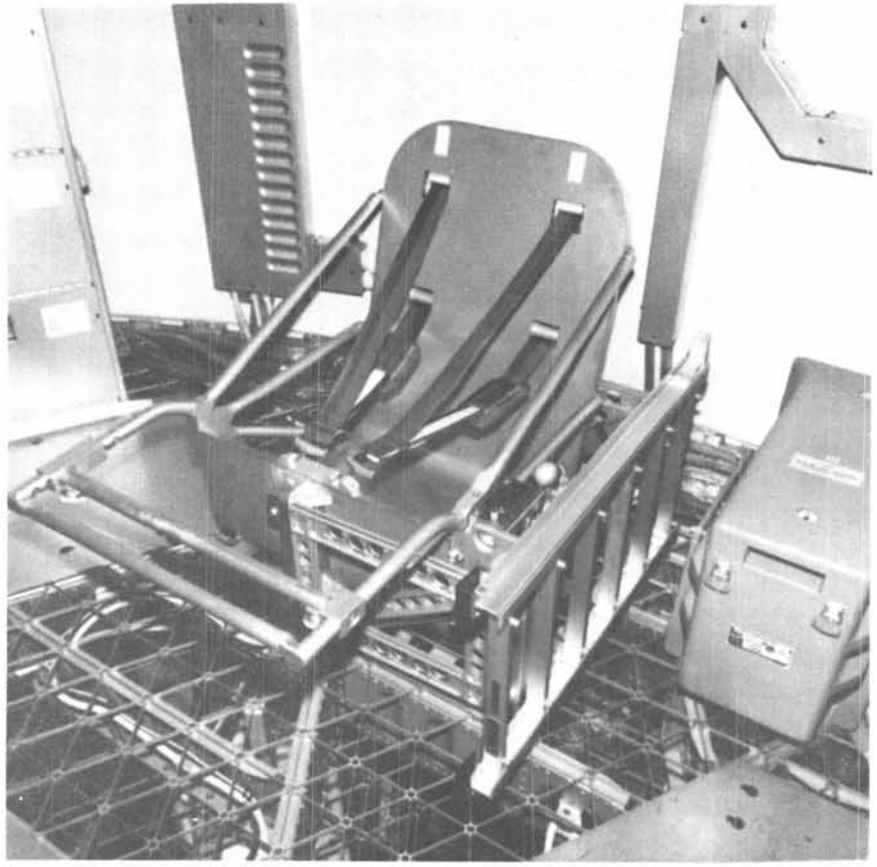
SKYLAB EXPERIENCE

The Skylab data (TV and movie films, still photographs, air-to-ground voice transmissions and post flight debriefings) has been studied and analyzed to determine what problems, if any, the crewmen had in utilizing the various body restraints developed for and installed on the orbiting workshop.

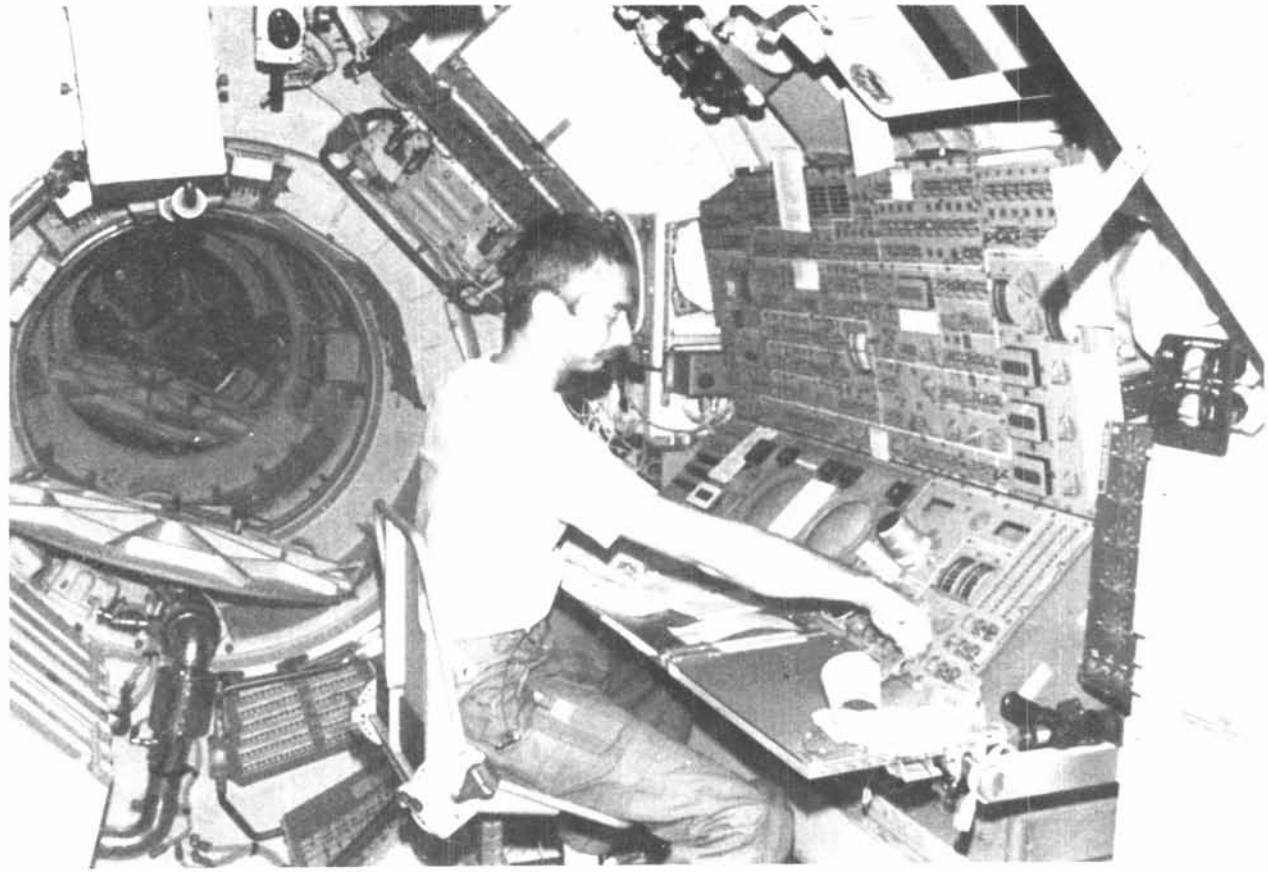
Skylab Restraint Assembly (ATM Chair)

The ATM chair was installed on the platform grid in front of the ATM control and display panel to provide the crewmen with body stability and restraint while they were performing the ATM experiments.

The SL-2 crew used the ATM chair throughout their mission. One crewman used it in conventional chair fashion, however, it was used unconventionally quite frequently by the other two crewmen. The body position that the user was forced into by the seat and lap belt was unnatural for zero-g operations. Figure 12 shows a crewman strapped conventionally into the chair. The straps and seat in combination caused some uncomfortable pressure points on the user's body.



BODY MASS MEASURING DEVICE
RESTRAINT HARNESS
FIGURE 11



CONVENTIONAL USE OF ATM CHAIR

FIGURE 12

The chair was more often used as an anchor point from which the crewmen could assume various positions to operate the ATM panel. At times they would half sit, half lie on it, using the toe-bar as a restraint. Figure 13 shows one of the SL-2 crewmen utilizing the toe-bar. At other times, it served as a sort of a nook from which to operate the panel.

The SL-3 crew didn't use the ATM chair. Apparently, each of the crewmen tried it early in their flight and discarded it in favor of the triangle shoes and ATM foot restraint panel as shown on Figure 14. They preferred the freedom of movement that the foot restraints permitted.

The SL-4 crew did not use the ATM chair either. It had been stowed out of the way by the SL-3 crew and apparently was left there for the entire SL-4 msssion. Again, the convenience of operation and freedom of movement permitted by the foot restraints far outweighed any potential benefit that may have been gained by using the ATM chair. It was just not required.

The following references contain crew comments concerning the ATM chair.

References	Appendix Page Number
4	4
5	7
6	8
7	12
13	24

ATM CHAIR TOE-BAR USE

FIGURE 13

ATM PANEL OPERATION WITHOUT CHAIR

FIGURE 14

References	Appendix Page Number
14	26
16	33
18	41
19	45
20	48
23	53
24	54
26	59
27	64
28	65
29	69
32	79
33	81

Thigh Restraints

The thigh restraints at the wardroom table received various comments from the Skylab crewmen ranging from "the thigh restraints are excellent" to "the thigh restraints are useless".

Most of the crewmen found the thigh restraints to be reasonably useful. Some of the crewmen used them exclusively because the foot restraints did not function well. (See paragraph on wardroom foot restraints in Experience Bulletin No. 9.) However, most of the crewmen found that the thigh restraints required the use of foot restraints also to provide

the maximum stability. The thigh restraints alone did not completely control the pitch of the user's body. Figure 15 shows a view of the thigh restraint at the wardroom table.

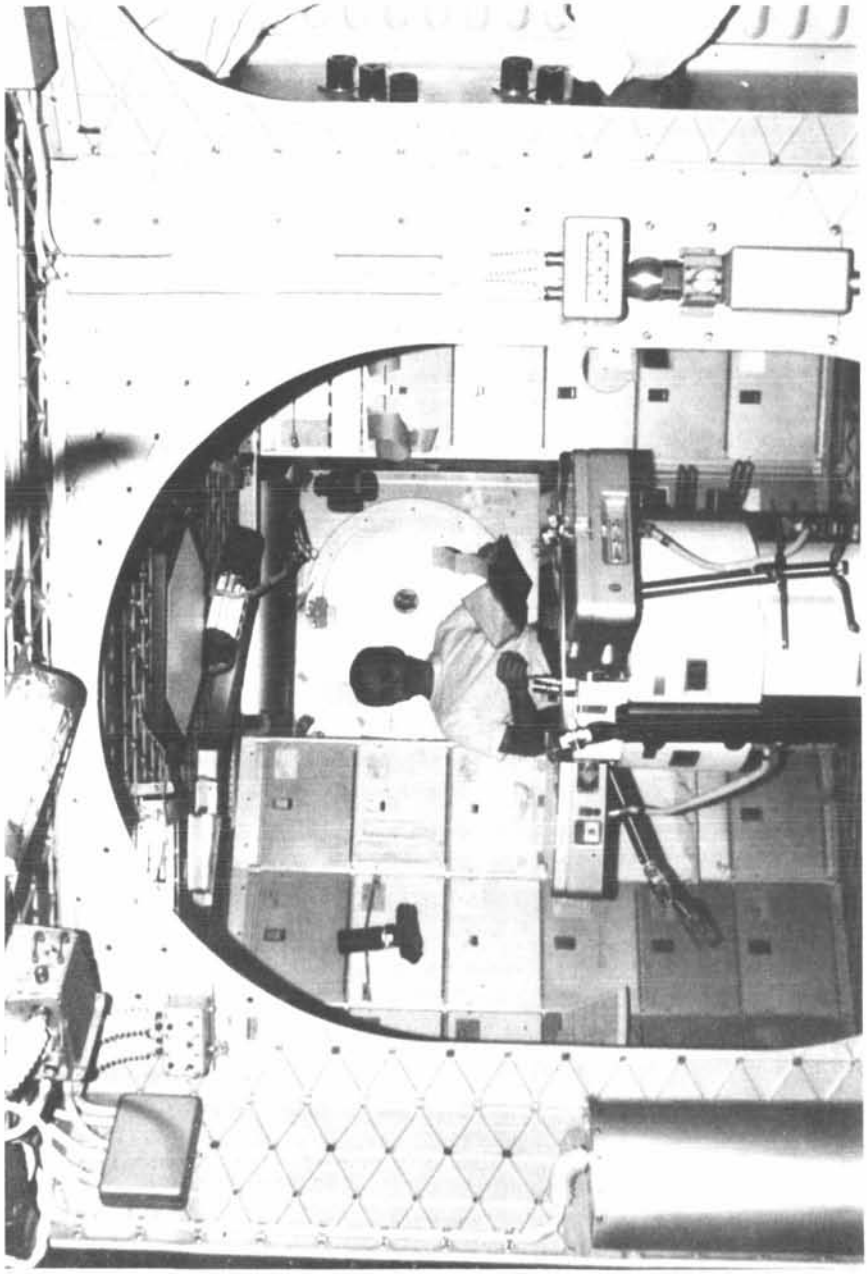
After removing the foot restraint platform from around the base of the wardroom table, the SL-4 crew found that the triangle grid and triangle shoes provided completely adequate restraint and were more convenient to use than the thigh restraints. The common comment was "the thigh restraints always required you to flex muscles to stay in." So, similar to the foot restraints, a positive, passive restraint was desired in body restraint.

The final analysis from the SL-4 crew was that "they are OK, but not necessary."

One main problem mentioned by the crewmen was that the table height was not correct for the natural zero-g body position. The crewmen had to hold themselves down to the table to use it. The thigh restraints did not help this situation.

The following references contain comments relative to the thigh restraints.

Reference	Appendix Page Number
4	4
6	8
7	12
15	29
16	33



WARDROOM TABLE THIGH RESTRAINTS

FIGURE 15

References	Appendix Page Number
18	41
19	45
20	48
24	54
26	59
28	65
29	69
30	76
32	79

M-171 Ergometer Restraint Harness

The M-171 ergometer, commonly called the bicycle, provided a unique experience in body restraint systems. The crewmen were to use the ergometer for exercise to maintain their physical conditioning in addition to the medical experiments. An elaborate harness had been devised to hold them in the proper position to permit pedaling the necessary speeds for the necessary amount of time. From the beginning of SL-2, the harness caused difficulties.

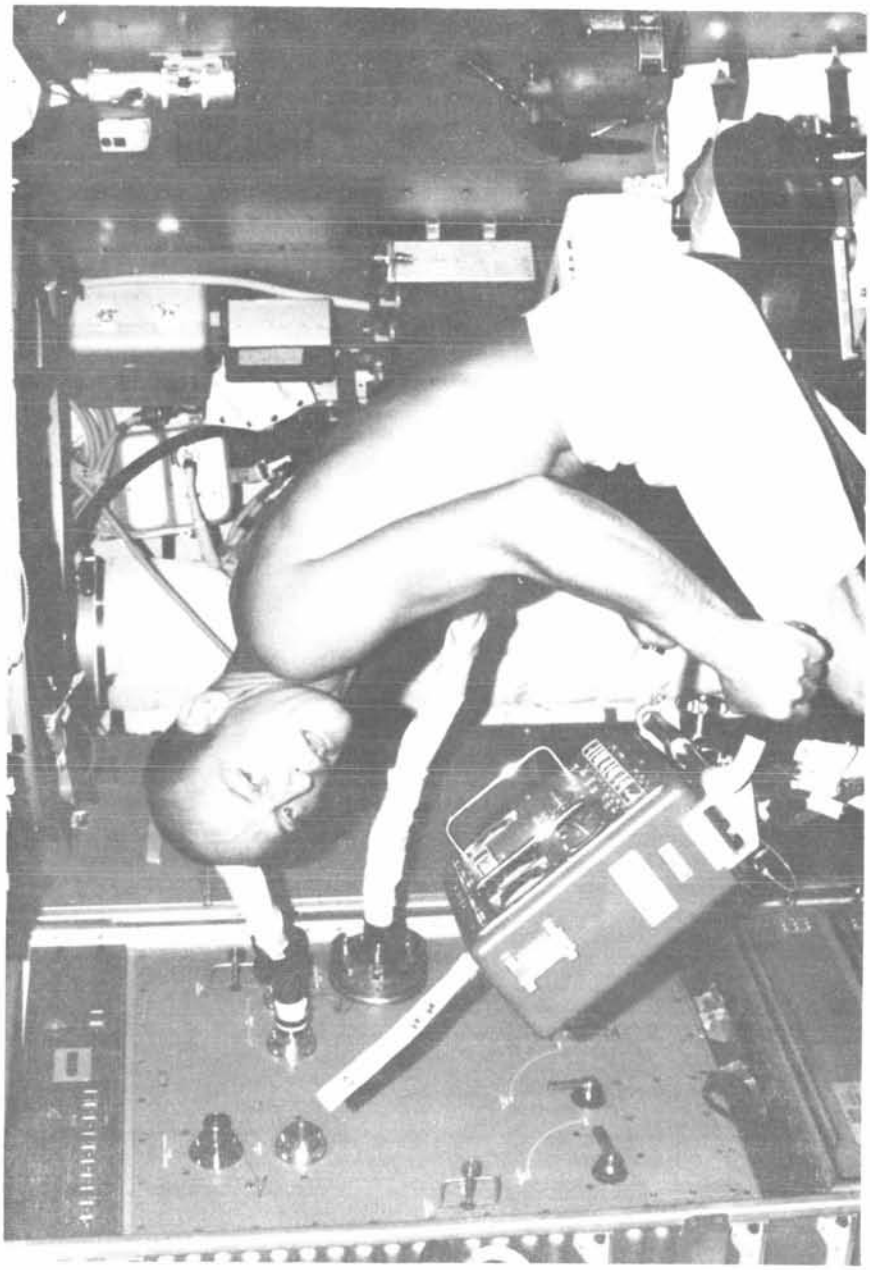
The crewmen found that the shoulder restraint interfered with their respiration while riding the bike. The waist restraints interfered with leg motion and blood circulation. After numerous attempts at modifying the restraints and trying various experimental efforts, the crew eliminated the harness altogether. The restraintless method of

riding the bike evolved to two different handholds and pushing the rider's head against the ceiling as described in Reference 10.

The ergometer user would hold on to the handlebars, or grab the ergometer seat between his legs, or push his head and hands against the ceiling of the experiment compartment. By alternating from one of these modes to another, the crewmen were able to perform their experiment protocol and maintain their physical conditioning. Figure 16 shows the handlebar hold mode of operation. The SL-2 crew did recommend that the handlebars be made longer to permit a more optimum hand location for better postural stability.

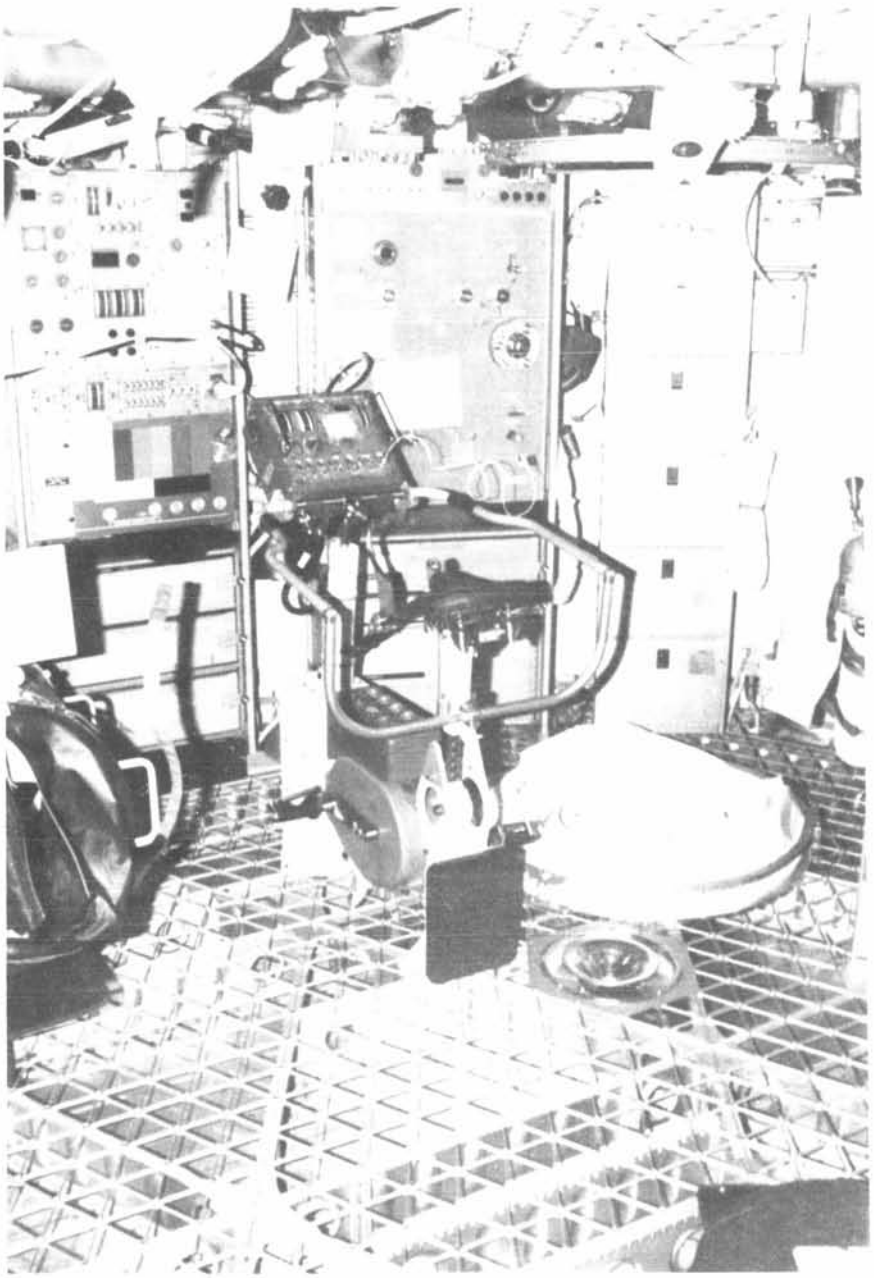
A longer set of handlebars was devised for the ergometer and sent up with the SL-3 crew. Figure 17 presents a good view of these new handlebars. When asked about the new handlebars, the crew replied that the the handlebar extenders permitted them to position their body relative to the pedals any way they wanted and that it was quite convenient. Figure 18 shows the lengthened handlebars in operation. Notice the contrast in body position with that indicated in Figure 16. Figure 19 shows the lengthened handlebars being used in conjunction with a ceiling head pad.

The SL-3 crewmen indicated that they had solved the problem with the original harness by reconfiguring some of the straps that had been incorrectly made and were extremely difficult to attach to the ergometer properly. After this problem had been overcome, the harness was reported



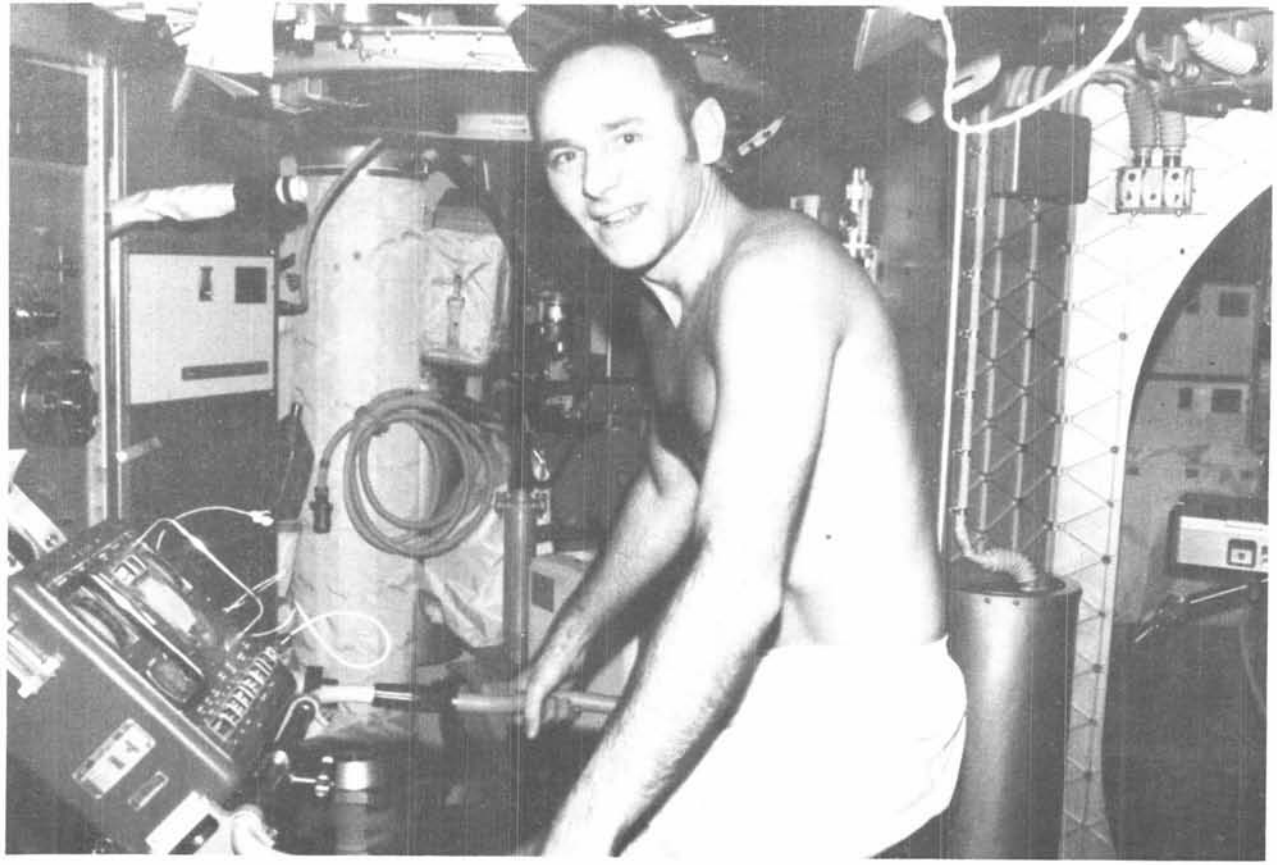
ORIGINAL ERGOMETER HANDLEBARS

FIGURE 16



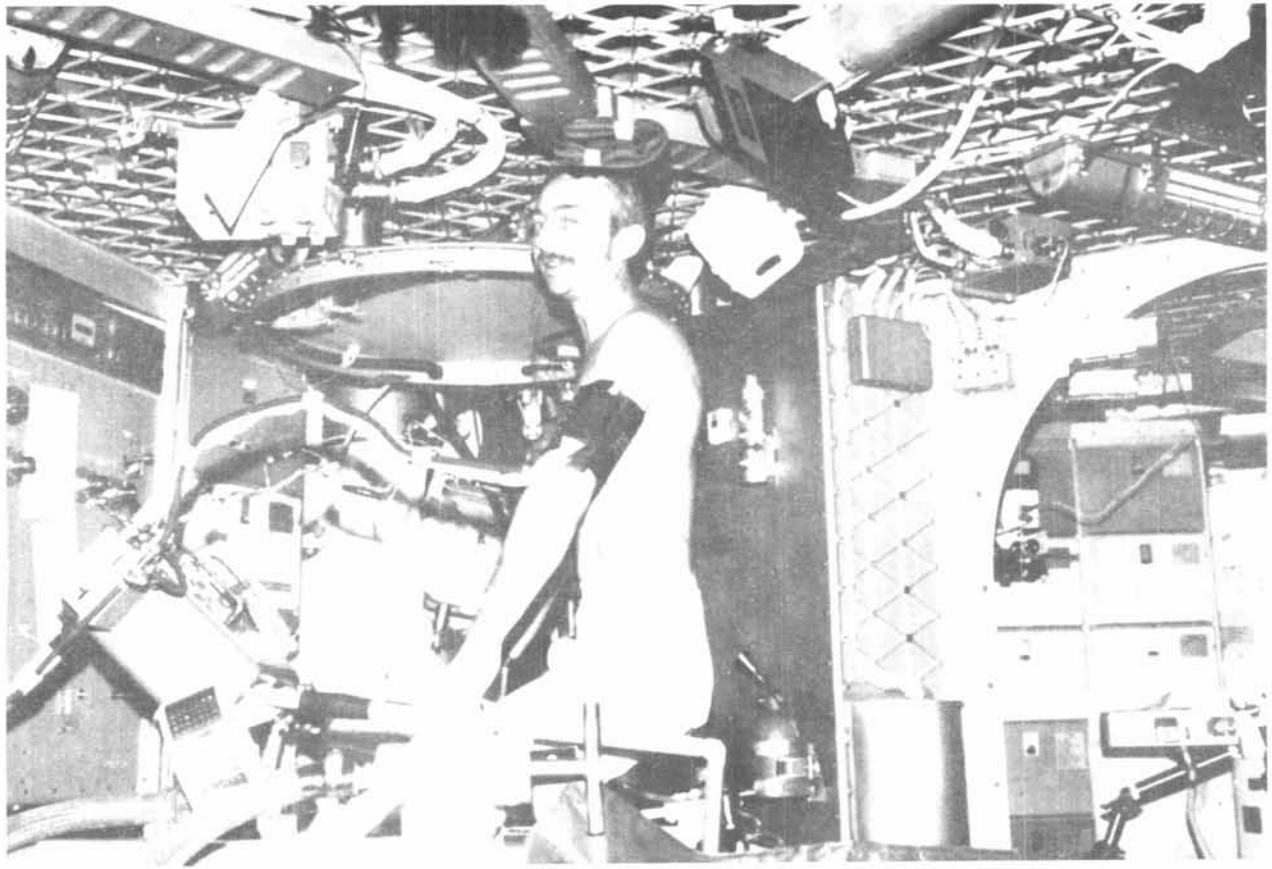
MODIFIED ERGOMETER HANDLEBARS

FIGURE 17



REVISED ERGOMETER HANDLEBARS IN USE

FIGURE 18



USING HEAD PAD AS RESTRAINT

FIGURE 19

to work quite well for one crewman but, it was not really needed because the handlebar extension devices also worked well and were simpler to use. However, at least one of the other SL-3 crewmen reported that the harness did not work well for him, that using the handlebar extension permitted him to maintain the proper position easier.

It appears that the handlebar extension solved the ergometer restraint problem fairly well. The SL-4 crew maintained their physical conditioning quite well (other exercise devices were also used) and made but one comment concerning the M-171 restraint system. They would have liked some kind of restraint to hold their shoulders down; something that operated on the head and shoulders, rather than push their head against the ceiling. It is not known wheather or not they tried the original harness at all.

The following references contain comments relevant to the ergometer restraint system.

References	Appendix Page Number
1	1
2	2
8	15
9	19
10	21
11	22
14	26

References	Appendix Page Number
17	39
21	50
22	51
25	56
26	59
33	81

Body Restraint Straps

The Skylab OWS had three different kinds of waist strap restraints: the waist strap on the ATM chair, the lap belt on the fecal collector unit, and the waist strap on the M-131 litter chair. The crewmen had various comments concerning the adequacy of these three types of lap belt restraints and the type of fasteners they utilized.

This ATM chair lap belt had an aircraft seat belt type of buckle which permitted the user to cinch himself firmly to the seat. This type of positive, firm support was acclaimed by the SL-2 crewmen, at least, as providing a superior type of lap belt restraint. Figure 20 shows the lap belt floating free at the chair.

The fecal collector lap belt drew conflicting comments concerning its usage. Some of the crewmen didn't use it, but merely held on to the handholds while using the fecal collector. Some of the crewmen used it but felt that it could have been improved. Some of the crewmen used it and thought that it worked quite well.

ATM CHAIR LAP BELT

FIGURE 20

The comments did indicate that the fecal collector lap belt, with its free end going through a loop, turning back on itself and fastening with a large amount of velcro provided a much better fastening device than the original M-131 litter chair lap belt. However it was not as firmly positive as the aircraft type buckle used on the ATM chair.

In general, all the crewmen had some difficulty with the M-131 litter chair. Part of the problem was probably due to the chair itself. In zero-g, the body does not bend naturally and nicely to the 90 degree bend required for a seated position. Thus, the only way the crewmen could fit themselves to the chair was to strap themselves down firmly with a lap belt. However, the lap belt was part of the problem, also. The velcro used as a fastener was not strong enough to hold when the strap was pulled as tight as the crewmen desired.

The Body Mass Measuring Device had a problem with its restraints also. The shoulder harness installed on it did not prevent a certain amount of "belly slosh" which rendered the weight measurements suspect.

A modified lap belt was fabricated to solve both the M-131 litter chair and the Body Mass Measuring Device problems and sent up with the SL-3 crew. As shown in Figure 21, it was a two inch wide, stiff fabric belt with an aircraft type of adjustable fastener similar to that used on the ATM chair. As with most design solutions that are required to solve two different problems, the new belt was not completely successful for either. However, it did enable the crewmen to fasten themselves into the litter

NEW LITTER CHAIR BELT

FIGURE 21

chair much more firmly and it did much to alleviate the situation at both the litter chair and the BMMD. One of the SL-4 crewmen commented that the M-131 belt was a problem, but this may have been due to the fact that the chair position (90 degree body bend at the hip) was difficult to attain and hold.

In summary, it appears that chairs and seats should not be used in zero-g for body restraint. If such a device is absolutely required for an experiment, the straps to hold the crewmen should be readily adjustable and provide firm, positive restraint.

The following references refer to the problems with the lap belts and chair-type restraints.

References	Appendix Page Number
3	3
4	4
5	7
6	8
7	12
12	23
13	24
14	26
15	29
18	41
19	45

References	Appendix Page Number
20	48
26	59
28	65
29	69
31	78
32	79
33	81

CONCLUSIONS AND RECOMMENDATIONS

1. The ATM chair was used very little as a chair. At best, it provided a "nook" from which the SL-2 crewmen could operate the ATM panel. It was not used or needed by the subsequent crewmen.

2. The thigh restraints required some degree of foot restraints to be satisfactory. However, with good foot restraints, thigh restraints are not needed.

3. The ergometer restraint harness, when rigged properly, was reasonably successful. However, it was not needed with the elongated handlebars.

4. When crewmen are required to be positioned precisely and securely into or onto a piece of equipment such as the Body Mass Measuring Device or the Litter Chair, adjustable body restraint straps that provide a firm, positive holding force must be used.

5. Chair-type body restraints should be avoided for zero-g operations.

6. If properly designed work stations are provided with adequate foot restraints, additional body restraints are not required.

RAW DATA APPENDIX

Reference 1

Dump Tape 149-14 (Final)
Time: 17:16:40 to 17:41:25

17 16 40 SPT For M171 run on the CDR, the postrun values percent O_2 71.14, 7 1 1 4. Percent water 6.06 6 0 6, percent CO_2 193, 1.93.

17 41 25 CDR Hello, friendly B channel. This is for M171; the CDR. On my run today, the only way I could ride the bike halfway efficiently was to move the seat all the way forward, and I jacked up the seat height to - I jacked the seat height up to number 6. And that puts my legs much more directly, or my hip much more directly over the pedals, and then I take the load, up-load through the harness on my hips and my shoulders. Okay, the first step, 55 watts, and the next step, 105 watts were nothing, and my heart rate did get as high as it normally does on ground. But the 155 was just like finishing up the 200-watt, 20 minute protocol that we had; I was really running out of gas. And yet, I was using muscles that I don't normally use down on the ground, so I don't know whether I'm going to get more efficient or less efficient or what's going to happen. So take it for what it's worth. End of MO - M171 message.

END OF TAPE

Reference 2

Final
TAG Tape 151-01
Time: 01:23:04 to 02:02:01
Page 6 of 7

	CDR	Okay. I think we got it now. The downlink portion of the Evening Status Report is not on B channel yet, because the PLT and the CDR haven't finished their exercise. We are - I'm on the bike right now just getting ready to start. And PLT is going to exercise also. So, that'll be a little late coming down.
	CC	Roger. Understand. And one thing, Pete. Have you had a chance yet to look at S019 any?
	CDR	No, I didn't - I didn't get to it. And we'll just wait until we get your instructions tomorrow.
	CC	Roger that, Pete.
01 56 56	CDR	What - what we've been doing, Dick, is the SPT has been trying to work out better geometry for his ... on the bike. And I think we're all trying to do that. We're - we're juggling around with this thing, trying to find the best way to ride it up here. And it's not at all appearing that - that each guy is going to come up with the same basic way of fixing whatever the problem is.
01 57 25	CC	Okay. Understand. And stand by 1.
01 58 24	CC	And, Skylab; Houston. We're taking a good look at the ATM configuration, since we're going to be doing unattended ops all evening. And we notice that both H-alpha doors, our TM indicates that they're open, and also the S054 exposure setting is 64 ... 256. So we would like to make sure that we go real carefully down unattended ops cue card on the ATM this evening. Also, be advised that during the evening, we will be putting together e - evening questions - a set of questions from today's operation. So sometime tomorrow, if you get a chance, you might go through them and put them on the tape recorder. We've still got about 3 minutes left in this pass, and I'm standing by.
01 59 12	CDR	Okay, we'll - we'll recheck the H-alpha 1 and 2 doors ... check on ... 54.
	CC	Okay. Thank you much.
	PLT	That's already ... That's my fault.

convinced, gives you it's own frame of reference all the time, but in zero g this frame of reference is up there on left to right reference frame; changes any time you want it to change. And it does not occur to be influenced by the vestibular system. Answer to number 4 is no.

16 33 34 SPT Number 5 is a very good question, because in the OGI mode yesterday, both the PLT and myself noticed that the very low settings for line target appeared to move slowly back and forth with a period of 1 to 2 seconds. I noticed today that the same thing occurred, and obviously it's a - not related to rotation. It's a drift that we have where headed steady here at zero g - It's a left-right, left-right, 1 to 2 second, small amplitude, but noticeable calculation. And number 6, no additional comment. Oh, yes, I do have one. In the litter mode, since one is strapped to the litter only by a very inadequate Velcro strap around the chest; you tend to flack, to jackknife, and it's very difficult to keep straight and to keep down on the - on the chair. When you get a ... in your litter mode data, would you mind - keep in mind that the internal frame of reference might not be parallel to the litter, but at some angle to it.

SPT Okay, tape recorder, here's the data from the SPT's M131-2 run, table 1. I'll read pitch and then roll for each of the ten steps. Table 1: 8.5, 304.5; 0, 303.6; 1.5, 304.0; 1.5, 306.3; 3.0, 304.0; 13.5, 299.2; 11.5, 304.3; 6.0, 300.7; 7.0, 301.4; 4.0, 304.8.

SPT Table 2. 197, 183; 207, 183; 206, 185; 212, 180; 215, 180; 215, 186; 221, 184; 224, 185; 222, 180; 222, 176.

SPT Okay, table 3. Are you hanging in there with me, kids? 213, 186; 218, 187; 219, 185; 218, 183; 218, 186; 220, 187; 226, 189; 221, 187; 220, 187; 213, 191.

SPT Table number 4: 4.0, 305.7; 3.0, 302.0; 0.0, 304.8; 7.0, 304.6; 10.0, 304.0; 10.0, 309.0; 5.0, 311.1; 3.0, 312.0; 6.0, 308.1; 13.0, 306.7.

16 40 38 SPT There's got to be a better way to do this stuff for your sake and mine. Right?

Reference 4

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

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

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

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

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

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

19 19 37 PLT Okay. Pressing on to page 3-4, food management. The wardroom table is, as far as an eating station, is very nice. Just like training. The thigh restraints I use two ways: either as designed or I also hook

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

19 23 20 PLT Okay, tape recorder. I find that for I don't know how long I've been holding the record switch up on this COMM box instead of the intercom box. Hopefully, (cough) I got the run down on work restraints. I got page 3-3 on there. I'll do page 3-4 over again. The wardroom table is convenient. It's - we've been using it just as we have in training. The thigh restraints I use two ways. One is to put my legs in in the ... method. The other is I hook my knees over the innermost of the two crossmembers and with light toe pressure against the work table pedestal, I maintain position that way. The foot restraint - for either the straps or the triangle fittings I haven't been using at all. Food reconstitution dispenser: those water dispensers need some kind of handhold in their vicinity.

19 24 16 PLT It's fairly difficult to press down on it, especially a juice bag, which is filling and unpleating it's accordian style at the same time. I think we need some sort of small fingerhold not a handhold, right around those water dispensers. The water gun works, as I suppose you know, it's easy to use. It takes about three shots of water before you get chilled water, but that's all right. The food tray has worked out fine. The beverage dispensers are too small. Each accordian dispenser that you put in there for each accordian container we put in there seems to be around 1.05 times as big as the drawer's design. The drawers need to be about 10 percent bigger than they are. They're hard to open, hard to close, hard to get drinks in and out of. The freezing dispenser has worked fine. The eating utensils have worked fine. It is a necessity that they be held in place magnetically. The teaspoon, I still think, is too small. Although I have brought my large spoon down out of the command module. The miscellaneous column, the sleep restraint is extremely useful, versatile, and very good, I think. You can

Reference 5

Final
TAG Tape 192-11
Time: 19:21:02 to 20:52:46
Page 1 of 5

SKYLAB AIR-GROUND VOICE TRANSCRIPTION

19 21 02	PLT	Sorry about that. The - (laughter) - the Doctor took off, but unfortunately he had his - the TV Power cable wrapped around his ankle.
	CC	(Laughter) Okay. Hey, the people on the ground can see some variation in the vehicle axis when you push off.
	PLT	They really can? Is that right?
	CC	That's affirm. Bet you never thought you'd really fly without wings, did you?
	PLT	We have - we have one of three responses here. One of them was incredible. The other two I'll have to let you figure out.
	CC	(Laughter) That was about 0.2 of a degree in X when you were running that foot race.
	CC	Hey, Joe. Did it turn out that you needed the straps in the chair or not?
	SPT	Yes, we did, Bill.
	CC	Copy. Does - do they hold you pretty firmly?
	SPT	Well, of course they only hold you well if you push up against them real hard. But so far, we haven't had any difficulty. One wishes, in retrospect, that those straps and also the straps on the M131 chair, and also the strap in the fecal compartment had positive buc - buckles on them, like the ATM chair, but yours are working.
	CC	That's the way they were originally designed.
	SPT	Yes.
	SPT	Incidently, I don't know whether we said this before, but we - we owe our thanks, appreciation, and awe to the - the people who designed the waste management system. And it's worked much better than anticipated; and it's been essentially trouble

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

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

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

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

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

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

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

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

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

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

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

CDR Roger.

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

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

SPT Hi, Paul.

PLT Hi, Joe.

PLT We got to talk - -

16 41 31 CDR At this time, as of yet, I have not had an opportunity to evaluate the conical shoe cleats

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

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

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

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

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

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

Reference 8

Final
TAG Tape 155-06
Time: 14:47:02 to 15:57:47
Page 1 of 8

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

14 47 02	CC	Skylab, Houston. AOS for 9 minutes.
14 50 03	CC	Skylab, Houston. The power load has been less than expected this morning, and because of that, we have not powered down the coolant loop and do not presently plan to do that. If this status changes, we will notify you.
14 56 07	CC	Skylab, we're going LOS in about 30 seconds. We will see you at Hawaii at 15:09. Also, we will be dumping the tape recorder at that time.
	SPT	Okay, Houston.
	SPT	Okay, Houston; be advised in the process of attempting to tweak up the visible alignment of S192, which there is no way you can do without putting loads on that whole assembly; I've lost the thermal alignment. I've gone back and starting this procedure over again to see if I can find it.
14 56 47	CC	We copy that.
15 10 00	CC	Skylab, Houston; AOS 6 minutes.
	SPT	Hello, Houston.
	CC	Go ahead, Skylab.
	SPT	Okay, this is the SPT. Are y'all ready for me to inhibit the TACS this morning?
	CC	That's affirmative, Joe.
	SPT	Okay. That'll be in work momentarily. Meanwhile, I'd like to tell you about some progress we've made in riding the bicycle, so you can pass it along to the M171 PIs.
	CC	Okay.

SPT	For their consideration in determining our protocol, we have discovered - we have made an amazing breakthrough, that the - stand by 1. That if you run the bicycle with no restraints at all, you can almost achieve your groundwork protocol. And we'd very much like to let the PIs get - for the PIs to let us run one more M171 protocol at our nominal rate to see what happens. Over.
CC	We copy that, Joe. How far are you haveing to lean forward? Can you say a bit about your technique?
SPT	Okay. Well, there's three things to do with your hands. Obviously they're going to take up part of the strain. One is to put them on the pedals - I mean on the handlebars.
CC	Okay.
SPT	Ideally, the handlebars would be longer than they are now and would kind of sweep down around you, so you could grab them in the right place. Another is to grab the center adjustment strap between your legs and hold on to that. And a third way is to put your hands on the overhead and push. And if you alternate those three, you use different arm and shoulder muscles, and it's really pretty good.
CDR	Hey, Bill?
CC	Go ahead.
CDR	I just ran my flight protocol block 5 minutes of 175 for a total of 20 minutes, and at the end of run, I had a 151 heart rate. And it's much closer to riding the bike on the ground. It's - it's just so much better, it's unbelievable. That restraint really is just a hindrance to you, and we've had to use different buckles in riding it. When you're riding holding on to the handlebars, you're more closely approximating running rather than riding the bicycle. When you ride holding on to the strap with the strap pulled down, it's sort of like - sort of like - you see a cowboy get on a bronc. That's the

		way you're holding yourself on there. Ah - bareback bronc. And when you ride it that way, that uses the muscles in your legs, the absolute closest to the way it is to riding a bike in 1 g on the ground. And when you put your hands over your head, you can adjust your body back and forth to achieve something in between running and riding on the ground.
15 13 13	CC	Thank you very much.
	CC	Hold off on the TACS inhibit until after the EREP pass, Skylab.
	SPT	Okay; will do. And another little note on the bicycle, Bill. We did a little inflight maintenance this morning. With the onboard lubricant, we lubricated the squeaky pedals.
	CC	Copy that, also. How do you feel that a restraint - an over-the-shoulder restraint would work? Do you think this would be more effective - a relatively fixed one that was well padded? Not straps.
	SPT	Oh, it'd be worth a try, Bill. But based on the shoulder restraint we have, the big problem with it is that it interferes with respiration. And the waist restraint interferes with leg motion and circulation.
	CC	We copy that, Joe; and thank you very much.
	SPT	Aye aye.
	CDR	Hey, I think Joe hit the right ticket there when he said a set of handlebars that sweep further back around you, sort of out and around your sides, where you can pull your arms along the vector that you're riding the bike and pedaling it at, which means that your doing - We're obviously expending work through our arms that's showing up in the data, and that's why they're cutting our data back down, in my mind, besides the restraint harness being a hindrance, because you've got to hold yourself down somewhere. So you are expending energy through your arms which is showing up - not showing up in the bike work.

	CC	Copy that, Pete.
	CDR	But you sure expend the least doing it the way Joe just described.
	CC	And we'll pass this on and get you a word back. And we're going LOS here in about 1 minute. We'll see you at Goldstone at 15:22.
	CREW	Roger.
15 21 13	CC	Skylab, Houston; AOS for 5 minutes.
	PLT	Roger.
	PLT	Houston, you got nothing else right now. Let me give the EREP guys a couple words on this alignment jazz.
	CC	They're pretty interested. Go ahead, Paul.
	PLT	Apparently, as you try to make these adjustments, which are tight, the visible and align adjustments you cannot make without deflecting the cooler in the optical ... But apparently what happens over a period of 5 to 10 minutes, that with the vibration of the pump in, is the thing settles back. Now, I'd lost the thermal, I started the search procedure on the pad over again, found it again; I got 42 of the 45 percent back. That's where it's going to stay. I'm trying to get a nice focus on the visible. I'd blown the whole stinking visible, and it was down to nothing on the right, and 30 on the left. And while I was finding the thermal again, I looked back to visible, and it was back up to 80 on the left. So it's all kind of a mystery. The machine seems to run itself; it gives you an alignment if it wants to. Right now, I'm using the drink-it-up-and-go-away-for-3-minutes routine; and, hopefully, we'll have some fairly good readings for this run today.
15 22 54	CC	Copy that.
	SPT	Houston, SPT.
	CC	Go, SPT.

Reference 9

Final
TAG Tape 155-10
Time: 20:47:08 to 21:53:53

SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

20 47 08	SPT	Houston, are you there?
	CC	We're still here. Go ahead.
	SPT	This is SPT. We're back on the PRIMARY FINE SUN SENSOR.
	CC	Copy, SPT.
	SPT	Just drove the thing straight up, about a ra - a half a radius up to edge of the limb, and she turned around and started coming back in.
20 47 30	CC	Copy. And, Skylab; we will be LOS in about a minute. We will see you in Hawaii at 21:48, yet. And a couple of questions. Did you have any problems cleaning the solonoid vents screens? Also, the tape recorder will be dumped over Hawaii on this next pass.
	SPT	The answer is negative.
	CC	Copy.
21 46 44	CC	Skylab, Houston. AOS 6 minutes.
	PLT	Hello.
	PLT	Hey, Houston, this is PLT.
	CC	Go, PLT.
21 46 55	PLT	Okay. For whatever it's worth, after we finished the M093, and out new free-form style of riding the bicycle, I rode my standard preflight protocol at the end of the second step, that is after 10 minutes, my heart rate was 130, 130. At the end of the third step, after 15 minutes, my heart rate was 153.
	CC	We copy that, Paul. Thank you.
	CC	Paul, while we're on that subject, the biomeds here want you to go in the unrestrained mode in the future on 171. That's all, crew.

PLT — Yes, I really think - today's the first day I tried it out, Bill. And during the 93 part, I was really, you know, trying different positions, so I - I probably got my heart rate up a little higher. I don't even know what - what I've been running on that. But surprisingly, it's a revelation. It really is to me, this being my first time, that it's so much easier than strapping yourself down. You're fighting the straps as much as you're working the bicycle I think, with - with all those - that paraphernalia we had on.

CC — Okay. We copy, Paul. Was there anything in particular about the straps that was giving you trouble?

PLT — Well, I'd say yes. In forcing myself down on the seat, I felt that I really had to pull down on that front restraint, the one that's got the parachute cone on it. And in so doing, the - the bottom edge of that weight belt dug into - into my leg just about the femoral artery there, and I felt that it was interfering with good circulation to the leg. Plus, the shoulder straps down tight interferes with respiration.

CC — Copy, Paul. Thank you.

CDR — Hey, Houston. I got a mystery for you.

CC — Go ahead, CDR.

CDR — I was just cruising through the middle of the OWS and I came across a DAC, that's a Delta, Alfa, Charlie fuse floating. And so, I just got a search throughout the vehicle - all four cameras that are out, rest of the cameras that are stowed, and the DAC fuse supply, and they're all accounted for. So, my question is, and it may have been reported, it may be not reported, I think somebody must have dropped one in the vehicle during tests, and it's just finally made its way out. At least I hope so, or we've got a pregnant DAC fuse around here that's not fessing up.

CC — Hey, Pete, is that the only loose item you found?

Final
Dump Tape 157-13
Time: 21:00:05 to 21:35:01
Page 2 of 4

21 18 11 CDR MARK.

CDR Stand by for the start of exposure. 270, exposure on star field 597, stand by -

21 19 06 CDR MARK. Start of exposure on star field 597.

21 20 15 SPT Friendly B channel, this is the SPT, at 21:20, debriefing the M171 run. The run went very well subjectively from a standpoint of restraint and difficulty, using no restraints at all. Now, when I do this I personally have different ways to use my arms. Number 1 is to let my body go up until my head is touching the wire channel near the speaker box on the ceiling and then I put my arms forard to that - in the grid and more or less balance and act as sway breakers. They don't take up much load. The other way is to hold on to the forward adjustment strap, and the third way is to hold on to the handlebars. I alternate the three ways so as to take the strain on different muscles, it works very nicely. Along these lines I would strongly recommend that the oncoming crews start now to train on a horizontal bike, where they will get this kind of lull. You have to bicycle on the wall and have a flat bed adjustable up and down so as to give the guy the right seat location. And it will slide in and out freely on wheels or something for them. They ought to train that way because it will train the right muscles and give somebody an idea of what the problem is. You might want - even want to take some baseline data that way if the guys have time. Okay. On the run itself, there were a couple of anomalous-looking things. For one, the O_2 consumed, once again, came out consistently and surprisingly lower than the CO_2 produced. And having seen this both ways, I'm inclined to think that this is a calibration drift or an inaccuracy in the machine, particularly after the trouble we had this morning - this afternoon in calibrating it.

21 22 29 PLT ... mark it, just a second.

CDR Okay. Stand by for the mark.

Final
TAG Tape 163-12
Time: 23:00:27 to 23:58:40
Page 2 of 3

Reference 11

		The method being used for ergometer restraint now is nothing. That is, no external devices at all - just the handlebars and the center strap, and, again, you put your head on the ceiling. Everybody uses the same handlebar setting, which is 5; and the seat setting, we're using 77. It really isn't very important, because you don't use the seat. Ideally, you can design some handlebars that would allow you to take the stress in the comfortable position where it didn't exert a pitch torque on your body. But that's dressing, and I don't think that they need anything new. What they need to do is train a little bit on a horizontal bike.
	CC	Joe, do you think it's worth the effort of a simple extension of the handlebars?
	SPT	That'd be nice.
	CC	Copy.
23 21 35	SPT	Question number 3: the SPT's opinions; I'll have the CDR and PLT look these over, and if they differ from me, they can put it on channel B. A - I'm sketching the corona; the other two aren't, and it's been only moderately helpful so far because the - there's not a lot of detail on it, and we can tell that the corona's changing by going back and reviewing our sketches, but the information isn't terribly useful to us. I don't understand part B: rolling of white light coronagraph to identify faint figures. No, we haven't found that helpful. Haven't tried it. H-alpha image does appear to move. It moves quite a bit as sunset approaches, and it lasts a good 10 to 15 seconds. And I expect that your rationale for that is correct.
	SPT	Okay. Is there any difference between the two H-alphas? I think that H-alpha 2 appears to have finer resolution, but that may be just because you can't get as much image magnification with it. There are no major differences. We've seen no pointing jitter other than the electronic jitter th that we described. That's attributal to crew

	CDR	Yes, well, let me answer a couple of them.
	CDR	Question number 2 about EKEP swabs. We got EREP swabs coming out our tape recorder. Swabs coming out our ears.
07 07 24	CC	You've got a big squeal there. What did you say?
	CDR	I say, question number 2, which was how about an inventory EREP tape recording cleaning swabs. We've got those things coming out our ears. Those guys don't need to bring any up on SL-3.
	CC	Okay, copy.
	CDR	And question number 3, the SPT does have all that data in his log book, and he will return it.
	CC	Copy.
	CDR	Number 4, and should the redesign of the waste management compartment foot restraint include acceptance of triangles, mushrooms and bare feet. If they just used a different cloth on the existing ones right now they will accept all of thos anyhow. And it's just that the cloth - it's that cloth that they're using - it's plastic and it just doesn't allow you to open it up or close it down, depending on what you're wearing on your feet at the time. They ought to be softer and longer.
07 09 01	CC	Roger.
	CDR	We do recommend you look for some restraint for the rotating litter chair. What we're using is just a plain old strap up here and it does the job but it's not too suitable. And on S082A, did the flare execute flag indicate flare 082 is operated in the FLARE MODE. To the best of the PLT's knowledge, it did. Got number 7 - well question number 7, I'll have to put on tape. And CDR, 8, what is the status of 553. Wheel 1 is completely done on 553. Wheel 2 has the three balls that are not - that do not come off - done, and two that do come off - done. And I'm ready to return that for them to examine the whole wheel.
	CC	Roger.

Reference 13

Final
Dump Tape 167-12
Time: 13:52:26 to 14:15:58
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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.

KERWIN (CONT'D) the electrode discs. If you didn't do this, the juice would seep out under and around the adhesive portion of the disc and it would ruin the adhesion. The discs would then come off very readily. So, we had to partly dry them and there's an art to that. If you dried them off a little bit too much, then it takes you quite a bit longer to get good contact. You'll notice that in many of our runs, we started the M092 run with high impedences in many of the electrodes. We'd press on because the pulse rates were reasonable, and we'd always have good impedence by the time we got 171. The 93 equipment and the electrode kit. I thought they worked rather well.

M171 equipment. I don't think we have to debrief a lot on the waist belt and shoulder straps. The story of that came down on B channel. We wound up discarding that whole thing and simply using our arms and legs to stabilize ourselves on the bike. I strongly recommend that method. It is true that the handlebars are not in the ideal position nor of the ideal length to give you good support during the run. But, I think they're close enough that we can live with them for the rest of the program. We do recommend to the follow-on crews that they ride the bike, if the equipment for doing so can be made available, in the horizontal position to get used to the

KERWIN (CONT'D) stabilization problem, and also, to get one crack at baseline data before flight.

M131. Stowage was adequate. The rotating litter chair really performed very well throughtout the whole thing. The bottle pressure was good, the controls and displays were good, the chair was very smooth, we never had a runaway problem, and we never had a problem where it wouldn't start. We had occasional tripouts, due to body motions on the chair, and the one outstanding problem there is the restraint of the individual to the chair. You'd find that assuming a sitting position and floating into the chair, the waist belt is grossly inadequate to hold your behind close to the seat of the chair.

The eye goggles were as inadequate inflight as they were pre-flight. They're too small. They were made small so that we could detect color changes in the skin of the individual, and we overkilled the problem. They should have been larger and more comfortable, and easier to block light out with. But they'll do. The otolith test goggles, unfortunately, that whole system was not optimally designed. It is so sensitive to small changes in the angle between the shaft on the bottom of the goggles and the individual's bite board, that it proved impossible, I think, for any of us to bite into the tooth

KERWIN (CONT'D) Concerning the clips on the board of a given wire clip, one side would be flush with the tray and the other side wouldn't. and you had to learn to slip your pads under the side that was flush; otherwise it wouldn't hold.

KERWIN The ATM chair. We finally arrived at a compromise setting for the chair that was acceptable for both Pete and me, with Paul kind of in the middle. I wound up not strapping myself in the chair all the time. You don't really sit at the ATM like you do in one g. Sometimes it was pleasant tc strap your waist in and cinch it up nice and tight and stay that away for a while. It certainly gave you good reach ad a nice stable point. But your muscles would get tired if you stayed that way all the time. It is not like sitting in a chair, where you move around a lot and cross your legs and keep your muscles loose. So sometimes we would be that way. Sometimes you would use the chair simply as a backbrace and you wouldn't use the belt at all. You would slide in, let your thighs ride up against the bottom of the tray, and your backside against the top of the back of the chair and work that way. And sometimes I would work hanging onto the back of the chair with one hand and my body floating straight out perpendicular to the ATM console, operating it that way. You moved around a lot.

PLT: I had the idea that I had to, maybe it's because your knees are relatively high, I had the idea that you really had to get yourself forward this way. That the seat was from wher you wound up with your feet--I think I would have liked the seat to have been higher on the wall and tilted this way a little more.

CDR: Yeah, I, there was, I'm wondering when you get a guy like Jack Lousma on that thing, it it he's really got enough room to get it all sorted out when he gets his feet jammed down in there and everything, because he may be - you almost had the feeling even as small as I am that I was a little crowded in getting in the right position. Paul is right, you hadto pull your body further forward than just perpendicular to the wall and when you did that, your feet were down in the slots you know, in back of the uring drawers and you had the feeling that maybe if they had been a little deeper and you could have gotten your legs down better or you cocked the seat back, I, there was let me tell you I, I gave you the supreme sacrifice, so there are some M-487 movies of your old dad on there operating the system, so--

PLT: W th a towel around his head

CDR: I, I really for analysing the design and what we are trying to say, I think if you'd look at those movies, you'll still become apparent to you what we are talking about. I think it will be of help the next time you put one of those things together.

SP: Well, was there an attempt to kind of get you into a squat position, that's reported to be the best position to be in I was wondering---

PLT: Yeah, I know, but what you really had to do, it took two hands there and a fair amount of force to hold you in that position the squat position is fine but is is a little too accensuated.

SP: Ok

CDR: It's a good thing you had a good, I had a feeling that I was glad the handholds were anchored as good as they were anchored or I Would have pulled them right out of the wall.

PLT: Yes, I used the belt all the time

CDR: Yes I did too and just as tight as I could get it.

SP: Probably the squatting position with one-g you got one-g helping against the springier thighs, where as up there it's tending to go back.

CDR: You got to do it with your arms

SP: In connection with that belt, in the M-487 briefings, I think there was a discussion of the belt and the necessity for the belt. You feel that the belt needs any changing--we made up another one to go up there. Do you--

CDR: No, it, it, I, there was some confusion between there was some confusion over in the Project Office between--they picked up the discussions between the M-131 belt and they said any belt that's got velcro on it, the guys don't think it's satisfactory and that's , is not satisfactory and that's wrong because the M-131 belt was just two pieces of velcro like this and you apply a load and it just pulled apart. Your belt goes thru a loop and covers around that velcro, I had the decided feeling that there was no way I could have pulled that belt apart.

PLT: Of course you had a lot of contact area

CDR: Yeah, you had a lot of contact and that belt worked fine in and and Program Office confused that and I think turned you guys on, on fixing up the Waste Management belt based on the M-131 belt and they are not comparable belts.

SP: I think in Joe's M-487 tape, there is a discussion that the ATM chair belt would be a better fecal collector belt and that might be where some of it came.

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

PLT: Yes, sir

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

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

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

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

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

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

SP: We kind of filled the place up

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

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

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

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

PLT: Yes

SP: You didn't have the tendency to pitch back and forthe on that particularly.

PLT: It wa s controllable, whatever it was, but it was good that it did have that joint in there. That was a good feature, the fact that you could swivel the double cross part.

SP: Would you rather have, if you're getting the tradeoffs on windows, I think we got the message that more and bigger windows, but if you got a choice of larger quantity of smaller windows versus a couple of big windows, which do you think you'd rather see?

PLT: I would rather have more small windows.

CDR: You mean to give you more viewing?

SP: Veiwing angles

CDR: Viewing angles? Yeah, I, we figured out we were going to see more out of the wardroom window as the bet a angle went up, it turned wout we pshyched that one out.

PLT: That's right, we had it completely backwards.

CDR: Getting further and further away rather than the window looking more and more at the earth.

SP: The color scheme of the OWS, was it pretty good, I mean, would you go over that again?

PLT: What was it? Yeah, it didn't make me sick or anything, so

SP: Various shades of beige

PLT: No, the walls were green I guess the sides were that pale green weren't they? (laughter)

CDR: It was all right.We did not miss the seals of the 50 states of the U.S. on the lockers in the wardroom. Oh, I suppose that you could sport it up here and there. We, we of course did not sent TV back to the ground of all our playmates of the years pinned up here and there. We always took them down before we did that.

CONRAD (CONT'D) a lot of those readings, although they probably would be interesting data. Also, it seems to me that, in the simulator, we used to see about 725 cfm on each floor, and they were only reading about 550 in flight.

WEITZ Also, if you turned off one of the four fans in the duct, you'd lose almost half your indicated air flow.

SPEAKER Now that you've had experience with the ATM chair, do you have any design improvements you'd recommend? Do you consider such a device necessary for restraint at a work station like the ATM that requires little motion but long-term activity and concentration?

KERWIN I would say, for the future design, that a chair of that kind is a very specialized tool, and we didn't really use it in zero g like you'd use a chair in one g. Part of the time you'd sit strapped in the chair; part of the time you'd loosen the strap and use the two points of contact, the front of the seat and the top of the back, and kind of wedge yourself into the panel that way. Part of the time you'd hang onto the bsck of the chair with one hand and operate the ATM with the other hand, because it was nice to keep moving and keep the blood circulating. I'm not sure I could sit right down and design it. Something

KERWIN (CONT'D)

like that was nceessary, was certainly highly desirable. You stuck your feet in the blue ring also. That was useful even when you didn't have the strap on.

SPEAKER

I think you've answered the intent of that question.

KERWIN

We didn't try it, but I think it would have been very tedious without the chair.

CONRAD

I operated the chair differently than Joe did. When I operated the ATM, I chinched in the chair. I adjusted the chair to what I thought was the optimum for that panel, but because I'm smaller than these two guys, they couldn't leave it there. I was hoping we'd find a position that would be optimum for everybody, but we couldn't without changing them. So I'd let them change it back, and then I operated in that mode without changing the chair again. The one time that I optimized it for me, I actually respect to the ATM panel, and cinched in pretty tight. I thought we'd get away without having any cushions, but I had a reasonable pressure point on my back. I liked to have the chair, and I would have designed it a little bit more this way facing the panel or tilting it. We did have the capability of doing that, but I just didn't want to change it every time. But I always operated the ATM by strapping

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

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

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

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

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

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

WEITZ (CONT'D)

I went to ATM, I could put on those soft, brown boots and restrain myself perfectly adequately.

CONRAD

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

SPEAKER

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

CONRAD | The TV, yes; but the VTR, no. You have to physically move from the ATM console to get the VTR switch.

SPEAKER | If you weren't strapped in tightly, you wouldn't have to move, would you?

CONRAD | Oh, yes. Yes, you would. It's about 4 or 5 feet away.

KERWIN | We get it in the one g trainer, not in the SLS.

CONRAD | Yes. It's in the SLS on the wall where you can reach it.

KERWIN | On the wall where you can reach it. That's not the way it is on a real vehicle.

SPEAKER | The question having to do with the ATM chair was pointed toward a couple of specific applications that shuttle has included, the manipulator control station, and the payload operation stations.

CONRAD | If you're going to operate panels like this it's unsatisfactory to do it with your feet locked to the floor, especially if you're going to be there for any length of time. I'm still extremely happy that I had the chair.

KERWIN | Yes. And I'll second that.

CONRAD | I never saw the original chair, which was too complicated and slid back and forth. Walt Cunningham got rid of it

CONRAD (CONT'D)

for that reason. I think his reasoning of being able to just float there with your feet hanging in there and operate it was wrong, and I'm glad I changed that position and went the way we did. I would have liked to have had a little padding on the back of that chair and to have been able to tilt it this way, move it in and out and up and down, which is all you have to do with an adjustable chair anyhow. It didn't need to go left or right or anything like that.

SPEAKER Did you tend to find that the general work area served as a maintenance station? Or did you repair various items either online in their use position or at random locations?

CONRAD We took the probe down to the lower experiments area where we had enough room to get all three of us around it. It was also a good place to lock ourselves in while we were working on it. We started out troubleshooting S019 up in the experiments compartment the best that we could, but when it was time to work on that, I believe you took it down to the corner of the experiments area over by that same pile of 600 lockers where the tool boxes are.

	SPT	Actually, the pole dynamics did not get out of hand by any means at all. Jack was very slow and very careful so there was never any appearance of any large angle coning. It was clear that he could have done so if he had wanted to. But he was being careful to avoid it, and what there was, he could easily damp by just holding his hand rigid and that damped out the energy in the pole very quickly.
220 01 39 42	PLT	I think it's also noteworthy to point out that when we lowered the sail down on the parasol, that part on the leading edge of the parasol that was blooming up and not covering the workshop, came down and forward so it exactly covered the - the foil - as if it - as its original intent was.
	CC	Okay, we copy that. That winds up the evening questions. Standing by for any comments from you or I have a news summary I could read up to you in the 4-1/2 minutes remaining at Madrid. The next following station, I'll update you again on this, is Guam for your private medical conference. Over.
220 01 40 27	CDR	Okay. We understand, Bruce. Let me give you one other tidbit. You sent up a message today and wanted to know how we liked the handlebars on the bike.
	CC	Yes, sir.
	CDR	The answer is, we like them real well. The reason is it allows you to position your body relative to the pedals any way you want. You can lean forward and pedal for a while; you can lean back and pedal for a while. If you want to pull up tight you can move into a position where you keep your arms slightly bent. If you want to extend them, you can move to another position. Probably - the thing though is - we've been using a wire tray on the ceiling for a headrest - with - putting some pads between our head and that headrest, without those arm extenders, that would not be possible - or it would be possible but not nearly so convenient. So all in all, I think we've got the riding - the - bike problem licked. We haven't had a bit of trouble riding it.

		We ride it and sometimes we ride it without hands and so - I think they can quit worrying about that one.
220 01 41 32	CC	Okay. We copy your comments and I guess you'd permit us to say that's using the old head. Over.
	CDR	The old what did you ...
	CC	Say again.
	CC	You ready for the news?
	CDR	Go ahead.
220 01 41 50	CC	Okay. Cost of living council has announced that Phase IV plans will allow small companies to boost prices about a month before major firms. Break. A "don't-buy-anything-day" boyscot - boycott sponsored by several consumer groups is floundering. In the beef department the problem is simple, there isn't much to buy. Break. The first phase in the Watergate hearings ended today. The committee will resume hearing testimony sometime in September. Break. The Justice Department is investigating major oil companies who own discount stations that compete directly with independent operators. Scientists report success with the first implanted heart pacemakers that can be recharged weekly through the skin. The rechargeable device is the result, in part, of the space-related technology. I guess that was a commercial. The Agriculture Department reported that the retail food prices could average 20 percent higher this year than in 1972. Federal Power Commission issued a new rate schedule today that will more than double the price of natural gas produced in the Permian Basin. And wheat prices have moved above $4.00 a bushel for the first time in the history of the Chicago Board of Trade; that's a 150-year history.
220 01 42 59	CC	The Commerce Department announced that more than half of the 1973-74 U.S. wheat crop has already been sold for shipment abroad. At Stanford, California, a control experiment showed that children who took massive doses of vitamin C

223 19 24 07 CDR

The tethers, the wrist tethers are good. The wrist tethers are good. The only disadvantage that I can - by the way, I give them a very good - is the way they sometimes - sometimes difficult to get them off your wrist to work them. They're so difficult, in fact, that you tend to once you have it off your wrist to leave it floating free and this could be - a dangerous situation in EVA and certainly gives you an additional - or blinds and hooks and things going around in front of your eye which you know, gives you added trouble when you're trying to - in you're rather clumsy glove and suit work on an EVA problem. How we can do it, I don't know. Maybe they should be somehow fixed so they can be wrapped once around the wrist and then snapped rather simply. But I don't have any answer for that.

223 19 24 57 CDR

ATM seat backrest restraint. Personally, I'd give it a poor. Mostly, not because of the chair itself, because the chair seems okay. It's the fact that when attached to the foot restraint there, the thing wobbles all over and makes noise and just doesn't seem stable enough. Somehow when you attach your foot to the same grid, you don't mind to flop around. I assume that your legs accept it, but when you attach the chair to it, and it flops back and forth by 3 or 4 or 5 degrees, at least in my case, it's very troublesome. I would suggest that this sort of thing would be good if it had more adjustments back and forth and then tilt as it does and particularly so it's affixed to a rather solid foundation. The seat itself is solid. Its attachment to the floor structure of the ATM is good. It's just that the ATM floor structure's rather loose.

223 19 25 57 CDR

Waste management hygiene equipment. Fecal collection equipment - I would have to give a good to that. The reason is - let's - let's talk off this thing just about as ... First of all, it takes time to work. It seems to me there must be a better way to get rid of waste material with putting a bag on, taking a bag off, weighing it, and all that. Now I realize that if those requirements had not come with this design of

223 19 28 34 CDR

Handwasher - good, except that the seal is rather - loose and - it bypasses soapy water just at the wrong time. It'll work 10 times - by the way, I would give the urine collection - I've already classed it. The handwasher, I would only give an adequate. Handwasher - it works right three or four times. The next time you put in a - a wash-cloth and try to work it - it backs up. It squirts out the sides and gets all over the ceiling. This is discouraging and requires time to clean and seems to me we could have doublesealed it and done away with all that trouble. Another problem with the handwasher is it only operates - By the way I'm talking about the hand squeezer at the moment. I'm not talking about the squirter. The squirter I'd give an excellent. It puts out hot water in the right direction. But let's go back to the squeezer.

223 19 29 27 CDR

The squeezer than has small holes at the bottom, so when you're squeezing washrags - And you can-not squeeze towels, and that's a disadvantage. In fact, if those holes get jammed up, I think that's what causes the backflow and also prevents drying the towel. It needs more screens with thicker mesh on the bottom than just a couple of small holes. All in all, the device is - the con-cept is good. And we need something like that in space. It just needs to be enhanced from - a user point of view. Fix it so it won't backsquirt, so it'll do bigger towels, so it'll get almost all the water out. Another disadvantage of the whole business is you have to dump it every night. It would seem to me that these sorts of things could be hooked up almost on a - automatic basis to the vent, so that you - as you squeeze down, it opens a vent and sucks the stuff out and you didn't have to dump the bag. All that takes time and extra work.

223 19 30 26 CDR

Fecal/urine in collector lapstrap and handholds. Handholds are not particularly useful I don't think. Don't use them at all. The lapstrap is so-so, but once again, it's not a positive locker. You need on that lapstrap a belt which you could

pull down and fit yourself tight. I will admit that it's nice, that's it's fairly easy to get on, but it still leaves you the feeling that in just a few minutes, you're going to float off and then you're going to be in trouble.

223 19 30 51 CDR

Waste management compartment hand washer and handrail - good easy to lock. I'd give it an excellent. Waste management ... ceiling handrail, same. Excellent, easy to lock. Waste management compartment light-duty foot restraints, poor. They're in front of the urine system. They will restrain you. The whole bathroom needs a little work on restraints. I think one of the best things that could be done is somehow making our restraints to the floor - when you're just taking the urine system and raise it off the floor by 6 inches, it would work just as well and everything would have been just right. The - I notice that when I'm doing the fecal operation, the place I put my feet is right behind the urine trays. There's a little well in there. You can put your feet in the well and then put your toes under the lip, and that works out superbly. And it seems to me that some sort of a little lip like that could have been placed in front of the urine system and then that'll end part of the - of the whole waste management compartment. You could float in there and use it.

223 19 31 54 CDR

Drying stations. They seem to dry the towels adequately although they float around. I have the feeling that I could use four and wish that they were further apart, but once again that's a constraint of space. In any event, they seem to work real well. The shower we have not used. Give you an evaluation later. Personal hygiene kit. I like it so-so. I think that - taking things out of out of the little kit all the time is a pain. We should of have attached Velcro to each item and then we could have taken the ones out of the kit that we wanted, put in our - with all the Velcro that's in there, which is an excellent idea. I've done some of my items that way, but some I have not. And that way you could reach in there and get them without taking out the box. Another thought on the box is that it's way too safely designed to

223 19 34 49 CDR — Another - the trays themselves are excellent. The - the we'll probably get to that in a few minutes. Let's - let's - That's - general talk.

223 19 34 59 CDR — Let's talk about thigh restraints. Thigh restraints are good. They're able to adjust tightly enough and at angles that are pleasing to the individual. I don't think they're exceptionally good without the - foot restraints because they're very small and you can't get a torque off of them. I think they might be improved if you put the front part of the foot restraint - of the thigh restraint and made it not longer, but wider. In other words, so it covers more of the - of the thigh up and down. Which would give you a place to torque off of, allow you to move around a little bit easier. But, all in all, I would have to rate those as a adequate - wardroom table, I would rate as a very good.

223 19 35 45 CDR — Wardroom light-duty food restraints, very poor. Very seldom does the food stick just right because the cloth that's over the cans is the size of the opening. I found that you can squeeze the cans a little bit and make them concentric and they'll stick pretty well. There are no other light-duty foot [sic] restraints except putting on the Velcro, which we did. Now it seems to me that we need maybe a spring on each side and some Velcro around it - in intelligent places so that we could - slap the - the - our drinks and eats on the table without always having to put them inside. In addition, when the cover goes on, it's difficult to attach anything to the table and - for example, the magnetic feature doesn't seem to work on the box. So that needs to be enhanced a little more to make it as simple as possible. Also we need a nice stowage place for the knife, fork, and spoon on the tray or - The one we've got now is plastic and it takes you forever to get it in there and when it's in there, it doesn't come out right.

223 19 36 52 CDR — Water gun seems adequate, fits good, puts out the right amount out and it's easy, too. I'd have to admit the water gun's good. I would tend to make a bigger rubber flap on it from the point of view that every once in a while you hit your teeth

a good possibility that they could get loose and zap you in the eye. I like the ones that come in the command module much better. The ones that were with the workshop are - could be dangerous type of bungee. And I am always very cautious when I use them. I prefer not to be around them. We've got them mounted all over, particularly on the front of the lockers in the wardroom to hold down anything - checklist, maps, camera, flight plan, food bundles, extra drinks, that is. Just anything that you might want to hold down. My suggestion there is the next time we go around we ought to build some bungees right in a lot of places like that so we can hold things down without having to get portable bungees. Obviously we're going to need them, so we ought to have them built right on the doors. Universal mounts are - the only thing I don't like about universal mounts is that the blocking - lock and lever is not over center. It should be further over center.

223 23 18 12 PLT

ATM seat/backrest restraint, I haven't used. I don't think anybody has except for maybe right at first. We find it just as convenient to strap - or to fix ourselves at the ATM with our feet. So, we're not using the ATM seat/backrest restraint.

223 23 18 28 PLT

Waste management/hygiene equipment is the next subject. Fecal collection equipment; I rate that very good to excellent. The only drawback to the fecal collection business is that it's too much of a nuisance to fill a new bag. There should be a better way of fastening a bag on there - a lot quicker. It takes you about 30 seconds to relieve yourself fecalwise and about 10 minutes to take care of all the logging and putting the thing in the heater and taking the one in there out, securing that and then putting a new fecal collection bag in.

223 23 19 12 PLT

Urine collection equipment works very well, also. Don't - Haven't had any spills; blowers all work good. It's a - just a great system. It's no fuss, no muss. There's some way we could save time in taking samples and changing bags and so forth, that'd be a plus for that system but as it is, it's pretty good.

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

time - even when we're vacuuming. And the vacuum will take the - the stuff off the screen even though the - that fan up there is running.

223 23 25 11 PLT Okay, next page, food management equipment. Wardroom table, I gave that an excellent. That's - Everything works very well there. We always have the table top stowed up above.

223 23 25 25 PLT The thigh restraints, I give them excellent, also. I use them every time I'm there. The wardroom light-duty foot restraints; they're pretty so-so. I give them adequate, I guess. They come out of their slots and they're a real bugger to put back in. So I've got one that's hanging out now and I'm just using the left foot at the moment until I get around to getting a screwdriver or something to stick those back in with. I - I use primarily the - the cutout for the triangle shoes because that's what I've got on most of the time. And I use a triangle shoe cutout and a thigh restraint for stabilization at the wardroom.

223 23 26 08 PLT Food reconstitution dispenser works real well. I haven't had any major spills; they've been charging up and dispensing satisfactorily.

223 23 26 20 PLT The watergun is a good device also. I have no complaints about it at all.

223 23 26 25 PLT The food tray, I got no complaints about that either. And we had to put a little Velcro on top of it to hold our drinks down, but the food tray seems to work very good.

223 23 26 34 PLT Food cans, they - they're working all right, too. I noticed, however, that when you take a can out of the freezer, like frozen meat or ice cream, and you immediately try to tear the lid off, why instead - what happens is the little key pull off without tearing the lid off. I guess temperature's down there sufficiently so a little force on there will peel the aluminum and the key comes off. I noticed that if you let them warm up a little bit, why, they work better.

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

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

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

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

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

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

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

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

Reference 21

TAG Tape 232-04/T-284
Time: 232:11:59 to 232:13:30
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SKYLAB AIR-TO-GROUND VOICE TRANSCRIPTION

	232 12 06 00	CC	Skylab, we're AOS Goldstone and Texas for 14 minutes.
		SPT	Okay, fine Story. And, have any rea-tile - real-time TV down-link or what are your plans this orbit?
		CC	We'll take real time on that, Owen.
		SPT	Okay. Looks like it'll be a couple of minutes before I've got any ATM pictures for you.
		CC	Okay. And, CDR; Houston.
23	232 12 06 54	CDR	Hey, Story, did I mention to you the other day that I tried your harness on the ergometer?
		CC	It was passed on to me, Al.
		CDR	Yes, it worked okay. They - apparently somewhere in the manufacture they doubled up some straps that go through that little elongated loop at the front, and it doesn't fit in there too well, so I don't think the SL 2 group could fit it in there just right. I removed it from there and put it on and it worked real well. It stabilizes you. You don't wobble from side to side. You don't have to hold yourself down; worked real good. I'm not sure that now that we've got these super handle bars that reach all the way around, you really need it that much. But it sure does do the job for what it was designed. You don't have to strain, just stand there and pedal and use your legs.
	232 12 07 48	CC	Okay, thanks. I put enough parabolas on that thing. In about 2 minutes, you'll be passing close to a 6000-acre forest fire in Oregon, and 2 minutes beyond that there is a 26,000-acre forest fire in California. You might be looking out STS window number 1.
		PLT	Do we pass over the storm on this rev, Story?

Reference 22

Final Dump Tape 235-01/D-275
Time: 235:00:03 to 235:02:10

235 00 03 17 SPT	This is the SPT on channel A with a message for Story Musgrave - Dr. Musgrave, Dr. Bill Thornton, Drs. Rammel and Michel; I think would be the four most interested in it. The message relates to use of the restraint harness which Story designed for work with the ergometer. And which is - not been very much service to date. Alan Bean rode just - with it yesterday and made comments which he transferred down on the real-time link already to the extent that it works pretty well for him.
235 00 03 55 SPT	In my own case today, I just got through more or less running my standard protocol, which I've been doing for the last, oh, 10 - week or 10 days. I start off with 100 watts for 2 minutes; 125 watts for 3 minutes; 150 watts for 25 minutes; about 4350 watt-minutes over a period of half an hour. Now I found that using the restraint system, I could not have delivered that much work without the use of my arms.
235 00 04 26 SPT	But let me go back to step and explain what I normally do. Normally, I sort of divide the upward force between my head and my arms. And my torso position, relative to the padals, is about the same as in riding a bicycle in one g. In other words, the line up vertically through the padals goes in front of my pelvis, and would more or less interset my chest if I were bending over the wheels a little bit. Now on the ergometer, with the re - harness system the way it is, Al has already mentioned that somebody put a tripler on that front strap that goes down in front of the crotch and attaches right in front of the bicycle seat. And that tripler makes the material so think that it will not fit into the slot.
235 00 05 20 SPT	And so, therefore, there is no way to restrain your waist harness back to the seat, and when you pedal without your hands on the handlebars and you pill up that restraint system in the front and the back, it pulls your pelvis too far forward over the pedals. And as a result, my pelvis was too far forward and my shoulders were too far back with respect to the pedals and I could get a good angle for the delivery of work into the pedals.

235 00 05 54 SPT

So what I ended up having to do, I did not use my head on the overhead, but I did have to use my arms forward on the handlebars to pull my chest forward. And this allowed my pelvis to sort of pivot back and again place my torso in a - in sort of a normal relationship to the bicycle pedals. And I then delivered the standard amount of work that I've mentioned before, although my heart rate was a little bit higher, say 3 to 5 beats per minute higher today when I finished than it was yesterday.

235 00 06 28 SPT

A number of times I tried releasing my grip on the handlebars and each time I did so, my pelvis rotated forward, my shoulders back, and the load on my legs became very significantly harder. I - I don't know whether 50 percent is the right term, but it was a lot more work for me to deliver - to deliver the necessary torque to the handlebar - to the pedals, when I released my hands from the handlebars. I wasn't doing all that much work with my arms. They weren't under a lot of tension, but it was just enough force to pull my shoulders forward and get my body at the right angle with respect of the pedals.

235 00 07 02 SPT

And so I really think that there's nothing basically wrong with the restraints, except that it can't be used exactly the way you had it designed, Story. Particularly, it just doesn't place your body at the right angle with respect to the - to the pedals.

235 00 07 22 SPT

Now, it's been mentioned to me that our heart rates are a little higher and our respiration was a little faster here. I suggested yesterday that that might be due to the extra compression on the chest when we put our head on the overhead and pushed down. Now if that should be true, then the harness system has the same objection because you are placing your upper body under compression with those shoulder harnesses as - as you pedal. So that's just sort of a second order thing right now, I guess. The first thing is to make the harness, to see if it'll work. But it did occur to me that my shoulders and chest were under some fair amount of compression as I was pedaling within the harness. So perhaps that's of some use to you, Story, and might shed a little more light on some of the difficulties the SL-2 crew had discussed or had when they tried to use the harness system.

malarky. You should either do one or the other and forget it because four times over one area to get it clean is - is a dumb way to go and it's one of the reasons we don't do more cleaning than we do.

239 01 56 47 PLT One of the best ways to get things wiped up around here, I've noticed, just take a wet rag and go around and wipe them up. When I wiped down the walls - especially in the wardroom food gets loose. You open up some of these cans and - and the little drops go flying all around and they stick all over you and you get spots of juice and other kinds of food sticking to the ... the refrigerators and to the food lockers, and the best way to get them off is just take a wet rag and wipe them down. And all this baloney about - about soaping a place and then rinsing it, then biociding it, then rinsing it again is just too much trouble with it.

239 01 57 28 PLT Some of it doesn't get done and we'd probably do more of it - more cleaning if we didn't have to go through this kind of waste - make-work waste-time procedure. Okay. How adeuqate is the ATM chair? Never use it; don't need it; and it's sitting back in the corner somewhere out of the way. And it's - To be honest with you, more in the way than anything else. I guess somebody - some guys may like it, but nobody in this flight ever uses it. So I can't comment on that too much since I haven't used it. I used the shoe grids only. Toebar, I don't - never noticed it was in there.

239 01 58 08 CDR It's on the chair.

239 01 58 10 PLT Well, it's on the chair, so that's why I never noticed it. Don't use the chair anywhere at all. So I don't have any improvement to recommend other than finding a good place to stow it that's out of the way.

239 01 58 20 PLT How come?

CDR ... (Laughter) Put a handle on it and ... (laughter).

Reference 24

Final Dump Tape 239-02/D-310
Time: 239:02:45 to 239:03:00
Page 1 of 3

239 02 46 47 CDR — This is the CDR and this information goes to EGIL. I've just performed the - housekeeping task for tomorrow called - 14G, which concerns how the water iodine concentration is in coming out of the chiller. Answer: 3-1/2 parts per million, 3.5 parts per million.

239 02 47 09 CDR — CDR out. That goes to EGIL.

239 02 52 47 SPT — Okay. M487-2 Bravo. This is the SPT. How adaptable are the various compartments to multiuses beyond their prime design function? I think it's already been mentioned that all of our tasks have already been designed for. We have very little free time to spend elsewhere. And so, if they even fit their prime design function that's doing well enough. And they don't need to be multiused. This window, I presume Al has commented on the fact that it does need to be designed where you can look at it from any angle. Might have been better to put it up in the - above the experiment level so that there was more room vertically, that is along the X-axis, because if you can orient your body in any direction, it would have been a very good multiuse facility. And the dome area is probably the only thing that deserves the word multiuse because you do everything else up there that requires a little bit of room where - some of our TV staging used to go on.

239 02 53 46 SPT — Sleep restraints have been quite adequate. Useful for nothing else.

239 02 53 52 SPT — Noneating uses? Essentially, nothing. Design mod, desirable. We need some restraints that work for our feet. The thigh restraints, I do use; foot restraints are almost useless because they don't fit the right thing. There is a place for the triangle shoes. It's the one clip in which I put my foot that almost invariably gets the triangle cocked. You put in there, and then you pull out, and if the triangle is half cocked, then you nearly - you have to arrest it by your fingers to get it turned around. So the one thing that might of been useful, turned out to be a hindrance for me.

239 02 54 23 SPT Sanitation problems: Really nothing. I think Al surely mentioned the place for food waste - dumping these cans and things like that.

239 02 54 35 SPT Personal hygiene: Well, I'm annoyed because there's no place to brush my teeth. I get around that by just sort of brushing them in water and chewing gum. I'm annoyed because I can't wash my hair very well. There's no place that you can really scrub your head down. I tried it a little bit with that soap for the showers, and that's no good. Should have had shampoo, and I think Jack mentioned that.

239 02 55 13 SPT It might be possible to put a little bag over your - top of your head sort of like a woman's - hairnet or dryer enclosure. And you put a little water and soap in and then just, you know, right - reach right through that to scrub your scalp. That might work and then you could squirt water in there and somehow get the water out. Anyway, a possibility.

239 02 55 41 SPT How adequate the ATM chair? (Chuckle) I needed it once and sat in it and found that it - it didn't fit at all. The grid to put your feet through is far better. Toebar, didn't even know there was one. No, we've never used the chair, we just got to find a better place to stow it, as Jack said.

239 02 56 06 SPT Garments are pretty comfortable. I haven't modified any of them. Too bad that the knife [sic] won't hold the knife; too small, slightly. Too bad the - no place to put the scissors. Sort of handy to have those scissors along. But it seems that every time you use them you got to unroll them because there's no place to - keep that string rolled up. I'm not quite sure what we ought to say on that - on the scissors. I just toss them in one of my pockets.

239 02 56 52 SPT The trousers do not doff easily enough because of the triangle shoes. You do need to hop in and out of your trousers every now and then. And it would be better if probably they didn't have that cuff in the bottom. I am going to try cutting mine out for a while. No, they don't wear; they don't abrade; they don't snag.

pretty well. And then of a faint aurora at 19:34 and 19:35. I don't have here the frame number on that. It would have been right after - oh, in the fifties. But the point I want to make is I've got an awful lot of auroral photography, now - at this point, presumably related to that activity on the Sun about a week ago. And most of it is on two cassettes, CI103 and CI104.

257 20 33 58 SPT

I've already sent a short note to Dick Underwood to let him know that these two cassettes in particular will need some special handling in order to be developed - at least these frames developed, at their maximum possible ASA. Because it is this slower CI film which I understand can't be developed further, as if it were - or develop it in such a way that it will correspond to a higher ASA rating.

257 20 34 28 SPT

So particularly, Wally, I wanted to alert you to that and make sure you relayed any groundwork that might be necessary to assure that these two cassettes and any others with auroral photography get special handling.

257 20 34 42 SPT

End of message relating to auroral photography for the S063 PIs, Wally Teague and Jack Lew, from the SPT.

257 20 35 05 SPT

This is a message to Ed Gibson, Bill Pogue, Jerry Carr. Info also to Ed Michel and John Rummel at the physiology laboratory. Let's go there, fellows. It shouldn't be too much longer now. Those fellows are up there on the bicycle. And that's what I wanted to mention to you, briefly. You may of noticed that we're putting out quite a few watt-minutes on the ergometer. And, as a matter of fact, we're putting them out at lower heart rates than we were a month and 6 weeks ago. There are a couple of reasons for that - for this - that - several of them I wanted to mention to you. First of all, there's a different way of riding the bicycle up here than there in is one g. And parts of it you can begin to per - practice down there in one g. Al Bean was the first to discover this.

257 20 36 03 SPT

And, of course, a professional bicyclist probably would have known it all along. But I guess it's called ankling. And the idea is that you apply a fair amount of a torque on the upstroke in - in addition to the downstroke. I've never bicycled that way and the appropriate muscles were probably never used. I don't think they're used extensively in running, or at least not as extensively as in bicycling. And you find up here than ankling - if that's the right word - at any rate, applying torque on the upstroke is a very big improvement - results in a big improvement in your ability to pedal this ergometer.

257 20 36 44 SPT

Now, I'd suggest that you be working out on the bicycle at least 2 or 3 days a week over there. And then, in addition to just putting out a lot of watts, that you also get in the habit of applying as much of the torque as possible on the upstroke. Al pointed it out to me after a couple or 3 weeks, and I tried it. Thought my legs couldn't deliver very much work that way, but kept at it for the next couple of weeks and found that those muscles do shape up, and you can begin to put out a fair amount of the work with the muscles that are required for pedaling on the upstroke.

257 20 37 24 SPT

And the next thing I wanted to talk a little bit about is the stability. You obviously have to figure out some way to counteract the torque of the downstroke on the pedals. And in my case - I'm thinking for Jack and Al - there are three ways that this is done. The first one's pushing with your head. And there is that nice duct on the overhead. We put a couple of cushions between our head and the overhead duct, and this stabilizes you pretty nicely. The second way is by grasping those handrails. They're a little bit low for me and I sort of have to grab them with my fingers. I've been meaning to raise them for about a month now and I never have gotten around to it. But that also will hold you.

257 20 38 05 SPT

And then the third way is by this ankling business. Now, I can't deliver any significant amount of work and counterbalance it with just ankling. In other words, I have to assist with either my hands on the bars or my head, although I think Al can manage to do it pretty nicely here, not fastened to anything. So in my case, I find that I sort of rest muscles by alternating between all three. I'll ankle for a while until those muscles get tired, then I'll grab the rail for a while. And usually all - the whole time I'm also contributing part of the counteracting forces by using my head on the duct. So, I think you may find that you also want to use, perhaps in different combinations, all three of these ways to help hold yourself on the bicycle.

257 20 39 05 SPT

There's a final thing that I wanted to mention, was - I'm not so sure but what our mechanical efficiency is improving. And this is something that either Ed Michel or John Rummel would have to answer more specifically by looking at the data. We are delivering more work, and we're also working at higher power levels than we were 6 weeks ago. But I'm not convinced that we're doing so with any higher O_2 consumption rate.

In other words, for the same power level, let's say, 150 or 200 watts, my guess is that we are delivering - or consuming - about the same amount of oxygen - or at the same consumption rate that we have been all along. And it's only our mechanical efficiency that is improving.

257 20 39 52 SPT

Therefore, our heart rate is going down. We're finding the work easier, because we're taking on the ideas like this ankling business and better ways to hold your head and hold the handlebars. I don't know that this last one isn't true - is true, but I'll want to think it more carefully when I get back with John and Ed. And if you're interested, perhaps they can give you some preliminary words now. So, I thought I would mention these ideas to you early, so you might start getting in a couple of months of extra practice, particularly on the ankling, and give you a headstart when you get up here. My thoughts might also be of interest to John Rummel and Ed Michel. So this message goes to them as well as Ed Gibson, Bill Pogue, Jerry Carr over in the astronaut office.

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

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

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

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

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

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

GARRIOTT 0.1 may be too tight. Stowage on 92, that's a pain. It started out to be a pain in the neck until finally they sent us a message on exactly which cuffs to use. Al took the time to sort through and put the ones that we were going to use into the slots for each of the individual people. After that, we never had any problem. So I suggest that you identify the ones that you are going to use and then stick with them until there's some reason you have to change. Once we got that organized, it saved us a lot of time instead of having a whole range of cuffs that were acceptable.

M171 Stowage: The only thing we stowed there was the sensor kit which was satisfactory. The hose we left up on the panel except after cleaning. After cleaning we would normally leave both ends free so it would get a little better circulation and dry out better.

Noise Level: It's a noisey machine - the old ergometer. We've already talked about the complications of trying to hear the ground over the pedaling.

LOUSMA I think we wound up using less handlebars than we had there, at least I did anyway. The only part of the additional handlebars that I used was probably the first 4 inches that stuck out of the other handlebars. I never used the rest of the handlebars that went around it. My method for riding

LOUSMA (CONT'D)

the bike was to cushion my head against the overhead and hang on with the arms to the hand grips that were there. Sometimes I'd move them back a few inches to include part of the new handlebars and then push with the legs and take up the opposing force with whatever combination of head, arms, and upforce on the pedals that seemed to be right at the time. I never used the remainder of the handlebars. Maybe the other guys can comment on that. The only other time I guess they came in handy was when I was pedaling the bike with my hands. I put my head underneath the crossbar of the new handlebars to support the back of my neck with the handlebars. And I didn't use the new handlebars much and maybe one of the other guys found more advantageous than I did.

BEAN

I found them to be extremely advantageous, I seldom used the pad on top of my head. Most frequently I used different hand positions. One thing that I did notice was that you could ride the bike several different ways. Putting your hands different places and letting the handlebars provide that ability lets you relax your legs and lets you extend them sometimes and with your knees up sometimes, just to make a change. One thing that puzzled me was that it looked like the insulation that was around those handlebars didn't really do the job. Maybe that Teflon wasn't supposed to also insulate the hanldebars. I kind of thought it was, but I

BEAN (CONT'D) did notice that a lot of times after the run if you held onto the handlebars, you flunked the isolation test whereas you let go of the handlebars, you'd pass it. Maybe that's not important, but I think it is something that was a little bit of a surprise.

GARRIOTT I also used the extension on the handlebars I think, but not all the way around, of course. I used them as far back as where the little jog occurs and then probably another 3 or 4 inches beyond the point where it jogs out to the wider width. I held myself on the bicycle essentially in three ways and you just mentioned all of those. It's partly by uptorque on the opposite foot and partly by handlebars and partly by my head. Of those three, I would probably be using two of them at a time. I'd try to just rotate around them, and when my arms got tired then I'd use head and uptorque, then sort of rotate around to try to keep reasonably or not overtaxed in any of those three methods. The handlebars, I thought, were useful. The remainder was to physically or mechanically hold the parts of the handlebar that you were using.

BEAN We replaced the screw in the pedals of that bike. It looks to me like, although it's a little bit hard to get your left shoe in, if we could keep those screws in there that the bike problem is solved. We didn't have any more problems

SPEAKER Did you use the integral lighting much?

SPT Well, I think we usually left it on, but we could have been either off or on, because we were using the EL. And the ambient both.

SPEAKER You were using both the EL and the ambient?

SPT Yes

SPEAKER How did you like the EL?

SPT I thought it was darn good.

CDR Spectacular, but you could have done it just as well without it.

SPT Didn't see any degradation of it, incidentally, that we noticed.

SPEAKER Would the ATM chair, we got your comments on the ATM chair, basically, would it have permitted a reach envelope adequate to the panel operation? If you'd used it?

SPT I don't think so.

PLT You wouldn't have had the same reach if you'd been sitting in the chair.

CDR No.

SPT You would have to be always hopping out.

SPEAKER You think you would still have been getting in and out.

SPT Oh yeah. And, for example, you could never have reached the VTR. As it was, I normally kicked out one foot, I don't know whether you did or not from the triangles. Then you leaned over, you could reach the VTR, you could reach the video selector switch, you could reach the whole panel. Never have to float. Couldn't have done that at all from the chair.

SPEAKER Did you have any problems completing building block operations in the alloted time that you had?

SPT Sometimes, not usually.

PLT It seemed to be dependent on the fineness of the pointing required, the number of instruments you had to use to get it pointed.

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

338 03 23 03 SPT Portable handholds; specify where and how used. I guess - I guess the problem is - they're probably adequate, but the problem is, for me, I don't have time to run one - run one up and then try to figure out where to put it. I'm interested in getting the job done and I sure don't have time to construct things in order to do it. If I used footpads many many times, I might do that, but I have not run into that situation yet.

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

338 03 24 05 SPT Universal mounts: I guess for the job they're going to do, they're very good. ATM seat/back rest restraints: I haven't tried it. I have the feeling it would be very much - way too confining. When I'm working on the ATM, I have material mounted all around there. And I swing my body completely back, to the right side, to the left side, straight up, in order to get to the material which I have posted for cue cards and one thing or another. Sitting in that chair would really tie me down. So that's why I haven't even attempted - I may drag it out one of these days when I get a chance.

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

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

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

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

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

338 03 27 24 SPT WMC Ceiling handrail: Don't use it very much. I guess it's adequate for - but I just flat don't use it very much at all. I guess when you ever need it, you might - you might find it convenient, but I'm usually using the walls. WMC light-duty foot restraints: Okay, going back to that ceiling handrail, I'd give it a inadequate also because it really doesn't have that much job to perform.

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

338 03 28 16 SPT Drying stations: I think they're too crowded together, so I - I'd give them - inadequate. They do the job, but it's just, I guess, too - too packed together.

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

338 03 29 11 SPT Personal hygiene kit: It's all right, except the place that they have it stowed is inside a small locker. I'd much rather find a place that we could stow it permanently outside so you wouldn't have to dig into a small locker and fiddle with it all the

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

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

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

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

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

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

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

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

the universal restraint - on a handhold, I'm talking about now - is a grand platform, it works fine except for the oscillation dynamics of the handhold in using for cameras and so forth. The DAC will - will stimulate a vibration in the universal handhold; however, it sets [sic] there and shakes back and forth in resonance with the shutter motion of the DAJ. But when you're trying to use the - the clamp mode of the universal restraint, I would say that there is not enough flexibility in there to allow for fine tolerance or - or to - say, to allow for - for a general manufacturing tolerance to the handholds.

344 21 45 42 PLT

The handhold - The lock is not very good. When you push it down to lock, it may or may not. Sometimes you get a nice, over-centered flex, about - and that's about one out of 100 times, when you pass it through a - one of these oblong handholds. The bungee is better, generally speaking. Are very, very nice pieces of equipment to have around, if we just had better ways of sticking them on things - attaching. ATM seat/backrest restraint, we have not used.

344 21 46 11 PLT

Fecal collection equipment: As far as the collection equipment, functionally, it is, I would say, very good. Urine collection equipment: I would say poor to adequate, maybe because of the difficulty in inserting the urine drawer and in removing it. One of the things I don't like about the urine collection equipment is the hole that was cut in through the pressure plate with this green thing with a spring leaf arrangment on - the four-leaf arrangement. The hole's in the wrong position for reaching in there and pulling the little tab. We have to do this every morning. And every morning I have to fiddle around and reach in there and almost cut my finger trying to pull that tab out.

344 21 46 51 PLT

The square hole was positioned incorrectly. Also, have - Every morning I have great difficulty pushing the collection - the thing that holds the urine bag - pushing that back into position and getting the Teflon thing over the separator inlet fitting and then pushing the thing on.

344 21 47 09 PLT And then when you try to push the little nipple onto the separator outlet nozzle, that is never a positive operation. It's already - always fit and twist and fiddle and fool around there trying to get that thing on. I do not like the design of the urine collection equipment issofar as the way these things fit together. When you push the urine drawer back in there, you - Every morning - I've done it now almost 30 times - Every morning I feel like I'm not doing it right. It's because of poor fit. Okay, the hand washer: It's great. I think we got a long way to go. I think that there ought to be some provision for some kind of little autoclave-type thing; you stick your hands in there and give them a nice squirt without fear of water flying all over the head and out into the experiment compartment and everything. I think we need - Either we put our - both of our hands through some leaf slots or could overlap these slots, if you want to, and use it like that.

344 21 48 03 PLT And then something that could be removed easily if - if you wish. But I think there's a lot of work that could be done in that hand washer, although I think it's really a great item. I would - I would consider that very good to excellent the way it is, but I think it - there are some - some improvements. I don't - I wouldn't want you to say just adequate, because I like it. But I think that with modification, it could be made even better. Okay, fecal/urine collection - collector lap strap and handhold: Well, I don't know how that was designed, but that sure wasn't - No one actually tried it out and noticed their posture when they designed that thing, because When I sit down to go to the toilet, I like to have a crook in my knees. And you have to straighten your legs almost straight out to use that and in order to get your bottom seated on the fecal collector properly, and that is a very awkward posture. It'd sure be nice if you could - if you had one that was more or less conventional in shape so that you could have a - a little bit of a crook at the knees when you're using it.

344 21 49 02 PLT

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

344 21 50 13 PLT

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

344 21 50 42 PLT

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

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

344 21 56 25 PLT

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

344 21 57 23 PLT

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

of going about this. I can't think of it offhand. I think one thing that would have been very handy up here would have been more rope, more of the PBI rope. I think that would have been very handy equipment to have.

344 22 23 22 CDR

The - On a few pieces of equipment we found some straps that were almost completely Velcro, and we found it very handy for lashing small cables, like TV power cables, DAC power cables, and things like that. No snaps on the EV. Just wrap them around three or four times and then Velcro them to themselves, and they're quite adequate. And I think probably more of those and less of the short straps would have been probably just as well. The ATM seat/backrest restraint: We haven't even used it yet. I think probably we'll give it a whirl one of these days, but as it stands right now, the SL-3 crew had taken it out and gotten it out of the area. And we've been plenty comfortable the way we were without it and just haven't any real requirement to go get it, put it in, and use it. Waste management/hygiene equipment. Fecal collection equipment: I would say adequate on the fecal collection equipment. I must say - I think I mentioned this in my last one, too - I was very pleasantly surprised about that. I found that it worked quite well. The process of collecting facal matter and everything was not quite as - as messy and bad as I had imagined it could be. The equipment, I think, works very well. I don't know just exactly how to tell you to improve it.

344 22 25 10 CDR

I just can't think of any other thing to say there. They - The - I've already mentioned foot restraints in the wardroom, and I see it's coming up again; so I'll get to that later. Urine collection equipment: I would say very good. I think that a little better system of sampling would be - would be in order here, a little bit easier system of sampling. The one we have takes just too much time, and sampling urine should be - should not be a 15- or 20-minute effort. It should be a 5-minute effort. We should try to find an easier way to do that. The handwasher, I found to be adquate.

344 22 25 52 CDR

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

344 22 27 03 CDR

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

344 22 28 27 CDR

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

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

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

CREW ...

CDR Okay, getting on with my report here.

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

the floor and - and hold a screw while Ed was busy working underneath. Ingress and egress positions are - are very good; are excellent in the wardroom. There's lots of room and no problem getting in and out.

356 17 02 52 CDR — Trash collection provision is - is excellent. Each man has a trash bag within arms reach of his eating station. Stowage volume and access is excellent. There's lots of room. And as more and more clothing is being used up and lockers are being emptied out, we're moving more and more bulk volume food, overage food down into the lockers near the tables so we don't have to spend as much time transferring from the wardroom up to the food lockers in the forward compartments.

356 17 03 27 CDR — Access is very good in all these stowage areas, these lockers in the wardroom. Temporary equipment restraints: We make extensive use of the bungees in the doors, and we make extensive use of Velcro. And they're all very good. I think the best temporary equipment restraint is the bungee with the flap. I don't want to call it a hook. It's really a hook, but it's long and - and flat, pinched. I like - I like that better than the sharp wire or the other type of hook; just about a 3/16-inch wide piece of metal bent into a hook.

356 17 04 09 CDR — Personal mobility aids: Now that we've got the - Well, I don't know what you mean by a personal mobility aid. I don't think there are any. The personal restraint devices: I think the thigh restraints are okay but not necessary. I would say that removal of the floor plates has greatly improved the ease with which we can harbor ourselves to eat our dinner and do whatever we want to do. Thermal comfort: It's very comfortable down in the wardroom. It's one of the more comfortable rooms in the whole spacecraft. Noise level is very low in the wardroom, as it is in the entire OWS, unless you've got the ATM/EREP cooling loop running. And then the dome takes the noise as it comes down the airlock and serves as a great big megaphone and - and sends it down to us slightly amplified.

up with food spills. This is a problem. We've spattered the window up. Of course, there's the window cover, but we occasionally do take that out. And we have to have the - out the window - and we have to have it - the window cover over it. Food spills are a major concern when you start locating anything in an area where you're eating.

356 19 13 46 PLT

Temporary equipment restraints: Again, the same thing. We did not have enough there. Personal - personnel mobility aids: Well, with the ceiling-floor proximity we have, it's no big problem. We do find it difficult to go over the wardroom table. We usually find ourselves going around one-g fashion, because there's not quite enough space between the top of the wardroom table and the ceiling to get over without pinging something on the table, knocking somebody's utensils off their tray, or if they're - happen to be out, or just in general getting in their way and kicking them in the head. Personnel restraint devices: Well, we've already kicked that one to death. We finally removed the pedestal, and that was just a - a bad scene all the way around as far as design is concerned, as far as I'm personally concerned in evaluating it.

356 19 14 31 PLT

Let's see. The - the ~~fire~~ THIGH restraint is useless. The pu - the natural posture of an individual is almost with legs straightened out, and when - in - trying to design a table to make you assume a one-g eating at-the-table posture is really out to lunch, that is not the way to go. I would rather eat up, like a sack - snack bar, where you're standing up and eating. And somebody's already mentioned the eating Japanese style, and I think that's the - that's the way to go. You need the tray close to your head, and you need room for your legs to almost straighten out. Otherwise, you got a perpetual tension in your abdomen, trying to hold yourself in. Thermal comfort: No problem. Noise level: No - Well, it's really not that bad. Illumination is no problem.

356 19 15 11 PLT

WMC, general arrangement and orientation: I've already beat that one to death, too. I don't

PLT Are more needed? Yes. And I think again one has to look very carefully what you are going to do. But in any case, you're going to be handling papers and you're going to be handling multiple pieces of hard - hardware of varying sizes. And one needs a way to stow that stuff temporarily while you're working at it, particularly around the film vaults, cameras, film packs, cassettes, filters, ring sights, lens - lenses, batteries, you name it, photo tom - Photomis heads. We're always cycling these things around, the transporters, the film cassettes that fit in the transporters, taking them off and putting them on, - putting them, stowing them, changing them out and handling them and juggle them, doing a five-ball juggling contest there in zero g.

365 21 41 14 SPT It was just - I would say that as far as restraints from the ... equipment, that the orbital assembly is totally inadequate. I don't think we - we were smart enough - I - that - that is not meant to be destructive criticism. That - that is meant to be a positive comment. Are more needed? Orviously, yes. Well, of course, the MDA and STS I took apart the other day, I think that they're both very, very bad - bad. I don't want to kick a dead horse. Are - are some unnecessary? I can't think of any restraints that are unnecessary, you can - unless you can talk about the ergometer.

PLT We took the feet off, but the other restraints - they were necessary. The M131 chair is a good example of how you can screw up a design on restraint. The belt didn't even hold you in there. It didn't - it still had to be modified and still difficult to tie down. And again that was just a case of - no one in the world was smart enough to know how to put a - you know, how to design a belt. So, again, that's not meant to be hy - hypercritical of that piece of equipment.

365 21 42 13 SPT When you lie down on that chair, the same thing. Any - any time you have to assume a certain posture - a sitting posture, you - you're in trouble, and you've got to have to force to hold you there. And I've also pointed this out that - that in the - the john is the same way - the toilet. You need the ... to be sort of chin high to you. We've talked about that before.

Reference 32

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 Did you find the ~~side~~ THIGH 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 ~~Side~~ THIGH 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 inadvertantly bump against things.

POGUE Sometimes painfully.

GIBSON It was difficult to pedal and give good measurements simultaneously. I used my arms, and the muscle activity in the arms always obscures the data.

POGUE A double yoke system of restraints would have been helpful on M171. The restraint system we had was not completely satisfactory. I needed a restraint to hold my shoulders down.

GIBSON We needed something to hold the head and the shoulders. We used a pad on the overhead to hold ourselves down. I used it for a mount until the pad became a health hazard, and we removed it. We had the head on the overhead. It seemed to work, but a restraint is needed which operates on the head and shoulder.

CARR Calibration: It should be more automatic.

CARR Body Temperature Measuring System: It doesn't matter whether a thermometer has a mercury column or an electronic readout.

GIBSON The response time was so long that it rendered the reading inaccurate. I'm not sure that gave useful data.

GIBSON ESS: We used it and didn't have any big problems. The MA: I thought it was well designed.

POGUE One thing that is sort of important, but has nothing to do with the M171 experiment, is our displays. I'm talking about everything in the spacecraft. The displays ought to have neutral density filters, if we are going to do any television in the future

CARR (CONT'D) felt that the experiment was time consuming and that it was not producing any new data.

POGUE I have one comment on M131. When you are adapting things to conform to the human body in zero gravity, you've got to be careful. We found that the body normally wants to assume a more or less erect, slightly arched attitude, and holding yourself in a chair was difficult. The seatbelt helped; although it was hard to adjust. The biteboard could have been better if it had one more degree of freedom. I was never completely comfortable. One problem was that the postural change made it very difficult to adjust the height of the biteboard properly.

GIBSON Regardless of the individual's shortness, we could never get the biteboard high enough in order to make it fit comfortably. We were on the ragged edge of it coming out of the strut which held it up.

CARR When I was stuck into the biteboard, I felt like a horse with a bit that's being reined in tightly with his chin being pulled down towards his neck and the back of the neck being somewhat arched. I always felt like my chin was being pulled down and in, and my neck was being arched. It was rather uncomfortable, and it was difficult to get away from that position.

GIBSON (CONT'D) needed a gain times 10 switch for maneuvering at a slow rate. It would have been useful for the S055 data. The S055 readout could be substantially changed by making 1-arc-second increment changes in the pointing. We needed finer adjustment in the pointing.

GIBSON ATM Operations Boards and ATM Chair: We didn't use the chair at the panel because it was a constraint that we didn't need. I preferred moving around and getting some exercise. Being able to lean back and stretch while at the panel, was a good way to stay mentally alert. Had we been strapped to the chair, we would have fallen asleep. The operations boards were a good idea. I would change their implementation slightly, but the concept itself was good. Without them it would have been difficult to handle all the paperwork associated with ATM. The clips which were used on the boards should be changed. Once the spring clips were sprung, they were useless. All the clips should have been the squeeze and release type.

On the left we had three boards. On one we kept all of the primary DAS codes which were on one JOP sheet. On the center board we kept the JOP 3 summary sheet. On the one on the right we kept the JOP 8 summary. We kept the schedule pad on the side of the board on the far left. The solar activity pad was kept on the lefthand side of the board on the right. The other