

TL797.032736

JSC-09549

SKYLAB EXPERIENCE BULLETIN NO. 15

CABLE MANAGEMENT IN ZERO-G

DISTRIBUTION AND REFERENCING

This paper is not suitable for general distribution or referencing. It may be referenced only in other working correspondence and documents by participating organizations.



National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

SEPTEMBER 1975

THIS PAGE IS
INTENTIONALLY BLANK

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

BULLETIN NO. 15


CABLE MANAGEMENT IN ZERO-G

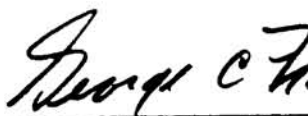
This document is the fifteenth in a series of releases which are intended to make available to NASA and contractor personnel those results from the Skylab Man-Machine Engineering Experiments which have design and requirements relevance to current projects and programs. This method of data distribution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

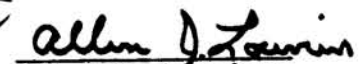
PREPARED BY:


V. Sova

REVIEWED AND APPROVED BY:


Robert L. Bond
Head, Man-Machine
Engineering Section


George C. Franklin
Ass't Chief for
Crew Station
Spacecraft Design
Division


Allen J. Louviere
Chief, Spacecraft
Design Division

SEPTEMBER 1975

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
SUMMARY	1
PRE-SKYLAB EXPERIENCE	2
SKYLAB DESIGN.	3
SKYLAB EXPERIENCE	4
CONCLUSIONS & RECOMMENDATIONS	6
RAW DATA APPENDIX	13

CABLE MANAGEMENT IN ZERO-G

SUMMARY

Skylab contained sufficient electrical outlets, powercords and cables to accomplish the mission requirements, however, several undesirable conditions associated with zero-g management of these devices became evident during the flights. The SL-3 crew found that not enough electrical outlets were available in the MDA to support operational requirements following installation of the rate-gyro six-pack as an inflight maintenance procedure. This necessitated bringing a high-power cable from the OWS thru the airlock into the MDA for an additional power outlet. Because the power cable had to go thru the airlock, the rapid closing of the airlock hatches in case of an emergency would have been hindered.

The crews found that there were not enough power cables to allow cables to be installed and left where repetitive operations were required.

Additionally, the crews reported that there were power cords and cables which got in the way during routine operations in the workshop. Also, environmental control umbilicals were a similar nuisance, but were fortunately only in evidence during periods of EVA prep and post operations.

On the basis of their experience, the crews have suggested design changes for future power distribution systems.

The intent of this bulletin is to call attention to a potential problem area and not to evaluate the power distribution system of Skylab.

PRE-SKYLAB EXPERIENCE

The Mercury, Gemini and Apollo flights were operationally mission oriented and therefore relatively few IVA experiments were onboard these flights as compared to Skylab. Thus, fewer cables and cords were present in the cockpit to present interferences to crew activities. However, with the advent of the Apollo spacecraft and the capability for crewmen to move out of their launch and recovery position and move freely about the interior of the vehicle, the interface problem between translating crewmen and electrical or environmental "snakes" in the cabin was recognized as a continuing nuisance. The short (8-10 days) Apollo missions seemed to contribute to crew tolerance of such nuisances.

The most widely recognized incident involving cables prior to Skylab did not occur inside a spacecraft. It was the inadvertent breaking of an ALSEP cable on the lunar surface by an EVA crewman. Thus, even partial-gravity environments present cable management situations which need a closer look by equipment designers.

SKYLAB DESIGN

The Skylab power distribution system was designed to provide an adequate number of power outlets and a sufficient number of power cables to carry out the mission. The total power distribution system was in turn divided into a high power and a low power system with corresponding power cabling. The hardware was of different physical size and could not be interchanged.

Experiments normally had their own power cords provided with the experiment package. The common power cords were essentially extension cords and were used as such to connect various equipment and experiments. The equipment connected to the power cords included TV cameras, lights, vacuum cleaner, blowers and other portable equipment. Virtually every compartment aboard the vehicle was replete with either requirements or crew discretionary activities which resulted in stringing cables from point to point. The interfaces between those items and the crewmen generated sufficient crew commentary to warrant discussion of the subject.

SKYLAB EXPERIENCE

It is interesting to note that the first Skylab crew commented only once on the power cord stowage (Ref. 1). The comment insinuates that there was a power cord stowage problem. The lack of comments concerning the cables and power cords by the first crew can probably be explained by the fact that the first crew was busy activating and repairing the crippled OWS and considered the inconvenience presented by the cables and power cords as the least of their problems. Also, the mission duration appears to affect the frequency of comments concerning a nuisance factor as evidenced by the comments by the subsequent crews.

The first complaint on the air-to-ground communications from the SL-3 crew was on day 222 (Ref. 2), stating that there were too many cables all over the workshop. The SL-3 crew also noted an interesting fact in that strings and cables did not get tangled in zero-g, instead, the strings and cables would bounce back upon touching something else (Ref. 4). Even though this comment was made during EVA it applies to all zero-g conditions, whether EVA or IVA.

The installation of the rate gyro six-pack in a high-power outlet in the MDA necessitated the routing of a high-power cable from the OWS to the MDA thru the airlock (Ref. 7 & Ref. 10). This cable routing thru the airlock presented a potential safety hazard along with the nuisance factor.

Numerous crew comments concerning cables and power cords pointed out the fact that it was bothersome and time consuming to string these cables, which then would hinder or annoy the crew (Ref. 10). This type of cable management was not deemed desirable and one crew suggested alternate methods of cable management such as a cable caddy, which could be transported to a needed location from a central storage location (Ref. 5, 6, 8, 9, 10 & 11). The caddy would have one of each type of cable used in the spacecraft, thereby allowing the user to have the right cable at his disposal without having to look for it. In order to simplify finding the right cable on the cable caddy, color coding of the cables was suggested (Ref. 9). Spring-loaded reels to take up the slack in deployed cables was also mentioned as a possible improvement (Ref. 5).

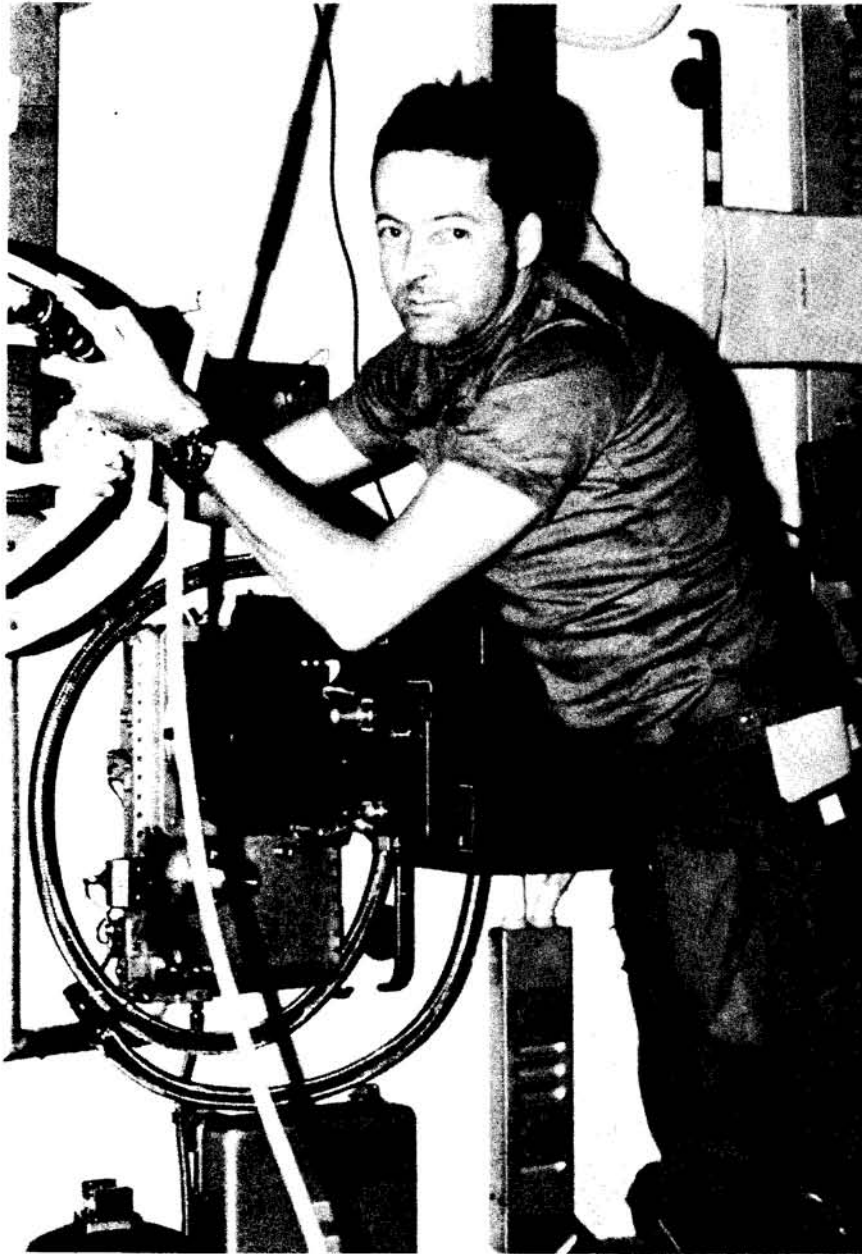
CONCLUSIONS & RECOMMENDATIONS

It is not the intent of this report to offer a solution to the cable and power cord problem in zero-g. Instead, the intent is to point out that a problem exists which affects:

- (1) mobility within a spacecraft
- (2) timelines by having the crew look for the needed cables and then deploy them
- (3) creation of possible safety hazards.

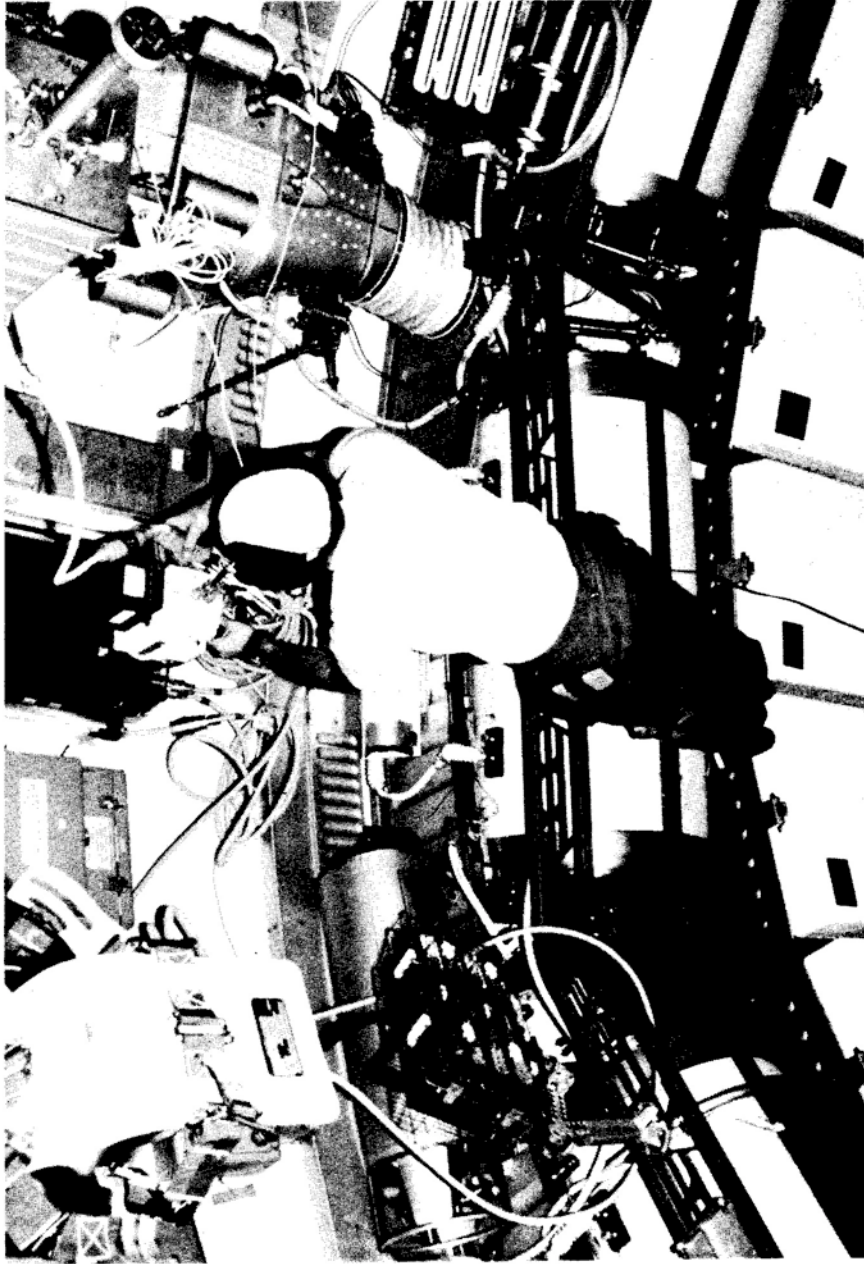
It is recommended that close scrutiny be given on future spacecraft to needed cable routing, number of cables, availability of different cables as required by crew timeline, the location and number of outlets and equipment which needs cables, and the possible use of something like a cable caddy as suggested by the Skylab crews.

Smaller volume of a spacecraft would compound the cable problems experienced on Skylab, therefore, it becomes increasingly important to recognize cables and power cords as a possible problem area which must be minimized for efficient crew operations.



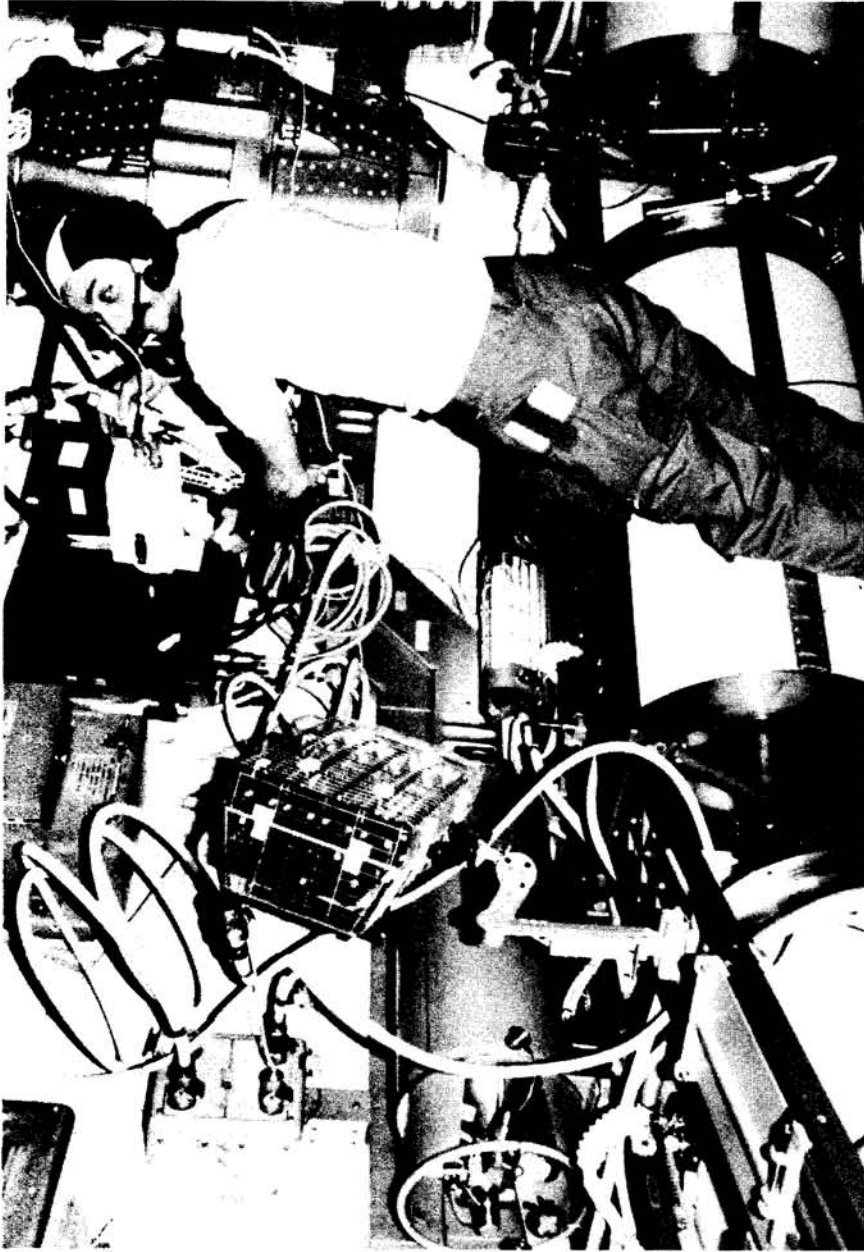
SL-2 SPT HANDLING A HIGH-POWER CABLE IN FLIGHT

FIGURE 1



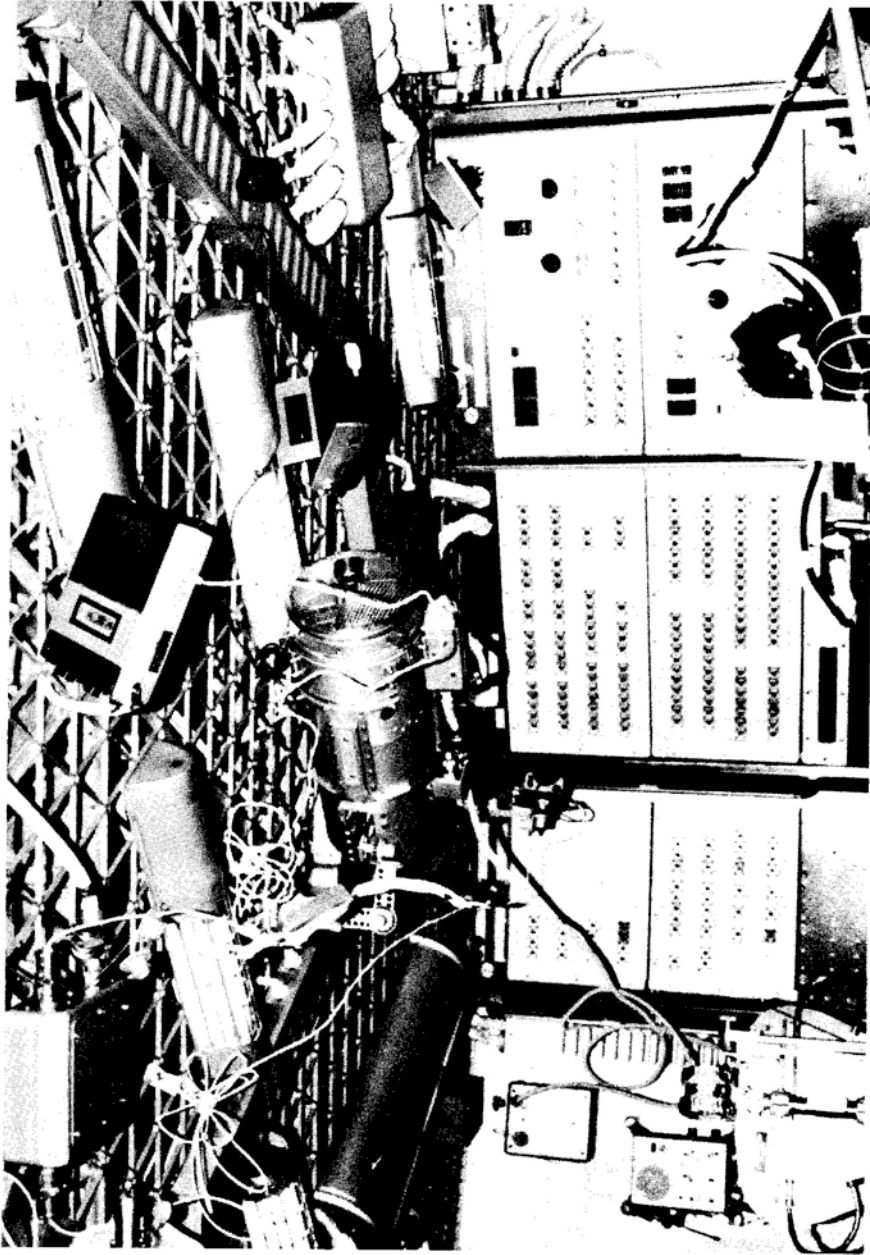
ASSORTED POWERCORDS ABOARD SKYLAB

FIGURE 2



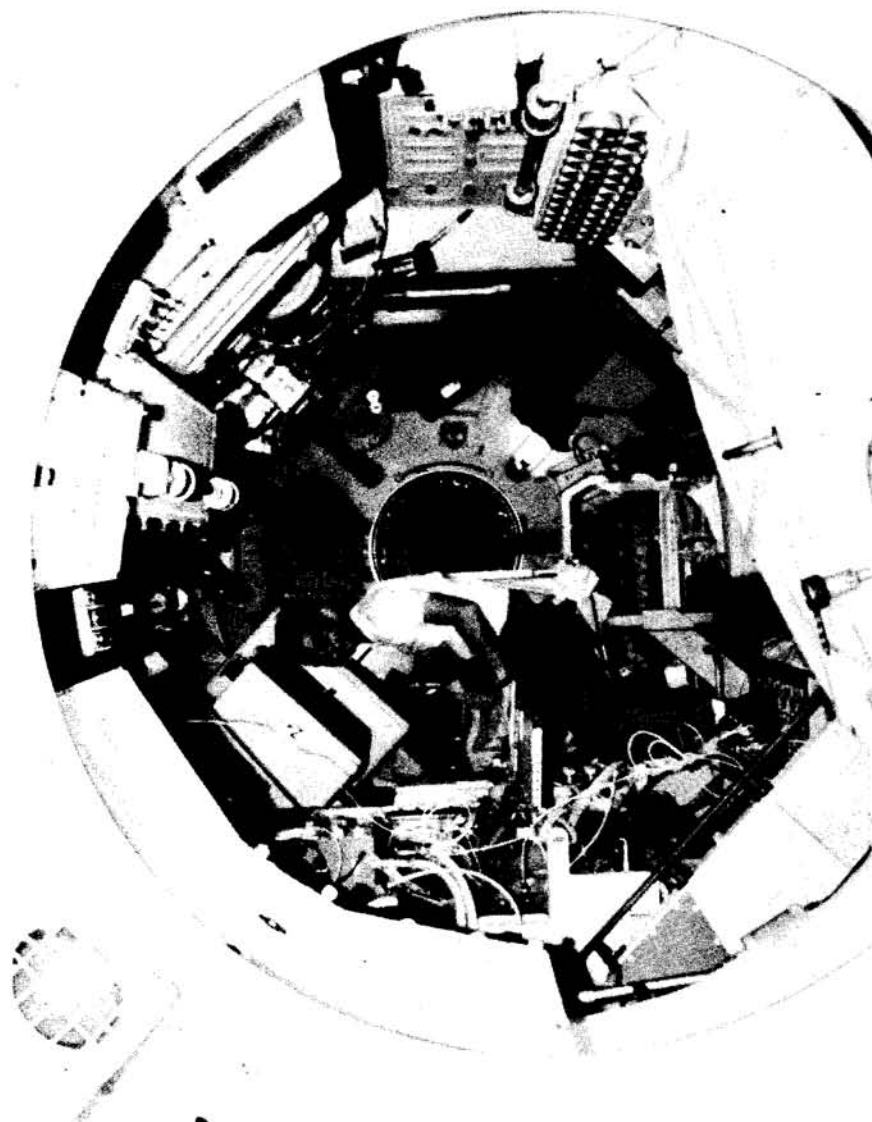
ASSORTED POWERCORDS ABOARD SKYLAB

FIGURE 3

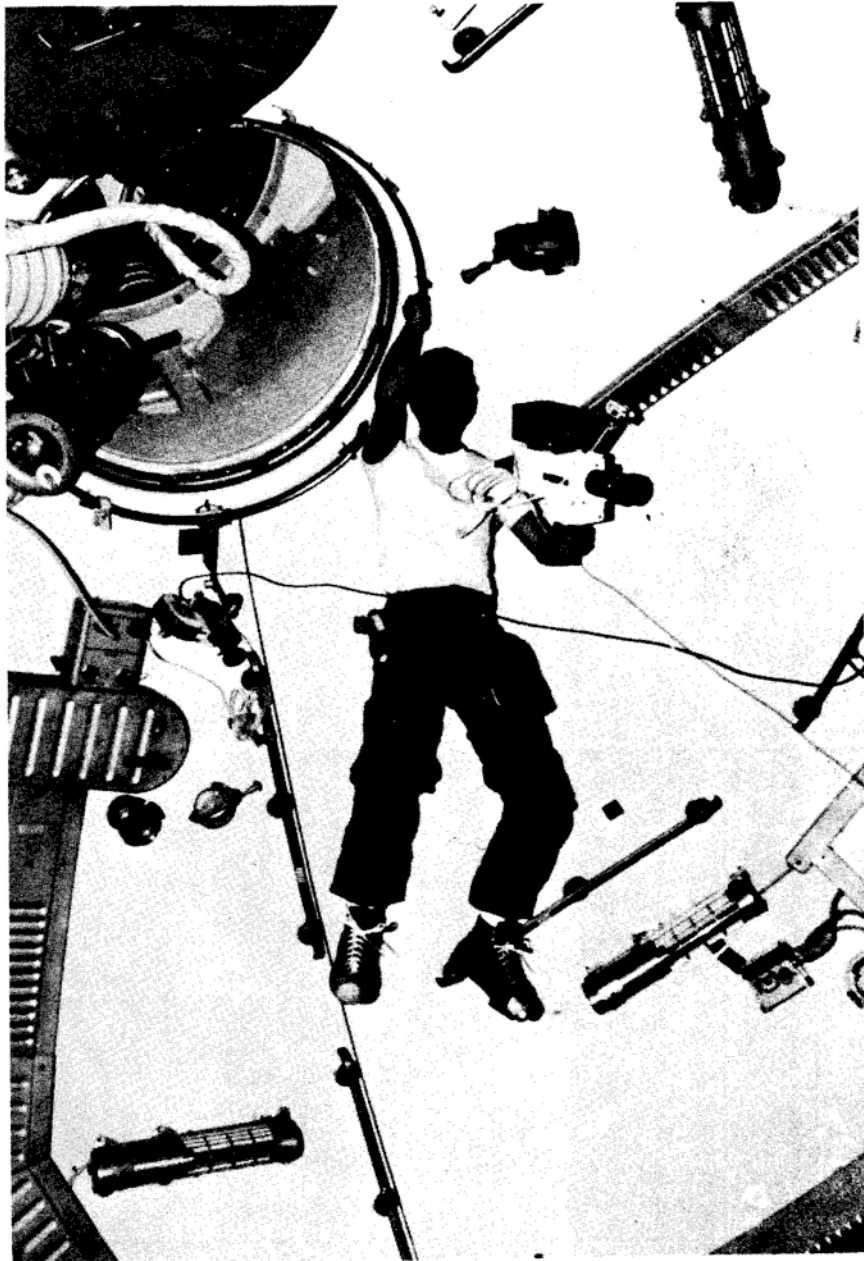


VARIOUS POWERCORDS STRUNG IN THE CEILING
AREA OF SKYLAB'S EXPERIMENT COMPARTMENT

FIGURE 4



TRANSIENT POWERCORDS AT THE ATM CONSOLE
FIGURE 5



POWERCORDS IN DOME AREA AND ECS UMBILICAL ROUTED THROUGH DOME HATCH

FIGURE 6

RAW DATA APPENDIX

<u>REFERENCE</u>	<u>SOURCE</u>	<u>PAGE</u>
1	SL-1/2 Final Tag Tape 171-04	A-1
2	SL-1/3 Dump Tape 222-01	A-2
3	SL-1/3 Tag Tape 227-05	A-3
4	SL-1/3 Technical Debriefing	A-4
5	SL-1/3 SWS-SYS Debriefing	A-6
6	SL-1/3 SWS-SYS Debriefing	A-8
7	SL-1/4 Final Dump Tape 356-06	A-11
8	SL-1/4 SWS-SYS Debriefing	A-12
9	SL-1/4 SWS-SYS Debriefing	A-14
10	SL-1/4 SWS-SYS Debriefing	A-16
11	SL-1/4 SWS-SYS Debriefing	A-19



Reference 1

Final
TAG Tape 171-04
171:09:30 to
171:11:00
Page 9 of 10

That and looking out the window are endless sources of delight that I - I don't think we could ever exhaust. I think they'll sustain Al Bean, and Jerry Carr and their troupes throughout their 56-day flight.

PLT Now, there have been many surprises, and I guess the main ones have been pleasant surprises. Mine is just a reiteration of what Pete said.

CDR You there, world?

CC Roger. That was the last question. We've got about 4 minutes left here. Have you got any last comments you want to make?

CDR Yes. I'd like to say publicly how much we appreciated the support from the ground; especially, with all the last-minute things that were done to put this spacecraft back in shape, all the EVA work. And although we laughed and kidded about banging CBRMs with hammers and so forth, it all worked. And the support from the ground has been fantastic.

SPT Second that strongly. What I was going to say was medically and subjectively, what's been such a pleasant big surprise to me is how nice we feel. We're able to get up in the morning, eat breakfast and do a day's work. I'm tremendously encouraged about the future of long-duration flights for that particular reason. Guess that's it.

CDR See you on the ground.

10 34 01 CC Okay. And thanks for the nice words. We've got about 3 minutes left here before LOS.

10 36 14 CC Skylab, Houston; 1 minute to LOS, Carnarvon at 17.

CDR Roger. Say, Hank. Last night I mentioned that one of the little details I had cleaned up in the stowage was where to put the TV power cable on the operative good TV when we stowed it. Be advised that the place that we use it the most is the 642 panel. And I'm going to leave it plugged into the 642 panel neatly wrapped up. Okay?

Dump Tape 222-01
Page 21 of 22

Reference 2

and connector belt. ... with
modifications significant ... it
comes to a number of spacepads.
... as we all pointed out ...
better operation ...

PLT ...

PLT Yeah.

222 02 40 56 CDR

Okay, we got too many jacks, power
cables and TV power cables strung around
the workshop. We got - and we
got to have - we got to have those
things built into the wiring
someplace so that they could reflect
directly in the way they reflected
other appliances and things. ...
the wire around it ... want to do that
or a tape recorder or a TV camera
or a blower. Looking around the
workshop ... 6 foot, 12 foot cable
... after the workshop had already
been configured ... There was no
way to think of everything and you
want flexibility, so need to make sure
the cords themselves have some sort
of adhering quality. I don't
mean - sticky - I mean every so often
on the cord is a little plug that
sticks in the hole on the triangular
grid or some sort of little clip
hook that snaps front that you could
lean above the - hook on, that way
you could keep these cords flush.
Right now you have to go get the
equipment strap and hang them up ...

222 02 42 27 PLT

One last question. How satisfactory
have the various environmental
elements of habitability been in
providing a suitable habitat.
Lighting, we just checked. Noises,
we checked. Temperature, humidity,
and airflow, we discussed all of
those. Think we feel that - that

Reference 3

TAG Tape 227-05/T-224
Page 4 of 8/1502

PLT You sure had a lot a - sure had a lot of wires and junk on the floor when you start doing that, though.

CC Roger.

CC And we've got a good TV down-link picture again.

CDR Wonder why you weren't able to get it on MON-2. I had it displayed there; just switched over to MON-2 but you never got it, huh?

CC Stand by 1.

CDR The one that had all the contrast and everything adjusted for you there.

227 14 15 42 CC CDR, Houston. We're having to use MONITOR 1 only from here on in because of the TV BUS 2 problem that we had. And I did not copy your last transmission down.

CDR I was wondering. What's the star tracker around the inner and outer gimbals that we think we have? It doesn't seem to lock on. See if you can get a better thought on those gimbal angles.

CC Roger; stand by.

CDR I'll quit fiddling with it for a minute and rotate the ...

227 14 16 35 CC CDR; Houston. It's going to take us a while to recompute some new star tracker gimbal angles. So why don't you just close the shutter and we'll get back to you, possibly at the Vanguard, with some new angles.

CDR Okay. I tried the ... once and all around and it just didn't work. Apparently, this 5.5 out of NuZ we got has got them off a little bit.

CC Roger that.

227 14 18 03 CDR Okay, I'll put the corona bath - back in 108 and give you some more UV MON.

CC Roger, Al.

Reference 4

LOUSMA
(CONT'D)

of the workshop to look at the view. Otherwise, you can only see the back of the ATM. From my waist up was above the circumference part of the edge of the workshop. You can look all over, you can look back there aft towards the sail and see the aft end of the workshop. It's a spectacular view. When you're inside, it feels like you're looking outside from a train window. But when you're outdoors, it makes you feel like you're sitting on the locomotive steaming down the track at a high rate of speed. It gives you a super feeling you don't have inside. That was my operation in the FAS in the foot restraints - as little as possible and out looking around as much as possible. I didn't see anything sharp that you could ding your suit on. I didn't see anything dangerous or likely to foul your suit on.

GARRIOTT They were adequate handrails and worked good.

LOUSMA

LSU Management: That really wasn't too much of a problem. We just did it like the checklist said. It was easier to clamp that umbilical in zero g than it is in the water tank.

GARRIOTT

Those darn umbilicals are still too large.

BEAN

They are. That's funny. They kept saying they're going to be great. They never have been. They still clamped, worked.

LOUSMA But not like they should.

BEAN I noticed that even in zero g every string didn't get tangled up, although it would swing around and interlace some. It never got in knots. That's helpful with the umbilical too. Zero g prevents things from dragging against one another and from making little knots. So, it can sort of swing behind you; it doesn't get into any trouble everytime it touches something. When it does, it immediately rebounds from it. It just stays out of the way. One of the nice things that occurs in zero g is that the umbilicals tend to mind themselves and not get into trouble.

LOUSMA Lighting: Lighting was more than adequate. Plenty of light to work by.

BEAN We didn't try to take any of those latches off.

GARRIOTT No, I did.

BEAN We had a problem one time. Somehow we had lighting everywhere except on the Sun end. Then we came over to ground, they did something, and then we had lighting on the Sun end thereafter. They never revealed exactly what went on. I guess if SL-4 doesn't have any lighting someplace, they should inform the ground. Maybe they have a command capability because thereafter it all seemed to work well.

Reference 5
TAPE 3, SIDE 2

SPT I think we generally felt that the times that we have worked out in the simulator are about right. About right for scheduling. Sometimes you get caught a little bit too short, but that's better than adding two or three minutes the whole array, and therefore losing time, overall.

SPEAKER Was there any difficulty filling the scientific airlock? We've talked about operation in the SAL. Did you have any problem in aligning the experiments to the scientific airlock?

CDR Aligning experiments to the SAL? I'm not sure what that is.

SPT Making them fit in the square hole.

PLT He means to make it line up.

CDR No, I never did. Did you?

PLT Better than one-g.

SPT Right.

SPEAKER On the high intensity light, did you have any problems with it at all?

SPT Worked like advertised. No problems.

SPEAKER How about any heating of it? Did you notice any overheating or anything like that?

SPT I didn't.

PLT I thought they worked about like they were supposed to.

CDR What are you going to do about all these extension cords and things in shuttle? We had extension cords all over the place for the lights and the comm. There was all sorts of cables all over there. Same thing for the cameras. And then there was remote cables for the cameras. We had more stuff strung all over that workshop. I don't know how you're going to lick that for shuttle. It's messy, but you can't predict ahead where you are going to need all these things. Have you guys given any thought to that? Same way with the space station. Only way I guess you could somehow eliminate it is to have more electrical plugs, but you still need extension cords, even with electrical plugs.

TAPE 3, SIDE 2

PLT Yeah, you always got to make one long enough to reach the furthest away, so that means that the close one, you got to coil it all up, or ----- Al's right, there's a lot of spaghetti all over.

SPEAKER What about that scheme they use, that automatic windup type.

CDR I think that would be great. I wish we would have had those on all our cables, where it reels out, its kind of stashed on the walls, it's part of the plug. You run over here, and if you want to plug your unit in, you grab the plug and I think that would have been fantastic.

SPT The only thing about those kind of things, is they are something else to break.

CDR You're not kidding.

SPEAKER You get it all reeled up inside there and you then have to take it apart to use it (chuckle).

CDR There must be something better than what we did, that's not too complicated, although I don't know what it is. Can't use sash weights, that's for sure.

SPEAKER Did you happen to get any pictures of any typical spaghetti situation?

SPT Must have.

PLT I'm sure it will be apparent in any of the film.

SPEAKER Did you use the high intensity lights for any other purpose than the experiments? In other words, did you use them for troubleshooting or anything like that, at all?

PLT I don't remember doing that. Once in a while for TV, but mostly for cameras only.

SPEAKER Under personal hygiene, on the waste management compartment, on washing, did you use --- With the washcloth, putting water in it, did you use it up against the dispenser, did you hold it away from it? Do you think you need to have a cover over the dispenser or anything like that?

PLT Did it both ways.

CDR Mostly again, just away though. Just kind of squirt. I think you really need something up there where you don't have to always go to a washer. You need to have a washer. You need something where you can just squirt water in your hands, wash your hands. And then grab a towel and wipe them off. Seems to me you could

TAPE 4, SIDE 2

SPEAKER Next question is on wire harnesses and installation. Any comment on any electrical equipment or wiring that appeared to be an annoyance or hindrance to the movement in the workshop?

PLT Electrical harnesses.

SPEAKER Electrical harnesses, cables, wiring.

SPT We had cables strung all over the place from time to time. Frequently we would leave it a little hap-hazard because we thought it was very temporary measure, only going to be up for an hour or so.

SPEAKER I believe this is in reference to the permanent wiring and not necessarily the extension cord and things like that.

SPT I don't remember any permanent wiring that got in the way.

SPEAKER Was any excessive fraying or damage observed to the fiberglass covers on wire harnesses, at the penetrations in the floor or other areas? No I believe the other crew reported to us that there was one cable somewhere, I've forgotten, just outside the waste management room or somewhere that they rubbed into, showed some evidence of wear. I've forgotten exactly where it was.

PLT I don't recall anything like that.

SPEAKER Did convoluted boots come loose from any exposed connectors in the workshop?

SPT Not that I remember.

SPEAKER Any difficulty with the electrical connectors for the food trays or the urine centrifugal separator? I believe they are O-G. There is a bayonette connector on the separator. No problems with these?

PLT No.

SPEAKER Was the clearance adequate for the mating and demating of connectors or the intercom boxes?

PLT No.

TAPE 4, SIDE 2

SPEAKER Were any problems encountered in mating and demating 0-G connectors?

PLT No.

SPEAKER Assess crewman's ability to mate and de-mate non zero-G connectors?

SPT No problems. A couple of them -- they were a little tight. The harness to the seive, subject interface box on the LBNP that you have to put a good deal of torque but that -----

SPEAKER Can you, if you care to compare zero or micro-dot versus the non-zero type connectors there?

SPT As far as the micro-dot, zero-G, the bayonettes, were all satisfactory.

PLT I had no problems with any of them.

SPEAKER Assess the utility outlet adequacy, accessibility number, and location. Were there sufficient utility outlets in the OWS?

SPT I thought it was marginal on the number of utility outlets available. We ended up having several places we liked to put the portable tape recorder and we were always having trouble making sure, disconnecting the tape recorder, plugging in a connection to DAC or something like that. So I thought it was sort of marginal. We should have had -----

SPEAKER That would be the low power outlet then?

SPT Low power outlet.

SPEAKER Down in the wardroom area?

SPT In the experiment area.

SPEAKER In the experiment area?

SPT Yes

PLT We never used the one in the head as I remember, we never. There's four plugs down there. Never used. There aren't enough high power outlets in the MDA, because we started using them up with other pieces of equipment.

TAPE 4, SIDE 2

SPT I think we could use a couple more in the experiment area and a couple more in the MDA.

SPEAKER Like at home, never enough.

PLT Never enough in the right place. One of the big pains of operating up there was to have to turn around for a place to plug your utility plug in. When you want to go back, you had to unplug the VCR and use the long extension cord thats strung in all the way from the workshop. That's one thing you don't like to spend your time doing is hunting around for a cable and then finding a place to plug it in. You want to go do your job and get it over with. The rest is a waste of time.

SPEAKER If any lights, intercom boxes, or heaters were replaced, any comments on the cause of the problem? You have already discussed lights I guess.

PLT We replaced one intercom box because it had an intercom transmit switch was failed in the on position. That was the one at the -Z cell and its all documented.

SPEAKER Any heaters replaced, do you recall?

PLT Dump probe heater.

SPEAKER Was there any problem encountered with static discharge.

SPT I noticed one time I saw it and maybe two thirds of the way through, something like that, that you could notice the static electricity on one of our garments. I don't know whether the jacket or what.

PLT I remember you mentioning that.

SPT There was only one time I even noticed static electricity and I could never see the arc jump. I could never see the spark. All I could do was feel like they had static electricity when you moved it near the hair on your arm. That was the only one time.

SPEAKER What were you performing, what operation?

SPT Just getting up in the morning.

SPEAKER They didn't have a report the last time of any?

Reference 7

Final Dump Tape 356-06/D-367
Page 9 of 14

except the noise level, of course, is reasonably high there. There's - there is sound focusing up in that dome area because of the spherical nature of the surface.

356 19 25 40 PLT

The airlock, general arrangement and orientation of compartment: Don't like the small size of the numbers on some of the panel; hard to see some of the numbers. Not early as bad as the MDA. Volume of compartment for ... Because of traffic through that thing, that's a lousy place to put an airlock. I think an airlock ought to be out of the main flow of traffic. But I don't know why it's - it's there, because it's reasonably close to the supposedly EVA work area. But we're - we have to go back and forth through that a hundred times a day almost, and the fact that it's so small in diameter does cause a small problem. And also,

we've had to string equipment through there. Like leave - Right now I have got a high-power accessory cable connected up to the video tape recorder from the dome area, a high-power outlet. Now personally, I think that is a questionable procedure, but that's what the procedures call for, and we've done it before for the reason. So it's not just - I'm not just directing this against the Ground from - from the procedure standpoint because we've done it ourselves, but I personally think that that's not the - the - the safest thing to do, is to keep a cable through there all the time. And what - that has to do with the volume of the compartment and the location. The fact that it - it's an airlock, the volume is satisfactory for its designed function.

356 19 27 02 PLT

But the fact that it's a tr - high-traffic-flow area makes the volume of the compartment, I'd say, marginal. Now don't get me wrong. I mean it's not hard to get - get in and get through there and so forth, but I just question the wisdom of locating an airlock in that position, relative to the major activity area - that is, between major activity areas and the workshop.

356 19 27 23 PLT

Ceiling-floor proximity: Course, you can move around there with no problem. Ingress, egress: No problem. No, it's no problem. The hatches -

Reference 8

POGUE

And it would be another - Another nice thing to have along with that would be a warning device that was some - that did something to tell you when you were within 5 minutes or 2 minutes or 1 minute to the end of the tape. Then you'd know you'd have - you'd - well that, at least, would be a warning.

QUERY

Are you talking about a ... or an audio?

POGUE

Either one. Both. One that has both, because sometimes the audio would get back on your mike, you could - It would be nice to have both of them.

QUERY

The next question has to do with the TVIS locations. And would you have liked to have seen more TVISs for different rotations or were your cables adequate in length?

CARR

Well, the cables were adequate in length. I guess the locations were okay and the big problem with the cables was that they just got in the way and it would have been a whole lot better to have had cables on - on caddies or something like that, you know, these inertial reel things like you get at the gas station, essentially. You pull it out and you - then you let go of it and that goes back. If you could have one with an inertial locking system on it where you could pull out as much cable as you want and

CARR
(CONT'D)

then lock it like the seat belts on your car and then use the cable and when you're through with it, you'd give it a pull and let it go back. That would have certainly have been a lot neater organization up there. But, of course, I don't think that's your problem as much as it is people that are just designing the workstations. But things like that would certainly have made the TV system easier.

GIBSON

I think I would like to have had one more station in the MDA. There was one adjacent to the ATM and I would like to have had one opposite - on the opposite wall, closer to the CSM. Because many - many times in doing TV in there you had to rig that wire and run it all the way around the vehicle. 180 around and then along the axis some way and if you wanted to leave the TV set up you had to really tie that thing down so someone - no one - someone else couldn't snag on it coming through.

CARR

Yes, that's a good point. You probably could have used the one right there at the EREP area.

QUERY

Yes. EREP activities.

CARR

Yes, so we didn't have to string the cable.

Reference 9

POGUE Yeah, I understand. I used ... Did you use them any time?

CARR I never used them, but Ed did on - -

POGUE I did and Ed did. And the biggest problem was finding the cables, hooking the cables and stringing them up. And I think you had to hook the lights on to a universal photographic - photography mount. No problems. They worked. They - I remember they were sort of awkward. You bend it around and twist and everything to get the thing pointed the right way, but then we did that with the same - that was the problem with mount, not the light.

CARR Also, in the tech debriefing, we made a pitch for cable caddies, instead of fooling with all of those utilities cables that we had that had to be coiled and strapped. The - the cable caddy is one that you pull on that's got an inertial lock like a seat belt in your car.

POGUE And each one of them ought to be pattern coded, or color coded, so that you know whether you have a utility cable, a high-power cable, a television, a camera cable, et cetera, et cetera. Because they are all white, well, of course, some of them are bigger than the others, but it is nice to have them that way.

QUERY

You'd recommend a color coding?

POGUE

A color coding or a pattern coded.

QUERY

Okay. Assess the adequacy of the portable high-intensity photo light.

CARR

They were quite adequate. They were rather directional in nature, so they caused shadowing for photographing.

POGUE

I got one big bug-a-boo about the high-intensity light. Functionally, they were great. The photography was good. But it - every time I turned those on, I got - was reaching over and getting a wrong switch and everything. In a way, it seemed like you always put the thing in position quick before you turn it on and you're always facing the front of it and the switches were always in the back, or hard to get to.

CARR

Out of sight.

POGUE

Out of sight. It would have been much nicer if the control would have been easily accessible from the business end of it. Because that's the end you were always facing.

QUERY

Speaking of the switches, what operating modes - Do you recall what operating modes you used?

Reference 10

POGUE Always the high, on.

QUERY High stop put at half?

CARR Yeah. Both channels, both ...

QUERY Was there a problem of heat out of those?

POGUE ... heat.

CARR Yeah, but they sure did some - It sure makes beautiful light for a photograph. The documentary photos are all very well lighted. We were very well pleased. And the M151 people are very pleased, too, because the light gave them some real good data, particularly M092.

POGUE Along that line, another thing too, with these cable caddies and all, there should be central repository for placing and stowing these things. You know, like you'd have one locker dedicated for all these cable caddies and so forth. It was a little bit of a management problem, in that you didn't know who had had it last and he had left it - where he had left it and so forth. We had a sort of a system, but it was not designed into it. That should be designed into it, a locker or something like that.

QUERY

Have some questions on wire harnesses and installations, any comments on any electrical equipment or wiring there- to that appeared to be an annoyance or hindrance to movement in the workshop.

POGUE

Well, we had the - you had the - this thing that you did right near the end where you had the cable stretched to the airlock. When we were doing the 516, multipurpose furnace experiments, 556 and all, a big number of them, we had the cable stretched through from the OWS dome area all the way up to around the tape recorder. But the reason we had it for the video tape recorder was because we had taken the power out for the tape recorder and had hooked up 516 to it. That was a bit of an annoyance.

CARR

Yeah, when we put the rate gyro six pack in, when Bean and his guys put it in, that automatically tied up one - one high-power outlet. And so what we had to do in order to get high power into the MDA for the things that we wanted was to run a big extension cord in from the dome.

QUERY

Yeah.

CARR

That was a bother.

QUERY

Actually, this question was down in the workshop, but that's good to get those comments, too.

CARR

Oh, I don't remember any annoying wire runs at all down in the workshop.

POGUE

The only - we had to camera thread - the threading camera had to have a cable run from a particular position. Again, this would have been, I think, adequately taken care of if we would have had cable caddies, but we're thrashing around taking them out and putting them in and that sort of thing.

CARR

The cable runs that bugged us the most are the ones we had to run ourselves.

QUERY

Yeah, that'd be natural. Was - and again this was OWS cable - was any excessive fraying or damage observed to Fiberglas cloth covers or wire harnesses at penetrations in the floor or other areas?

CARR

No, they were very well ...

QUERY

One of the other crewmembers said coming out of the waste management area and something that they used one of the cables as kind of a handhold and that it did start kind of wearing somewhere down in - in the living area there.

Reference 11

QUERY

Was the clearance adequate for mating and demating of connectors on the intercom boxes? Again, this is the OWS.

CARR

There's two intercom boxes that we played with, the M131 or SIA number 131 had to be changed out and then the other one down in the experiment compartment by M131. We disconnected and connected that up for a documentary photography and in those cases there were no problems.

QUERY

Now a few miscellaneous questions. Assess the utility outlet adequacy, accessibility, number and location of utility outlets.

POGUE

There's no problem with any of them. There was no problem with any of the outlets. It would be nice to have one more on the minus-Z SAL, because that's where all of our activity was and we ended up a lot of times having to un - disconnect certain things in order to connect other things up. That's only - -

CARR

Well, see if you had a cable caddy right there for each one of the outlets - if it had just - was right into a cable caddy, then it would have been very handy because whenever you finish with it, you just let it go back into the caddy and what you would do is size your caddy so that it can make the minus-Z SAL or over to the film

CARR
(CONT'D)

threading station or places like that. And it would have been very - a whole lot more handy that way. The way it was - the way we used it, you had to string a cable and you hope that it would stay there and nobody would need it. But it never failed, somebody else always needed the cable and would take it down and use it. Then you - next time you wanted to use it there, you'd have to go find the cable and put it back in. And this is overhead time that you don't want to spend in space, stringing cables.

QUERY

You have answered part of this now; I'll just give - Any problems or comments or problems with replacement of intercom boxes? I guess you discovered that you didn't have any - or heaters. Did you replace any heaters?

FOGUE

No, I don't think any of them ever came on.

CARR

Yeah.

QUERY

I know the duct heaters didn't.

CARR

The only heater that we did - did anything to was that probe into waste - -

FOGUE

That's right. We took that out at first and then put it back in near the end.