

CB

October 4, 1973

MEMORANDUM

TO: DD4/J. R. Hordinsky

FROM: CB/W. Thornton ✓

SUBJECT: Scheduling for SL-4

The following are the long delayed answers to your questions. The memo given you 2 weeks ago described rather fully the pre and post-flight requirements, the rationale, methodology and gave exactly the proposed pre and inflight schedule of the anthropometric study.

Since the CYBEX gear is being put in B-7 it would be logical to combine EMG with it. This is not desired by the "official" electromyographers and is being dropped from consideration.

I have talked to Hoffer, Rummel, and Whittle, and the following schedule was agreeable.

The Leg-1 measurement is the multiple circumference determinations using the tape jig that is currently being done by Hoffer. Arm is a similar series being done by Rummel as is the trunk; however, the latter uses a simple tape. A single leg and arm determination will be made in flight. Estimated performance times are 8 minutes for Leg-1 (it is assumed the same time will be required for the crew for one leg and arm as for the double ground measurement) and 12 minutes for arm and trunk.

The photo is a front side and rear view using a Hasselblad and dedicated magazine with a special film. Time should not exceed 3 minutes/subject.

Stereo photos require an estimated 10 minutes/subject, but this is the responsibility of Whittle.

William Thornton

Enclosure
cc: DB2/G. W. Hoffer DB6/J. A. Rummel DB3/M. W. Whittle

CB/WThornton:cao:10/4/73:2321

Preflight

	Leg-1	Arm	Trunk	Photo	Stereo Photo
F-30	+	+	+	+	+
F-15	+	+	+	+	+
F-5	+	+	+	+	+

Inflight

F+1					
2	+	+	+	+	
3					
4	+	+	+	+	
5					
7	+	+	+	+	+?
14	+	+	+		
28	+	+	+	+	
56	+	+	+		+?
67	+	+	+	+	

Postflight

R+0	+	+	+	+	
R+1	+	+	+		+
R+2	+	+	+	+	
R+4	+	+	+		
R+5	+	+	+	+	
R+14	+	+	+	+	+
R+28	+	+	+		+

ANTHROPOMETRIC STUDIES FOR SL-4

The value of detailed measurements of crew body size and configuration before, during, and after exposure to weightlessness should be obvious. The multiple circumference measurements of Hoffler, for example, allows volume determinations of limbs to 100 cc. It is now obvious from this data and mass data that fluid shifts occur over the period of a few days after exposure to and return from weightlessness. Documentation of these changes over the entire body will add a great deal to the knowledge of these fluid shifts. Such measurements will also document slower changes that occur in body morphology through fat/muscle derangements.

There have been consistent reports and spotty photographic evidence of acute change and accommodation in body and facial configuration caused by gravitational unloading and possible fluid shifts. Everyone, for example, has seen the "puffy" facies of weightlessness which seems to disappear over a longer mission. Further the crews have reported lumbar and cervical hyperextension as well as other "postural" changes. They have also commented on engorged cephalic veins. These complex changes can best be documented by photography, especially color photography which will enhance the superficial veins' appearance.

Since there is disagreement over body composition postflight, the best methodology available should be added to the existing radioisotope studies. Total immersion specific gravity measurements, properly done, is generally considered the most accurate.

A very simple way of following shifts in body mass and especially fluids is a simple center of gravity (mass) measurement. This should be done preflight and repeatedly postflight. It would also be possible to do inflight.

Girth Measurements

Methodology - Limb tape jigs which allow accurate girth measurements every three cm. over the entire limb would be accomplished per the enclosed schedule. These plus truncal measurement pre and postflight are currently being accomplished by Hoffler and Rummel. Inflight measurements should be added and will require the addition of tape jigs plus crew familiarization. They should in every case be made in the standard anatomical position. Truncal measurements should include buttocks, abdomen, chest in inspiration and expiration, and also cervical girth. Only one leg and arm would be measured inflight.

Impact - Fabricate and stow tapes, familiarize crew and requires added inflight time which is estimated to be 12 minutes for two men per measurement.

Photography

Methodology - Associated with each girth measurement, a front, rear and side view of each crewman should be made in shorts against a standard grid and in anatomical position. Inflight this would be against the iso-grid. Also inflight a totally relaxed side view should be made of each crewman. All photos should be made using a so-called IR color film which will enhance the superficial venous pattern. Also the same type camera, a 70 mm Hasselblad, lens, filter and flash should be used, and photos taken by the crewmen pre and postflight for training and uniformity. The schedule is included.

Impact - The qualified 70 mm film must be added to a dedicated magazine and stowed. Crew must be trained at an estimated time cost of 30 minutes/man preflight. The estimated time cost is 5 minutes for two crewmen per series plus 5 minutes stowage and unstowage.

Center of Gravity Measurements

Methodology - A rigid back board with a foot board and a roller beneath will allow determination of longitudinal center of gravity measurements. The subject simply lies on the board which is moved until balance occurs. Inflight the subject could extend in the same position as pre-flight without support and with a girth cord which would be repeatedly accelerated until a point of balance was found which would be measured with onboard tape.

Schedule - F-30 and F-1, F+ 7-10 then every 2 weeks. R+0, 1, 2, 3, 7, 30.

Impact - Construction of a simple board. Performance would require approximately 1 minute pre and post and could be combined with a physical. Inflight estimate 10 mins/crewman.

Specific Gravity Study

Methodology - Immersion specific gravity by a group expert in the field such as the Cooper Clinic in Dallas. Should be done as late as possible pre and early as possible postflight.

Impact - Transport of crew and impact on schedule.



William Thornton, M.D.
October 5, 1973