

June 24-28, 1974

EVALUATION OF ASTRONAUTS' ABILITY TO OPERATE APOLLO HAND CONTROLLER DURING
SIMULATED BOOST PROFILE

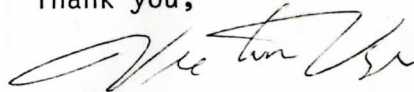
INFORMATION SHEET FOR SUBJECTS

You will be participating in a project to evaluate, under realistic Shuttle acceleration vector profiles for typical ascent from lift-off through MECO, the overall reach and visibility limits and suitability of the Orbiter forward crew station, and the suitability of the F-12 ejection seat/restraint harness/A/P22S-6A pressure suit combination, and to verify that the crew station reach/visibility limits are also suitable under an abbreviated entry acceleration profile.

The following six pages give a general over-view of the program, of which it is assumed you are already familiar. The pages following this will give an over-view of the medical monitoring requirements, as well as safety requirements of the project, and the centrifuge.

If there are any questions, please feel free to ask either Mr. Daymon, or Dr. Voge.

Thank you,



Victoria Voge, LT. MC USN/FS

EVALUATION OF ASTRANAUTS' ABILITY TO OPERATE APOLLO HAND CONTROLLER DURING
SIMULATED BOOST PROFILE

GENERAL CONSIDERATION:

A: The objectives of this test profile are:

1. To evaluate, under realistic Shuttle acceleration vector profiles for a typical ascent from lift-off through Main Engine Cut-off (MECO),
 - a. The overall reach and visibility limits and suitability of the Orbiter forward crew station (right seat), and
 - b. The suitability of the F-12 ejection seat/restraint harness/A/P22S-6A pressure suit combination;
2. To verify that the crew station reach/visibility limits are also suitable under an abbreviated entry acceleration profile.

B: Previous reach and visibility studies have been conducted at Rockwell International and at JSC, both suited and shirt-sleeve, horizontal and vertical. The majority of the problems have been identified in the vertical, suited mode, and critical controls and displays are being located based on this work.

The acceleration profiles to be seen by the Shuttle test pilots during the Orbital Test Flight (OTF) phase of the program are significantly different than any previous experience, both during ascent and entry.

- 1, During ascent and prior to solid rocket motor (SRM) burnout, the acceleration vector is essentially aligned with the X-axis (eyeballs in), with a small eyeballs up component because of the ejection seat back angle (rotated 10^0 aft of the Z axis of orbiter). After solid rocket booster (SRB) separation, this "negative g" portion of the vector is increased because the total thrust vector rotates downward to a line between

the main engines and the center of gravity. Prior to MECO with the acceleration stabilized at 3 g, this negative-g component is slightly greater than 1.0.

2. The Orbiter lift and drag relationship during entry is such that the resultant acceleration vector is practically vertical, causing primarily eyeballs down. For example, at $\alpha=30^0$, and an entry L/D of 1.5, the resultant vector is about 4^0 aft of +Z, and this combined with the 10^0 aft seat cant give an extremely small eyeballs-in component.

This centrifuge test program will simply match typical acceleration profiles and verify that the previous control/display location work is or is not valid.

The "g" load variation will be from (+)3 - (-1)1.12g, as illustrated in the design EQUIPMENT:

1. Orbiter cockpit: the right hand side of the forward Orbiter crew station will be mocked up in a low fidelity fashion (cardboard volumes including drawings of controls and displays). Exceptions and/or additions will be included where appropriate to answer specific questions peculiar to the left hand seat (abort pushbutton, circuit panel L4, etc). The only high fidelity items will be the inclusion of a hand controller and an attitude indicator (8-ball).
2. Ejection seat: The ejection seat will be a standard, unmodified Lockheed F-12 ejection seat, orientated relative to the crew station to simulate the 10^0 cant angle relative to the Orbiter Z axis. This seat is baseline for the OTF program.
3. Pressure Suit: The pressure suit will be a standard A/P22S-6A full pressure suit with a standard (non-bubble) helmet. The suit and helmet are baseline for the OTF program. The suit will be supplied with a 10 CFM air supply from an outside source, checked for hydrocarbon content, at low pressure. The face mask will have a 70 psi air supply from a "tested for purity" bottled source. There will be a 1 1/2" water pressure

difference between the two (greater in the helmet). A visor-down situation is anticipated for the runs.

4. Attitude indicator and Hand controller: the attitude indicator will be installed and driven to match the appropriate vehicle attitude time history for the run being simulated. The attitude error needles will be programmed to provide a tracking task for the test subject using the hand controller (for those runs that the acceleration vector effect on MTVC is being investigated). This tracking task will not affect the programmed attitude display on the 8-ball, nor will it in any way be "closed loop" with the centrifuge itself.

SUBJECTS:

1. Test subjects will be supplied by NASA Space Center, at Houston, Texas, will be astronauts, and whose names are as follows: Col. Joe Engle, USAF; William E. Thornton, M.D.; and Cdr. Richard H. Truly, USN.
2. At the conclusion of the satisfactory completion of the test, any remaining available centrifuge time will be used to familiarize other astronauts with the Shuttle-unique acceleration profiles.

RUN PROFILE AND SCHEDULE:

1. The runs will tentatively take place during the week of June 24-28, the static and dynamic test runs taking place the week prior to this time.
2. Brief description of profiles to be used:
 - a. Ascent Runs:
 1. Familiarization: A typical ascent, beginning with lift-off and going through MECO. Three axis attitude indicator driven with total vehicle attitude. Tracking task available to be flown as desired by subject.
 2. MTVC: Same as familiarization run, except that subject required to solve tracking task during run.
 3. Reach/Visibility: An abbreviated run capability that powers the

centrifuge directly to the "worst case" ascent acceleration vector (3 g acceleration just prior to MECO) and remains there as the subject investigates the cockpit reach/visibility.

b. Entry run:

1. Familiarization/Reach/Visibility: an abbreviated portion of an entry acceleration profile. Three axis attitude indicator driven with vehicle total attitude. Tracking task available to be flown as desired by the subject.

c. Data runs:

1. Each of the three test subjects will make approximately 10 (ten) suited centrifuge runs, distributed as follows:

a. Ascent:	Familiarization	2
	MTVC	2
	Reach/Visibility	4
		<hr/> 8

b. Entry:	Reach/Visibility/	
	Tracking	2

c. Total:		<hr/> 10
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2. Prior to one ascent run for each crewman, a pre-launch period of one hour will be accomplished with the crewman in the 10° head down attitude, in order to subjectively evaluate any effects of the blood pooling that may occur during this time.
3. Deviations to this test run schedule may be made only after agreement between the test subject, other principle test participants, flight director, and flight surgeon and/or MSC.

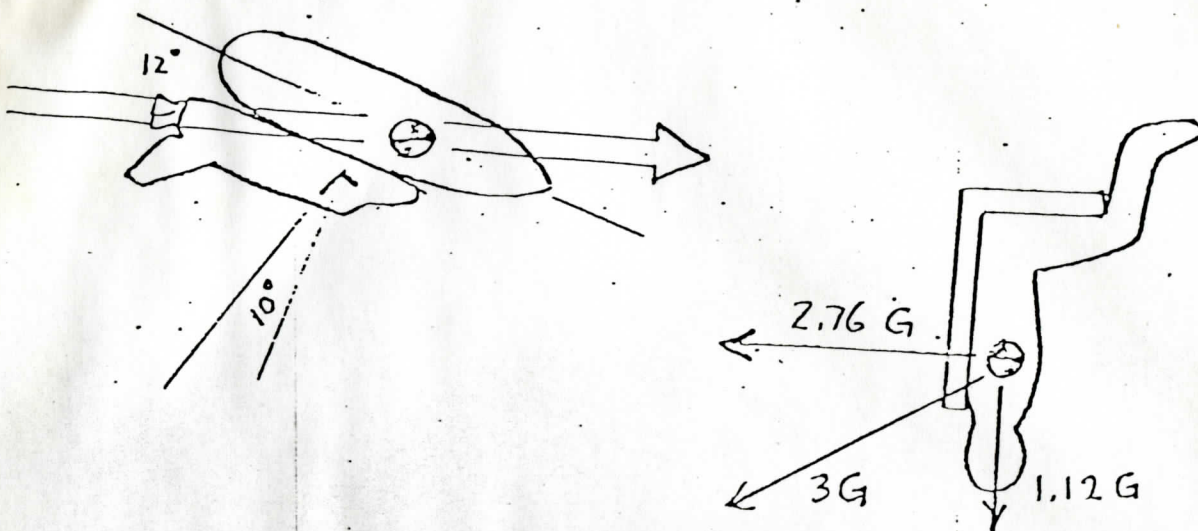


FIGURE 1 - ASCENT

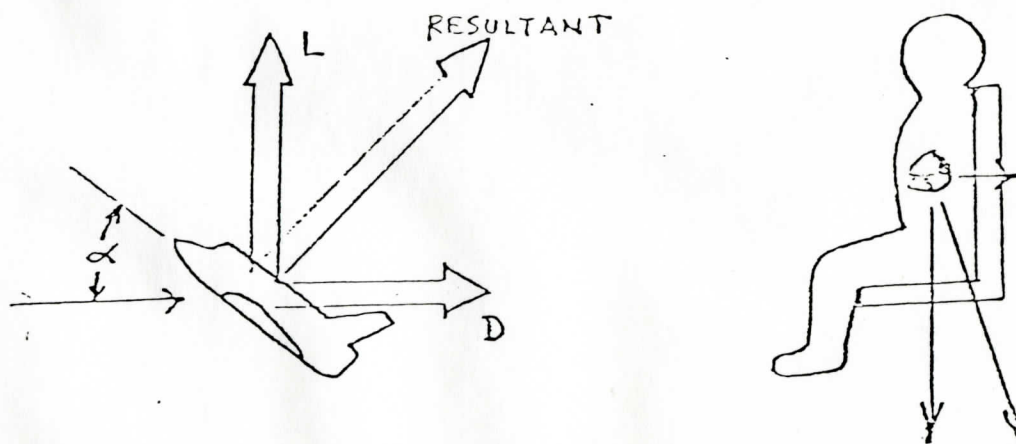


FIGURE 2 - ENTRY

MEDICAL MONITORING:

1. The following parameters will be monitored on the 8-channel medical medical monitor, and/or oscilloscope:

1. EKG--one lead
2. blood pressure (if possible)
3. Gx
4. Gz
5. } hand motion error
6. }
7. } integrated error--roll and pitch
8. }

2. Constant T.V. monitoring of subject's face
3. Constant voice communication (hot-mike).
4. Stop-the-run switch, within easy access of subject

GENERAL CONSIDERATIONS - MEDICAL TEAM CONCEPT

Two hospital corpsmem, supplemented by other military personnel, will be assigned to assist the medical officer. The dispensary, with its ambulance, will be on an "on call" basis, in the event that an emergency requiring such services occurs. The mission of the team is to be able to effectively manage all medical emergencies from occurrence through stabilization, and evacuation to definitive care or hospitalization--without assistance.

A "pre-run" physical examination of the subject will be conducted by the flight surgeon in the designated private area (prep room), with only key medical personnel present. An immediate screening "post-run" evaluation will be made at the conclusion of the session after the subject is removed from the vehicle by flight surgeon and two corpsmem. A "post-run" physical examination and interview will be conducted in an uncomplicated atmosphere on site in relative privacy after the subject has been cleared by the immediate evaluation. Upon completion of the examination, the project engineer will normally be granted access to the subject for program debriefing.

SUBJECT SELECTION CRITERIA

All subjects will be NASA personnel (astronauts), as designated by Houston Space Center. The names of some may be found in another part of this paper.

These subjects will have been found qualified for such duty on the basis of a thorough physical examination within twelve months prior to participation. Preflight instruction should establish subject familiarity with the centrifuge, and the program in general, and the possibilities for potential injury, as well as can be ascertained. Under no circumstances will any subject be exposed to any test condition without his "enlightened" consent. Therefore, subjects will be given prior instructions of possible hazards of each condition--safety precautions to be taken, and in the use of all equipment. He will also be briefed on the progress of the project at each session. It is recognized that the criteria devised in advance cannot adequately encompass all potential medical anomalies or injuries. However, a list of arbitrary criteria will be presented and considered.

EXAMINATION:

All subjects shall have a complete physical examination within twelve months preceding participation in a study. This examination shall be a standard flight physical examination, and the subjects shall not have had any injuries or illnesses within the time since their passing this examination which would eliminate him (them) on the basis of flight duty requirements.

The flight physical examination shall include the following in addition to data obtained during the clinical evaluation:

- a. dental examination
- b. urinalysis
- c. CBC
- d. EKG - 12 lead
- e. chest x-ray -- PA and lateral (L)
- f. ophthalmologic examination
- g. audiometry
- h. complete mental status examination

All subjects shall be free of x-ray and physical examination evidence of gross skeletal defects (e.g. severe scoliosis/kyphosis, spina bifida occulta or degenerative changes), and a review of overt cases by the flight surgeon and orthopedic service will be done, if necessary.

CHRONOLOGICAL DESCRIPTION OF A RUN

1. Pre-run physical examination, to include urinalysis and EKG, and questionnaires.
2. Preparation of subject, to include placement of EKG leads, and blood pressure sensor and cuff.
3. You will be assisted to gondola by corpsmen, and adjustment of suit and harness will be done by NASA technicians.
4. Begin countdown and run.
5. There will be an interval of at least 4 minutes between each "run", and runs will terminate at discretion of project officer.
6. There will be constant voice and T.V. monitor communication between you and flight deck personnel, - the majority of briefing and debriefing will be done during this time.
7. Upon egress from the gondola, you will be assisted by the medical officer, corpsmen, and your suit and harness will be cared for by NASA technicians.
8. You will receive a "post-flight" physical examination by the flight surgeon, and you will be asked for a urine specimen, to answer some questionnaires, and an EKG will be taken.
9. Any further debriefing by NASA personnel will then take place.

All endeavors for your safety will be made. The Hospital corpsmen are well versed in all emergency procedures. Please feel free to ask any and all questions you may entertain.