REQUIREMENTS STATEMENT FOR "G" ORIENTED "G" SUPPORT

BY

J. G. GAUME, M.D. and K. O. ROEBUCK

I. Introduction

National survival in the coming space age will be determined by how soon and how extensively manned space operations can be accomplished. As has been stated in the Martin Space Program proposal, the key to the opening of the space age is the placing of a man in a minimum earth satellite orbit and returning him safely to earth. Once this feat has been accomplished, the door is open to advanced, extensive space operations.

Volume 3 of the Martin Space Program proposal discusses equipment and techniques to accomplisn this task. One of the critical functions is the programing of the highest deceleration possible during re-entry, without harm to the man. Available data indicates that a man is able to withstand approximately 15 g's for one to two minutes if "g" force is applied to his body transverse to his long axis and from front to back. These criteria can be met by a "g" support designed to automatically assume the position optimum for human "g" tolerance and, if possible, containing devices for attenuating the "g" loads imposed on the man.

II. Purpose

The purpose of this program is to verify the feasibility of the proposed "g" support and to determine the best of several possible designs. The program will be accomplished by developing and testing prototype models of the support.

III. Other Factors

A. Known

1) According to performance studies already made on the vehicle in previously referenced Volume 3, the g-load and time history of a vehicle in various re-entry trajectors, is known. From these, the optimum pathways for manned re-entry will be chosen.

2) G-tolerance of man
Optimum position
G: time: tolerance relations

Acceleration Physiologically Effective in g's	Duration of Acceleration
3	9 min. 31 sec.
4	6 min. 21 sec.
5	4 min. 45 sec.
6	3 min. 48 sec.
7	3 min. 10 sec.
10	2 min. 6 sec.
* 15	1 min. plus

* Extrapolated Value

B. Unknown
Physiological effects of a "g"-oriented support.
Optimum "g"-load for orientation producing least physiological effects.
Feasibility and design of "g"-attenuation devices.
Physiological effects of intermittent applications of high "g" loads.

IV. Studies to be Accomplished

Collection and analysis of recent data on human acceleration experiments.
Design of experimental program to fill in insufficient data from item 1.
Materials for support structure.
Optimum "g"-load to orient support.
"G"-attenuation devices.
Availability and specifications of acceleration test devices.

V. Work to be Done

The "g"-support verification program can be accomplished by testing the supports on either a sled track or a centrifuge programed to simulate the required deceleration. It is thought at this time that the sled track test facility should be used for two reasons:

A. It more nearly simulates actual flight conditions, and,

B. It is more accessible to Martin-Denver.

The initiation of the acceleration test program necessitates the following:

A. Negotiation for use of test facilities.

1. Holloman AFB, MDC.
2. Edwards AFB
3. WADC Acceleration Lab.

B. Modification of available test fixtures or design of new ones for prototype testing.

C. Design and development of the proposed "g" support.

D. Programing of testing.

E. Data reduction and feedback into design.

VI. General Discussion of Concept

As discussed in Moon Base Report (E-7) the controls should be designed to be operable by pressure of fingers, toes, rotation or flexion of wrist, thus utilizing motions involving the strongest muscles, small amplitude of movement and those least susceptible to inactivation by high "g" forces.

The control panel should be designed to be in front of the pilot at all times, and thus would have to either be integrated with the "g" support or, possibly, involving the use of two fixed control panels, one for forward and one for reverse acceleration.

The concept of a "g"oriented, completely integrated "g" support, controls and console for a manned space cabin has been proposed for the following reasons:

A. To automatically place a crewman in the position of greatest tolerance to high "g". The support can be designed to orient the man in the optimum position regardless of the amount or numbers of "g" forces imposed upon him. The support would automatically assume the resultant vector of these multiple "g" forces.

B. To increase man's ability to perform a given task during high "g" loads.

C. To design the controls and control panel fully integrated with the "g" support, so as to enable the men to perform as many control and monitoring tasks as possible, during high "g" loads.

Several design configurations may be feasible. Appendix A includes initial specifications and design concepts for this project.

VII. Program Schedule

A. Design--one month.

B. Negotiation for test facilities--one month.
(Track and centrifuge)

C. Fabrication--3 to 4 months.

D. Transport to test site, setting up and calibration--one month.

E. Test--1 to 2 months.

F. Data Reduction--one month.

G. Design verification or modification.

H. Retest if required.