TEST PLAN

Shuttle Manned Centrifuge Test

Naval Air Development Center

Warmenster NAF, Pennsylvania

June 1974

May 20, 1974

INDEX

Introduction

On May 17, 1974, a limited series of manned centrifuge runs at the Naval Air Development Center (NDAC) was approved by the Orbiter Program Manager. The runs are scheduled for June 24-28, 1974. This test plan describes the planned test program.

A test report will be written following the conclusion of the test runs. Comments on the test plan should be directed to CDR R. Truly, (CB), phone 713-483-2221.

Test Objectives

The objectives of this test are to evaluate, under realistic Shuttle acceleration vector profiles for a typical ascent (lift-off through MECO):

1. the overall reach and visibility limits and suitability of the Orbiter forward crew station (right seat), and

2. the suitability of the SR-71 ejection seat/restraint harness/ A/P22S-6A pressure suit combination.

A secondary objective is to verify that the crew station reach/visibility limits are also suitable under an abbreviated entry acceleration profile.

Background Information

Previous reach and visibility studies have been conducted at Rockwell International and at JSC, both suited and shirt-sleeve, horizontal and vertical. The most 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 OTF phase of the program are significantly different than any previous experience, both during ascent and entry:

Ascent

During ascent and prior to SRB burnout and separation, 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° aft of the Z axis). After SRB separation, this "negative g" portion of the vector is increased because the total thrust vector rotates downward on a line between the main engines and the center of gravity (see Figure 1). Prior to MECO with the acceleration stabilized at 3 g, this negative g component is slightly greater than 1.0.

Entry

The Orbiter lift and drag relationship during entry is such that the resultant acceleration vector is practically vertical, causing primarily eyeballs down (see Figure 2). For example, at α = 30° and an entry L/D of 1.5, the resultant vector is about 4° aft of +Z, and this combined with the 10° aft seat cant gives 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.

Test Conductor

NADC will provide a test conductor for this test and will ensure that the test is run as governed by appropriate NADC centrifuge operations and safety instructions.

Test Hardware Description

Orbiter Cockpit: The right hand side of the forward Orbiter crew station will be mocked up in a low fidelity fashion (cardboard volumes

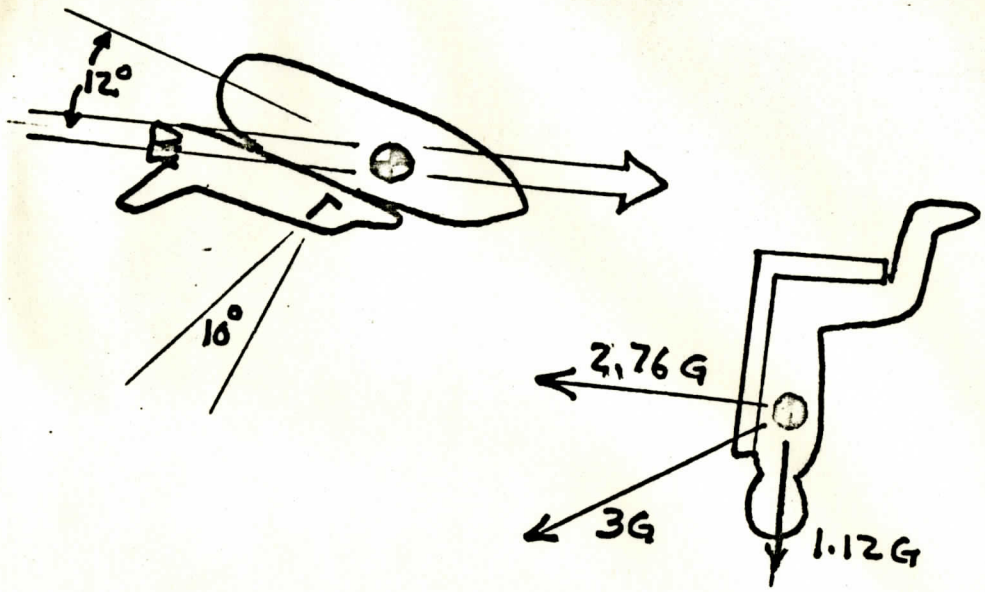


FIGURE 1

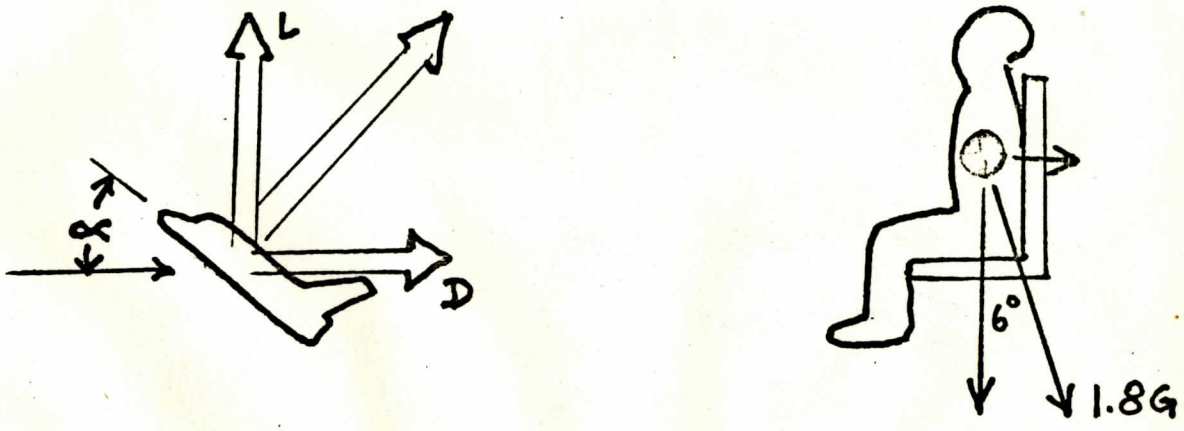


FIGURE 2

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 breaker panel _____, etc.). The only high fidelity items will be the inclusion of a hand controller and an attitude indicator (8-ball).

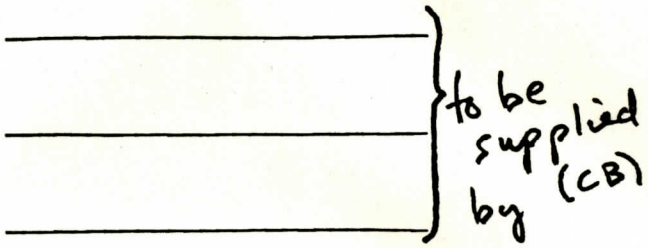
Ejection Seat: The ejection seat will be a standard, unmodified Lockheed SR-71 ejection seat, oriented relative to the crew station to simulate the 10^{o} aft cant angle relative to the Orbiter Z axis. This seat is baseline for the OTF program.

Pressure Suit: The pressure suit will be a standard A/P22S-6A full pressure suit with a standard (non-bubble) helmet. This suit and helmet are baseline for the OTF program.

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.

Test Subjects

Test subjects for the evaluation will be:



At the conclusion of the satisfactory completion of the test, any remaining available centrigure time will be used to familiarize other astronauts with the Shuttle-unique acceleration profiles.

Test Approach and Run Schedule

Each of the three test subjects will make approximately 10 suited centrifuge runs, distributed as follows:

Ascent:	Familiarization	2
	Reach/Visibility	4
	MTVC	2
Entry:	Reach/Visibility/ Tracking	2
	TOTAL	10

Prior to one run for each crewman, a pre-launch period of one hour will be accomplished with the crewman in the 10° heads down attitude, in order to subjectively evaluate the blood pooling that will occur during this time.

Provisions will be made to document (TV or photographically) the test runs, and a ~~briefing~~ debriefing will be conducted after each run.

Deviations to this test run schedule may be made after agreement between the test subject, other principle test participants, and with the approval of the test conductor.

APPENDIX A

JSC Points of Responsibility -

Item	Name	Mail Code	Phone
Test Plan & Report	R. Truly	CB	2221
Ejection Seat	W. Laughlin		
Pressure Suits & Suit Support			
Cockpit Configuration	W. Langdoc		
Attitude Indicator & Hand Controller			
Program Office	F. Haise		
Hardware Transportation Arrangements	H. Hunter		
Tracking Task			
G Vector vs. Time Profile			
Vehicle Attitude vs. Time Profile			