ENGINEERING REPORT/INVESTIGATION

STATIC EJECTION TEST NO. 2 7-31-64

EL CENTRO TEST PROGRAM [redacted] STATINTL

TEST CONDITIONS:

Static ejection out of F-106 A/C, 8:15 A.M. on 7-30-64 Temp. 90° F, wind 5 to 8 k., tail.

Modified parachute and C-2 seat with hi-energy 2174 rocket catapult.

TEST PURPOSE:

To demonstrate static performance of hi-energy rocket catapult and modified parachute.

TEST RESULTS AND CAUSES:

1. Seat rolled and yawed to right, landed 270 feet forward and 320 feet to the right. Attained calculated height of 419 feet.

Cause of Yaw: Hi-energy rocket catapult sensitive to c.g. shift in lateral plane. Normal conditions for this unit and did not adversely affect seat performance.

2. Parachute did not fully deploy.

Cause: Deployment between legs; dummy roll caused right foot to catch chute.

CONCLUSIONS:

1. Parachute operation normal. Chute would have inflated 100-150 feet up if not caught by leg and delayed.

2. A calculated lateral c.g. shift of .25 inches to the right would cause the rocket to thrust seat/dummy to the right as experienced.

This degree of c.g. shift can be expected operationally. Yaw and roll as witnessed is not unusual and is not harmful to a satisfactory ejection. A yaw-roll of one rev. per sec. is fully acceptable and in some cases desirable in order to move pilot let-down out of flight path and probable fire on a low altitude ejection. This degree of yaw has been specifically designed into some seat programs.

The yaw tendency is most pronounced on a static test and least effective on an in-flight test due to the initial forward velocity (equal to speed a/c). It is unlikely that yaw would have been produced on the test configuration if it had been an in-flight test.

RECOMMENDATIONS:

1. That an additional static test be performed. No special effort be exerted to laterally balance or ballast the seat/dummy combination.

All components to be as near operational status as possible.

The dummy is always a problem-arm-leg and hip joints are too stiff on-this test note that the hip joint kept the dummy in a sitting position. It is probable that a man's leg would not have maintained the chute entanglement for such a long period and

permitted chute deployment and recovery.

Check the dummy to insure he doesn't have excessive off center c.g.

Use a new seat - this was the second test on this seat and it may possibly have been warped, although this was checked prior to reuse.

The last time (1963) we made static tests we did not get chute inflation and recovery because of the low altitude performance of the "low-energy" rocket catapults.

On this program we are looking for static recovery if possible. We are using the best performance rocket yet developed to attain this.

Static test parachute deployment and possible entanglement on dummy or seat is still there - but any improvement in "LOW and SLOW" escape envelope is extremely desirable as borne out by ejection statistics.

2. That the programmed in-flight ejection tests proved as planned. White it is recognized that in-flight ejection tests have a degree of risk, it is considered that this seat/rocket combination with its improved performance is safer than the lower performance combination successfully tested in this aircraft a year ago.

HIGH ENERGY ROCKET CATAPULT (2174)

1. The Rocket Power Inc. 2174 high energy rocket catapult used on this program is an improved unit recently developed and fully qualified with industry and the USAF.

Briefly - the improvement over existing rocket catapults consists of an increased sustainer rocket motor impulse. Although the thrust level is no higher for this rocket motor than the existing "low energy" rocket catapults, the thrust is sustained for a longer period of time giving essentially a flat-longer thrust curve.

The thrust and acceleration imparted to the seat/dummy by the catapult portion of the unit is the same for both types of units. (vertical g forces)

The high energy rocket motor has an improved nozzle to completely eliminate rosion of the thrust section, thereby elimination any possible thrust mis-alignment during burning.

2. Test and Service History:

a. 2 in-flight tests for RCAF CF -104 from T33 A/C.

b. Approximately 30 static ejection tests.

F-104 G	5 ea.
CF-104	2 ea.
F-105	2 ea.
F-106	4 ea.
F-101	7 ea.
XC-142	6 ea.
XV4A (Hummingbird)	4 ea.

c. Approximately 17 sled ejection tests (60-600K)

F-106	15 ea.
CF-104	2 ea.

d. Unit approved and installed on:

XV4A Hummingbird
F-104G Test A/C

Approved for installation on:

CF-104
XC-142 L.T.V. Tri-service transport
F-106 - retrofit program

e. Selected as G.F.E. on

VAL
COIN

TEST DESCRIPTION

Seat launch as expected, vertical g's equal 18, from T.M. Rocket ignited and seat sustained roll, head back as expected. Seat also yawed to the right under rocket thrust. At burn out position was back horizontal and face rotated approximately 90° to the right, right side down.

Trajectory continued, forward and approximately 45° to the right. Some roll and yaw continued, but at reduced rate. Seat landed approximately 270 feet forward and 320 feet to the right.

Seat/man separation was good-parachute deployment started-down the outside of right leg, and around and between the legs, finally catching the chute around the right leg and foot.

Dummy had some roll which wound chute around leg resulting in halt to normal deployment. This condition prevailed for 4.3 sec. Dummy's foot rolled back by pilot chute pull and chute cleared right foot, at 2.6 sec, to impact. Line stretch out, quarter bag release appeared normal, and chute started to inflate at impact. Total time was 9.7 sec.

Trajectory ground distance was approximately 420 feet and calculated height was 419 feet.

This data is read from Hulcher prints and summarized on following page.

HULCHER FILM DATA

TEST DATA:

camera	Frame 1	Frame 2	Event	Approx Time-sec	Note
	1	-	Start	0	
	2	-	Rocket ignition	0.2	
	7	6	Burn out	0.7	1/4 rev. yaw and roll
	12	15		1.2	3/4 rev. yaw and roll
	13	16	Lap belt sep.	1.3	Smoke visible
	14		Seat/man sep.	1.4	Feet free
	21	29	Pilot chute visible	2.0	
	31	44	Canopy over rt leg	2.8	Approx. 8 ft. of canopy out
		64	Left foot on canopy		" "
	44	72	Peak trajectory	4.6	" "
		88	Left foot off canopy		" "
	68	108	Canopy off rt. foot	7.1	" "
		121	Quarter bag out		
		139	Lines extended		
	90	140	Quarter bag off		
	93	147	Dummy impact	9.7	
		148	Seat impact		

Trajectory height calculation, using time from Hulcher prints, from peak to impact, and assuming no drag:

$$S = 1/2\ at^2 = 16.1 \times 5.1^2 = 419 \text{ feet.}$$

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