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AUTHORITY

AFRPL ltr, 29 Sep 1971

AFRPL-TR-69-168

ALTITUDE SIMULATION BY TEST FACILITY 1-42B DURING REPEATED START-STOP OPERATION OF A ROCKET MOTOR

John Denker

TECHNICAL REPORT AFRPL-TR-69-168

July 1969

AIR FORCE ROCKET PROPULSION LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
EDWARDS, CALIFORNIA

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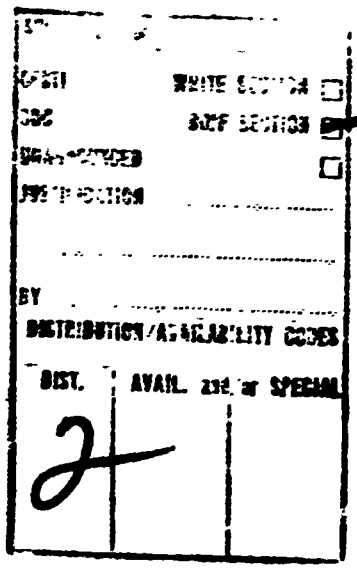
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FOREWORD

The test described in this report was authorized as a part of the Air Force Rocket Propulsion Laboratory's Project 305803ARX which is directed by the Liquid Rocket Division. This project provides the personnel, facility and equipment to simulate the space environment during firings of rocket propulsion systems having up to 50,000 lb_f thrust, including those which utilize toxic propellants. The rocket motor was developed by Thiokol Corporation (Utah) under contract to the Solid Rocket Division of the Air Force Rocket Propulsion Laboratory. Mr. John Denker (RPRO), Mr. Ralph Felix (RPMMA), and Mr. Blen Nance (Thiokol) were the project engineers. The firing was performed on 11 June 1969.

ABSTRACT

One rocket motor assembly was successfully fired and extinguished repeatedly in the low pressure environment of Vertical Test Cell 1-42B at pressure altitudes of 98,000 to 105,000 feet which demonstrated the capability of this design of propulsion system to start-stop on command in the space environment. All components of the test facility functioned properly, making this test firing fully successful.

NOMENCLATURE

A_d/A_*	Area, Diffuser Inlet, in^2/Area, Sonic Throat, in^2
H	Pressure Altitude, feet
P_d/P_t	Pressure, Static/P. Total at Expansion Ratio A_d/A_*,
RPRO	Air Force Rocket Propulsion Laboratory, Liquid Rocket Division, Test Operations Branch
RPMA	Air Force Rocket Propulsion Laboratory, Solid Rocket Division, Advanced Motor Technology Section
VTC 1-42B	Air Force Rocket Propulsion Laboratory, Liquid Rocket Division, Test Operations Branch, Vertical Test Cell 1-42B

I. INTRODUCTION

One rocket motor, which was developed by Thiokol and intended for use in space propulsion systems, was fired in the simulated space environment of Vertical Test Cell 1-42B to determine if this motor design will start-stop thrusting on command in the low pressure space environment, and to determine delivered motor performance. Several signals to start thrusting and several signals to terminate thrusting were sent to the motor to establish reliability of reaction for the design and performance was determined from measurements of combustion pressure, thrust, and cell pressure.

Performance parameters and configuration of the motor are classified, and are therefcre not included in this report of facility performance but will be reported by the contractor.

II. FACILITIES UTILIZED

Data was recorded in digital format on a 192 channel Consolidated Systems Corporation tape recorder, in analog form on direct-inking Westronics recorders, in frequency modulated format on an Ampex tape recorder, and in analog form on a 36-channel Consolidated Engineering Corporation oscillograph. One, 2-stage ejector system, driven by steam, and a 28-inch diameter cylindrical diffuser, which was driven by the rocket motor gas, evacuated the test cell of gases to provide the requested 80,000 feet minimum pressure altitude. Thrust and pressures were sensed by strain-gage type transducers which were energized by direct current. The thrust mount and force measurement system were evaluated prior to use for this series of tests and found to be repeatable to .24% at the 90% confidence level and pressure measurements are repeatable to .5% at a 95% confidence level. The electrical signals which fired the rocket motor were recorded on tape in frequency modulated form on an Ampex (FR 1300) recorder furnished by Thiokol.

III. SIMULATED PRESSURE ALTITUDES

Vertical Test Cell (VTC) 1-42B will theoretically produce pressure altitudes as high as 150,000 feet by use of an engine-driven diffuser in series with up to three, 2-stage steam-driven ejector systems which operate in parallel. During the firings of the Thiokol motor, one 2-stage facility ejector and a cylindrical 28-inch diameter ejector-diffuser, which was driven by rocket gases, were used. Simulated altitude was held well above the minimum requested 80,000 feet (98,000-105,000 feet) and all facility equipment functioned satisfactorily. Figure 1 shows the history of the test facility pressures. Values of pressure from gas tables for isentropic expansion are also shown as a gage for comparison to measured values of facility performance.

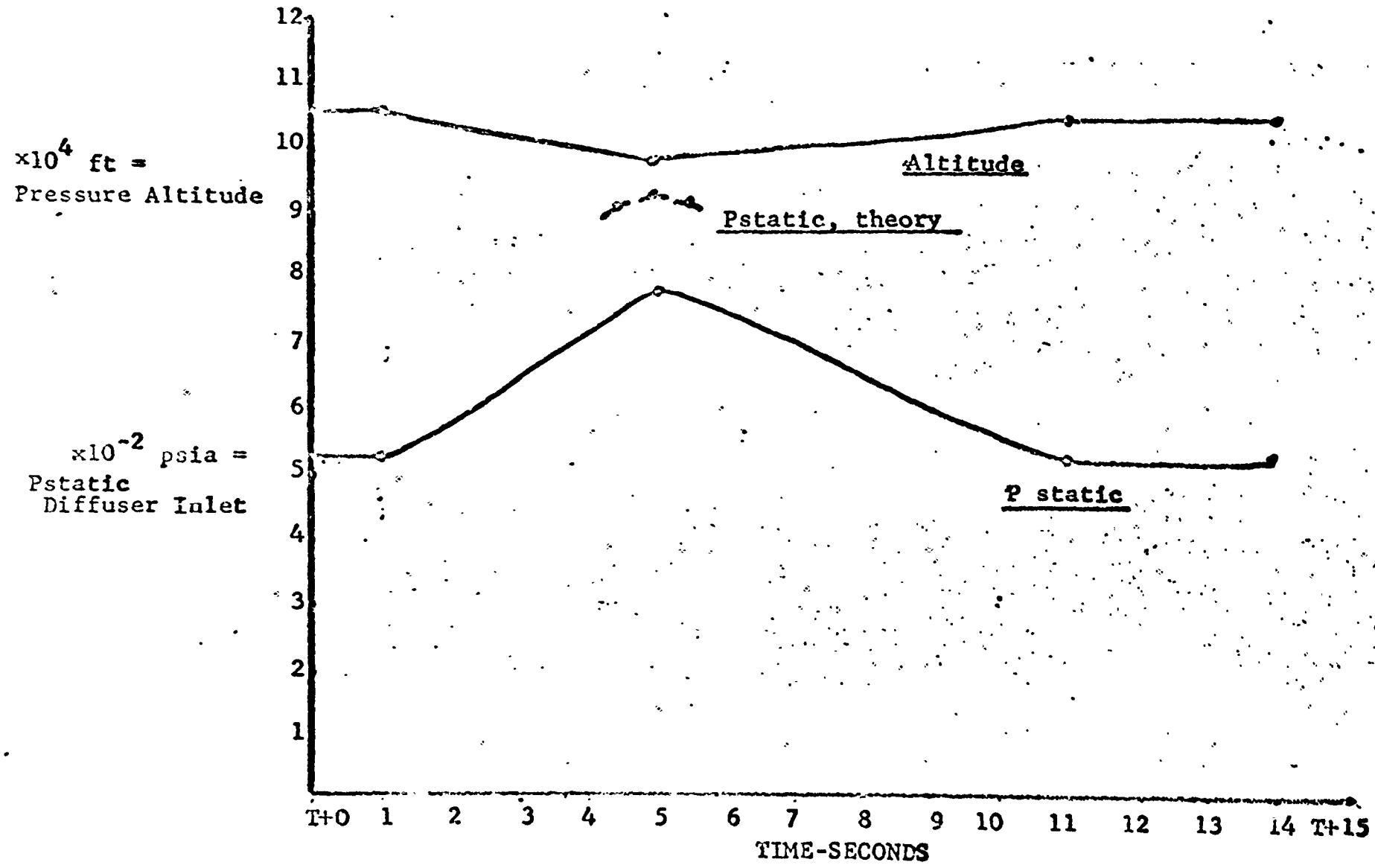

FIGURE I - ALTITUDE SIMULATION BY VTC 1-42B

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*

Air Force Rocket Propulsion Laboratory
Edwards, California 93523

2a. REPORT SECURITY CLASSIFICATION

Unclassified

2b. GROUP

N/A

3. REPORT TITLE

Altitude Simulation by Test Facility 1-42B During Repeated Start-Stop Operation of a Rocket Motor.

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Test Report - 11 June 1969

5. AUTHOR(S) *(First name, middle initial, last name)*

John Denker

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
July 1969	6	None

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. 305803ARX	AFRPL-TR-69-168
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	

10. DISTRIBUTION STATEMENT This document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of AFRPL (RPOR/STINFO), Edwards, California 93523.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Air Force Rocket Propulsion Laboratory Air Force Systems Command, USAF Edwards, California

13. ABSTRACT

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DD FORM 1 NOV 65 1473

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT