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

John Denker

TECHNICAL REPORT AFRPL-TR-69-55

February 1969

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

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FOREWORD

The test described in this report was authorized as a part of 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 14 February 1969.

ABSTRACT

One rocket motor assembly was successfully fired and extinguished repeatedly in the low pressure environment of Vertical Test Cell 1-42B 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
RPMMA	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 therefore 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 (98000 and all facility equipment 93000 ft)

functioned satisfactorily. Figure I 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.

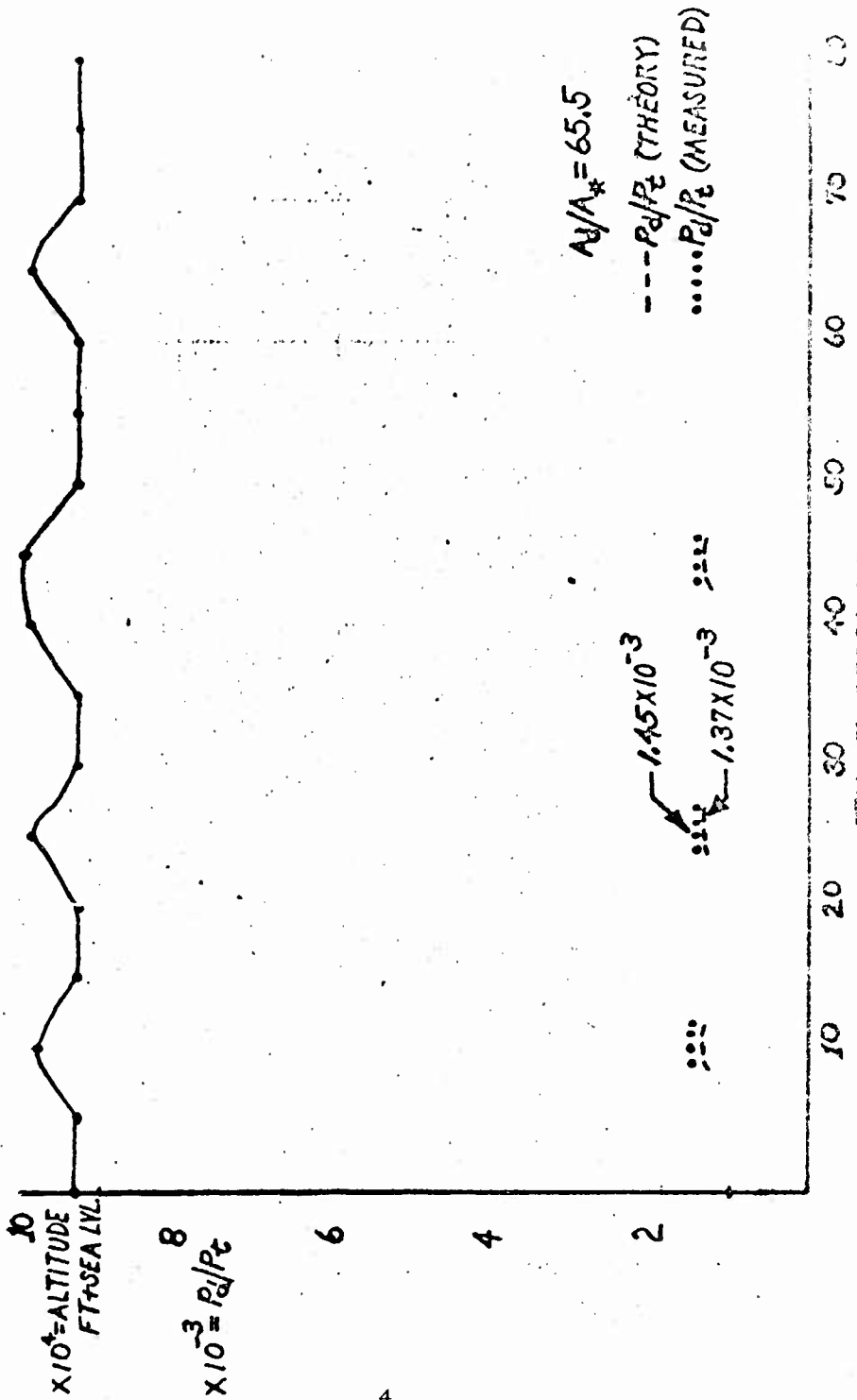


FIGURE 1- ALTITUDE SIMULATION DURING REPEATED PULSES

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