

UNCLASSIFIED

CONFIDENTIAL

D2  
United Aircraft  
ALVRJ/char

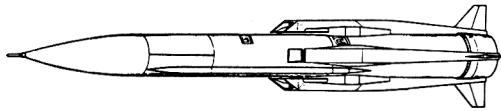
# Propulsion Characteristics Summary

## RAMJET

ALVRJ

(ALVRJ)

United Aircraft  
Research Laboratory  
Hartford, CT  
Spec. None  
(SEE STATUS)



(Advanced Development Program)

(NASC, AIR 536)

## FEATURES

A fixed geometry demonstrator ramjet with an integral solid rocket booster designed primarily for air-to-ground missile applications. The ramjet cruise operation utilizes JP-5 fuel. The solid rocket booster, being developed by the Navy (NWC), is used to accelerate the system from launch velocity to ramjet take-over Mach Number. The system converts from boost to ramjet mode by ejection of the rocket nozzle insert and four plugs at the ramjet inlet diffuser exits, and utilizes the solid rocket case as the ramjet combustion chamber. Modulation of the ramjet fuel flow is provided permitting operation from sea level to 35,000 feet altitude.

## AVAILABILITY

Program Initiated	Feb 68
Development Contract Award	Jun 68
Experimental Engine	Jul 72
Installation Engine	None

## CONTRACTUAL

NASA Contract N00019-68-C-0605 with LTV (MSD) and subcontracted to UARL covers R&D and six hot flight tests during period of Aug 68 through Dec 73 at a total contract cost of \$11,400,000. The solid rocket booster is furnished by the NWC.

## STATUS

The Program was initiated in Aug 68 and will culminate in six hot flight tests between Feb 73 and Oct 73. Engine direct-connect tests and vehicle aerodynamic tests have been initiated. No specification, all data was furnished by the contractor.

## GENERAL

(Design Point (D.P.) = Mach Nr 2.3)

Inlet	Cruciform (4 duct), aft mounted, fixed geometry	Fuel Control	Variable
Area Variable	No	Fuel Equivalence Ratio	0.383:1
Combustion Chamber	Four inlet passages dump into cylindrical section	Fuel Capacity (JP-5)	192 lb
Combustion Inside Diameter	14.9 in.	Fuel Tank	Positive expulsion
A <sub>c</sub> /A <sub>3</sub> Ratio	0.40:1	Fuel Pump	Ram air turbopump
D.P. Combustion Efficiency	98%	Fuel/Air Ratio	0.026:1
D.P. Total Press. Recovery (Critical)	79%	Hot Section Material	Inconel I718
Exhaust Nozzle	Convergent-divergent, A <sub>5</sub> /A <sub>3</sub> = 0.511, A <sub>6</sub> /A <sub>3</sub> = 0.700	Operating Temp Range	-85 to 100 °F
Exhaust Nozzle Exit Diameter	12.87 in.	Acceleration Limits:	
D.P. Nozzle Efficiency	96%	Axial/Lateral	20/10g
Ignition	Pyrotechnic or pyrophoric	*Booster, Solid Rocket:	
Ignition Limits	---- to ---- F/A	Propellant	**C-483
Fuel	JP-5, MIL-T-5624	Propellant Weight	403 lb
Fuel Injection	Spray nozzles in four inlet diffusers prior to dump	Prplt Sp Impulse	243 lb-sec/lb
		Average Thrust	22,700 lb
		Action Time	4.13 sec
		Avg Chamber Pressure	1150 psia
		Igniter	Pellets, pyrotechnic

\*All booster performance based on 59 °F and sea level operation.  
\*\*AP/CTPB/AL/Benzene/Iron Oxide (67/14.413/17/0.587/1%).

## SIZE & WEIGHT

Length, Overall (with tank)	98.5 in.
Diameter, Nominal	15.0 in.
Weight, Ramjet at Takeover	
Operation (w/o inlets, wet)	502 lb
Weight, TV at RJ Takeover	1027 lb
Weight, TV Launch Weight (Goal)	1467 lb

## UTILIZATION

An Advanced Development Program providing an experimental demonstrator engine directed toward potential application for Air-to-Ground Missiles.

DOWNGRADED AT 3 YEAR INTERVALS;  
DECLASSIFIED AFTER 12 YEARS  
DOD DIR 5200.10

7/11/80

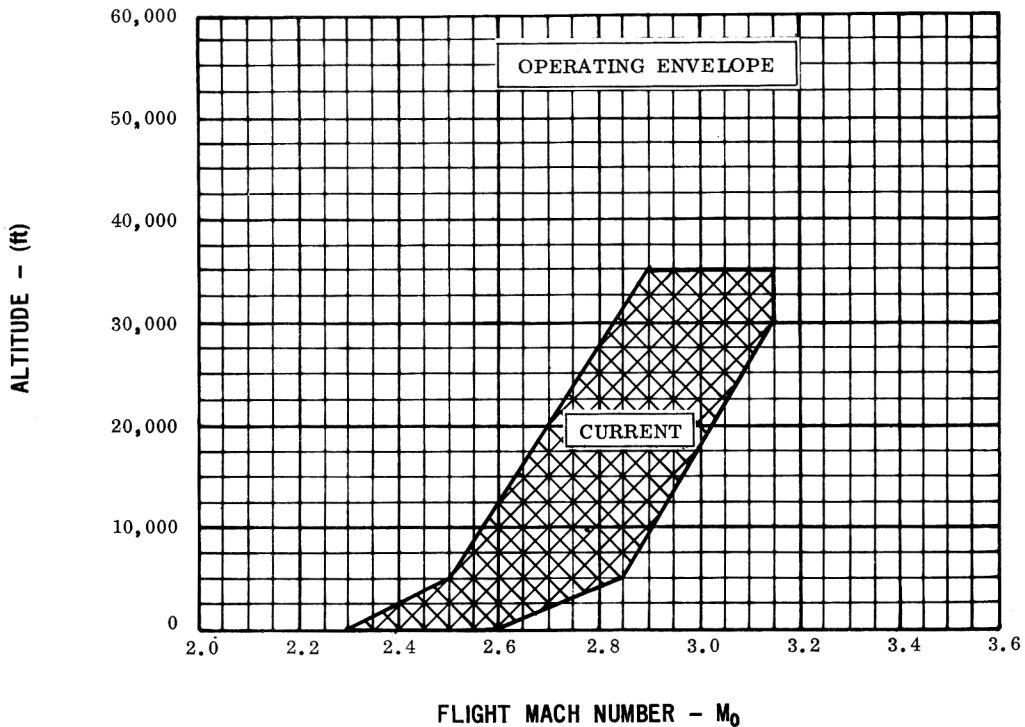
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# Performance

## ESTIMATED RAMJET CRUISE PERFORMANCE (FLIGHT TEST)

MACH NUMBER	2.53	3.07
Altitude (ft)	500	35,000
Net Jet Thrust (lb)	2940	966
Net Jet Thrust Coefficient	0.258	0.239
Exhaust Nozzle Coefficient	0.98	0.98
Net Jet Specific Impulse (sec)	1090	1110
Specific Fuel Consumption (lb/hr/lb)	3.300	3.240
Fuel Flow (lb/sec)	2.660	0.900
Combustion Chamber Pressure (psia)	120	-----
Inlet Total Pressure Recovery (%)	69%	44%
Combustion Chamber Gas Temp (°F)	2680	2770
Test Vehicle Predicted Range (N. Mi.)	35	110

## U.S. STANDARD ATMOSPHERE 1962 - ESTIMATED PERFORMANCE



## ENGINE SCHEMATIC

