Standard Missile Characteristics

SM-64A

NAVAHO
North American

TWO XJR47-W-7
WRIGHT
ONE XLR83-NA-1
NORTH AMERICAN

BY AUTHORITY OF
THE SECRETARY
OF THE AIR FORCE

1 MAY 57
SECRET

SM-64A
POWER PLANT

Nr & Model: (2) XR147-W-7  
Mfr: Wright Aeronautical  
Engine Spec Nr: 179, 4, 179, 5  
Length: 48.0"
Weight: 1250 lb

BOOSTER
Nr & Model: (1), XLR83-NA-1  
Mfr: North American  
Engine Spec Nr: PC-78-8  
Fuel Type: JP-5  
Oxidizer: Liquid Oxygen  
Chambers: 3  
Fuel Feed: Turbine Pump

ENGINE RATINGS

Design Mach Nr: 3.25  
Altitude (ft): 45,000  
Thrust (lb): 20,970

BOOSTER
S, L: Static LAB SEC  
Max: 415,000 110

DIMENSIONS

Wing: 40.2"  
Incidence: 0°  
Dihedral: 90°  
Length: 87.3"  
Height: 14.9"  

BOOSTER
Length: 91.5"  
COMBINATION
Length: 95.2"

GUIDANCE

SYSTEM
  * Inertial  
CONTROL  
System: Auto-Navigator and Auto-Pilot

ACCURACY  
CEP - 50% hits within 2 nautical miles  
* No radiating equipment

LAUNCHING

LAUNCHED VERTICALLY FROM A CONCRETE PAD USING AN ERECTED VEHICLE ADAPTABLE TO EMBRACE BOOM OR MOBILE CONCEPTS OF OPERATION.
PREPARATION AND LAUNCH TIME

Variable between 8 to 16 hours depending upon permanency of the base or operations, includes time for assembly of aerodynamic fixtures, check-out of all systems, guidance system alignment, fueling and launching.

WARHEAD

Type: Special Store  
Weight (lb): 7000

Type: Alternate  
Weight (lb): 3000 or 15,000

FUZE  
Barometric switches backed up by an electromagnetic or piezoelectric contact fuse.

Mission and Description

Navy Equivalent: None  
Mfr's Model: -

The SM-64A is a surface-to-surface supersonic strategic missile, the primary mission of which is the destruction of enemy targets at ranges up to 5500 nautical miles.

The missile is a canard configuration with a parallel, expendable liquid rocket propulsion booster mounted on the underside of the vehicle. The wings are a mid, low-thickness ratio trapezoidal design. The fuselage features side inlets incorporating multi-shock supersonic diffusers.

The entire airframe is of titanium stressed skin design and includes multi-cell wing construction.

The control surfaces consist of a rear vertical tail surface, forward horizontal surfaces and triangular wing tip ailerons. All of these surfaces are completely movable. In addition the three thrust chambers of the rocket engine on the booster are individually hinged for control during launch.

The missile warhead and guidance equipment are housed in a pressurized compartment under controlled temperature conditions. Both the missile and booster propellants are contained in integral tanks which are also pressurized. Nitrogen gas is employed to pressurize the fuel tanks while the booster LOX tank is pressurized by oxygen vapor formed in a heat exchanger.

Additional features of the missile include fuel dumping provisions for short range missions and an auxiliary power plant which is fed by a monopropellant.

Development

The SM-64A is the ultimate vehicle in the WS-104A (NAVYHO) program and will meet the military requirements for the 5500 nautical mile range.

Release of XSM-64A to detailed design accomplished Dec 54  
Initial flight of recoverable version (XSM-64A) Jun 58  
First flight of SM-64A (operational suitability tests) Sep 61

WEIGHTS

Loading  Lb  
Empty: 24,400 (E)  
Final: 32,300 (E)  
Gross: 120,500 (E)

BOOSTER
Empty: 12,850 (E)  
Final: 16,450 (E)  
Gross: 169,500 (E)

TOTAL
290,000 (E)

(E) Estimated—Based on a 7000 lb payload

FUEL

Location  Nr Tanks  Gal  
Forward 3 7742  
Nacelle 2 4116  
Total 5 7164

Grade: JP-5  
Specification: MIL-F-5624

BOOSTER
Forward Tank: (tot) 10,785  
Oxidizer: Aft Tank: (tot) 10,785

Type: Liquid Oxygen

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SM-64A
## Loading and Performance—Typical Mission

<table>
<thead>
<tr>
<th>CONDITIONS</th>
<th>DESIGN MISSION</th>
<th>ALTERNATE MISSION</th>
<th>ALTERNATE MISSION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LAUNCH WEIGHT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combination (lb)</td>
<td>290,000</td>
<td>280,000</td>
<td>290,000</td>
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<tr>
<td>Missile (lb)</td>
<td>120,500</td>
<td>117,000</td>
<td>120,500</td>
</tr>
<tr>
<td>Fuel (JP-5, 6.88 lb/gal) (lb)</td>
<td>86,500</td>
<td>86,500</td>
<td>77,800</td>
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<tr>
<td>Payload (lb)</td>
<td>7,000</td>
<td>3,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Booster (lb)</td>
<td>169,500</td>
<td>163,000</td>
<td>169,500</td>
</tr>
<tr>
<td>Fuel (JP-5, 6.88 lb/gal) (lb)</td>
<td>50,120</td>
<td>47,990</td>
<td>50,120</td>
</tr>
<tr>
<td>Oxidizer (LOX, 9.52 lb/gal) (lb)</td>
<td>102,790</td>
<td>98,380</td>
<td>102,790</td>
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<tr>
<td>Wing loading (psf)</td>
<td>161</td>
<td>156</td>
<td>161</td>
</tr>
<tr>
<td>Take-off Thrust/Duration (lb/sec)</td>
<td>405,000/96</td>
<td>405,000/90</td>
<td>405,000/96</td>
</tr>
<tr>
<td>Time, Take-off (sec)</td>
<td>120.0</td>
<td>114.0</td>
<td>120.0</td>
</tr>
<tr>
<td>Booster Assisted SL-59,000 ft (sec)</td>
<td>96.0</td>
<td>90.0</td>
<td>96.0</td>
</tr>
<tr>
<td>Ramjets Firing 59,000-70,000 ft (sec)</td>
<td>24.0</td>
<td>24.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Range to Booster Separation (n, mi)</td>
<td>27.0</td>
<td>27.0</td>
<td>27.0</td>
</tr>
<tr>
<td>Peak Mach Nr at Rocket Cut-Off (n, mi)</td>
<td>3.45</td>
<td>3.45</td>
<td>3.45</td>
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<tr>
<td><strong>COMBAT RANGE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Launch Altitude (n, mi)</td>
<td>5300</td>
<td>5830</td>
<td>4530</td>
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<tr>
<td>Average Cruise Speed (kn/M)</td>
<td>1868/3.25</td>
<td>1868/3.25</td>
<td>1868/3.25</td>
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<tr>
<td>Initial Cruising Altitude (ft)</td>
<td>57,400</td>
<td>58,000</td>
<td>57,400</td>
</tr>
<tr>
<td>Final Cruising Altitude (ft)</td>
<td>82,900</td>
<td>85,100</td>
<td>78,600</td>
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<tr>
<td>CEP (%/n, mi)</td>
<td>50/2</td>
<td>50/2</td>
<td>50/2</td>
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<tr>
<td>Total Flight Time (hr)</td>
<td>3,050</td>
<td>3,233</td>
<td>2,53</td>
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<tr>
<td>Burnout Weight (lb)</td>
<td>32,300</td>
<td>28,700</td>
<td>41,300</td>
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<td>Time (hr)</td>
<td>3.02</td>
<td>3.20</td>
<td>2.53</td>
</tr>
<tr>
<td>Altitude (ft)</td>
<td>82,900</td>
<td>85,100</td>
<td>78,600</td>
</tr>
<tr>
<td>Distance (n, mi)</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Mach Number at End of Slow-down</td>
<td>2.8</td>
<td>2.8</td>
<td>2.8</td>
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<tr>
<td><strong>TERMINAL DIVE</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Distance (n, mi)</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Altitude (ft)</td>
<td>90,300</td>
<td>92,600</td>
<td>85,300</td>
</tr>
<tr>
<td>Impact Speed (kn/M)</td>
<td>850/1.3</td>
<td>784/1.2</td>
<td>1057/1.6</td>
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<tr>
<td>Impact Angle (deg)</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
</tbody>
</table>

### NOTES
1. Launch Thrust (booster only)
2. Cruise Thrust
3. Ramjets ignite at 59,000 ft, booster separates at 70,000 ft.
4. See Note b = page 6

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Performance Basis:
(a) Data source: Contractor's Estimate
(b) Performance based on powers shown on page 6

SM-64A

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NOTES

FORMULA: DESIGN MISSION

Launch of Missile-Booster Combination: Missile is launched vertically from sea level with a predetermined altitude-time boost program. A gradual forced turn is initiated at 3500 feet. The forced turn is completed at 51,000 feet (altitude-150°) and a zero-lift ballistic trajectory phase is entered. At 59,000 feet, (altitude-160°) rocket cut-off and ram-jet start is effected. The missile continues in the zero-lift ballistic trajectory to end of boost (M 3.25) until an altitude of 70,000 feet is reached. At which point the booster separates from the missile.

Transition to Cruise: Mach number control is initiated and the missile is brought to equilibrium at the initial cruise altitude, altitude and cruise Mach number.

Cruise and Dive-in: Missile cruise-climbs Mach 3.25 until altitude of 82,000 feet is attained. At this point (approximately 35 nautical miles from target) ram-jets are cut off, a pitch-up of 5° to altitude of 90,000 feet is accomplished. At this peak altitude the missile decelerates to Mach 2.8 and the automavigator range and rate signal initiates dive-in. The dive-in is conducted in the power-off condition and missile impacts at Mach 1.3 (sea level).

FORMULA: ALTERNATE MISSION I

Launch of Missile-Booster Combination: Same as for Design Mission

Transition to Cruise: Same as for Design Mission

Cruise and Dive-in: Missile cruise-climbs at Mach 3.25 until altitude of 85,100 feet is attained. At this point (approximately 35 nautical miles from target) ram-jets are cut off, a pitch-up of 5° to altitude of 92,000 feet is accomplished. At this peak altitude the missile decelerates to Mach 2.8 and the automavigator range and rate signal initiates dive-in. The dive-in is conducted in the power-off condition and missile impacts at Mach 1.2 (sea level).

FORMULA: ALTERNATE MISSION II

Launch of Missile-Booster Combination: Same as for Design Mission

Transition to Cruise: Same as for Design Mission

Cruise and Dive-in: Missile cruise-climbs at Mach 3.25 until altitude of 78,000 feet is attained. At this point (approximately 35 nautical miles from target) ram-jets are cut off, a pitch-up of 5° to altitude of 85,200 feet is accomplished. At this peak altitude the missile decelerates to Mach 2.8 and the automavigator range and rate signal initiates dive-in. The dive-in is conducted in the power-off condition and missile impacts at Mach 1.6 (sea level).

GENERAL DATA:

(a) Ram-jet engine ratings shown on page 3 are engine manufacturer’s estimated design point performance ratings. Liquid rocket ratings are engine manufacturer’s guaranteed ratings. Power values for performance are as follows:

<table>
<thead>
<tr>
<th>Flight Mach No.</th>
<th>NACA Pressure Altitude (ft)</th>
<th>Gross Thrust (2 engine) (lb)</th>
<th>Specific Impulse (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.25</td>
<td>45,000</td>
<td>39,000</td>
<td>1587</td>
</tr>
<tr>
<td>3.25</td>
<td>85,000</td>
<td>5800</td>
<td>1587</td>
</tr>
</tbody>
</table>

(b) All performance is for the NACA Standard Atmosphere with no wind. An approximate 1900 lb increase in empty weight has been estimated for the missile carrying the 15,000 lb payload in order to provide strength and stiffness required for the dive-phase. Approximately 400 lb of ballast must be carried for the missile carrying the 3000 lb payload in order to insure adequate stability and control throughout the flight trajectory.

The SM-64A incorporates fuel dumping provisions which will enable missiles with ranges as short as 2500 nautical miles to dive in at weights no larger than those for maximum range. From the stability and control standpoint it is desirable to maintain the same combination gross weights at launch. Hence, for reduced range missions excess fuel is carried aloft and dumped.

REVISION BASIS:

To revise characteristics data.

PERFORMANCE REFERENCE:

N A A, Report No. AL-2076 std Dec 1954