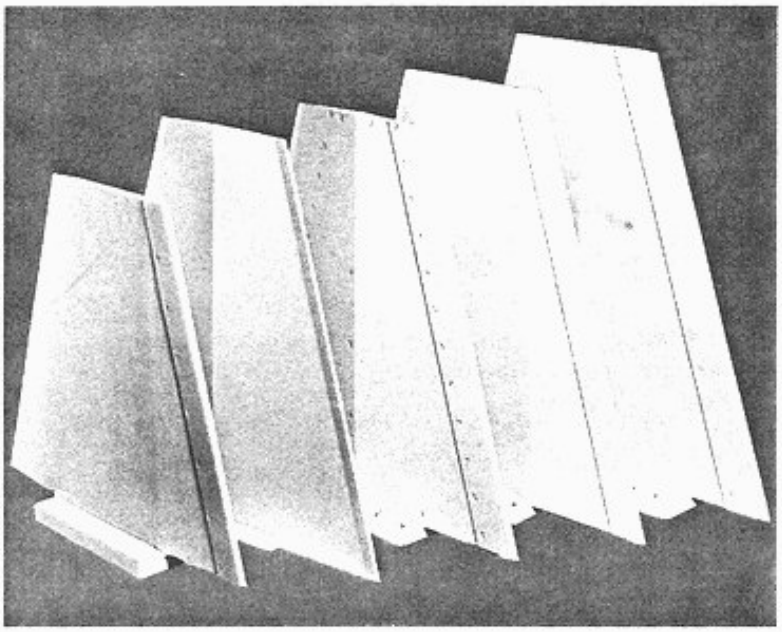
STANDARD FINS

NIKE ROCKET MOTOR

PROVEN HARDWARE CONFIGURATIONS AND SIZES FOR BOOSTER AND UPPER STAGES



MISSILE SYSTEMS DIVISION

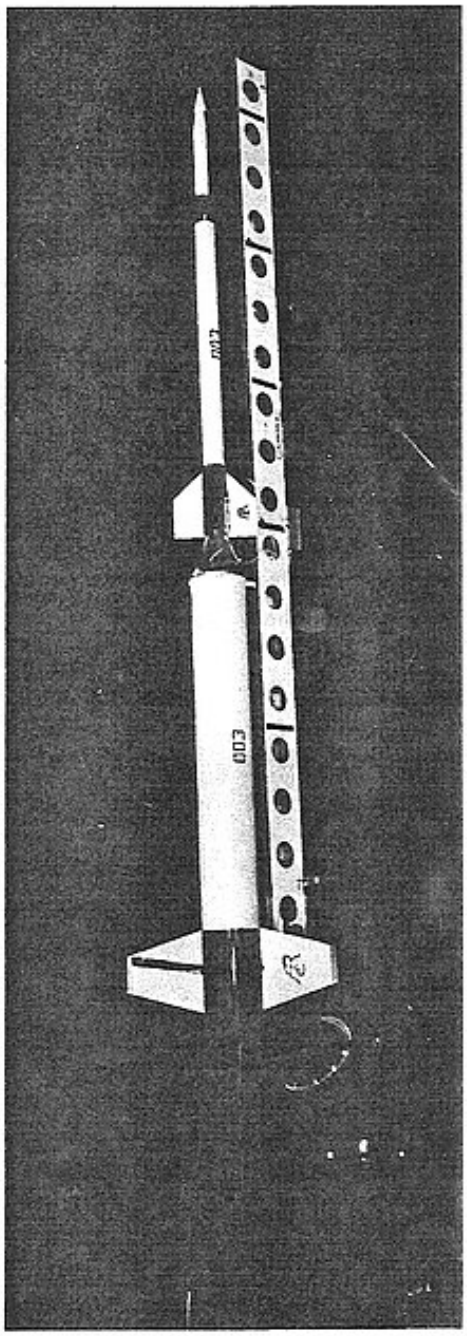
STANDARD NIKE FINS

Atlantic Research has developed an assortment of fin assemblies for application with the NIKE M5, M5EI, or M66 rocket motors. The five different assemblies described in this booklet have been produced in quantity, fully ground tested and are flight proven. Each design features manually adjustable incidence for roll control which can be accomplished in the field with common hand and alignment tools. The variety of style, weight, aerodynamic performance, load capacity and choice of size provides a selection to meet nearly every application requirement.

LIGHTWEIGHT STANDARD FIN (2.5 SQ.FT.)

This assembly is specifically designed to improve the performance and stability of NIKE boosted vehicles at an economical price. The features of low weight and cost are achieved through a unique construction approach without compromise to flight load and trueness requirements. The fins are formed of aluminum panels with foamed interspace support and mounted on an efficient steel supporting structure (shroud). A sleeve covers the shroud and nozzle area to form a smooth stage fairing.

Although commonly used on first stage applications, the Lightweight Standard Fin has the capability for upper stage service.



ENGINEERING FEATURES

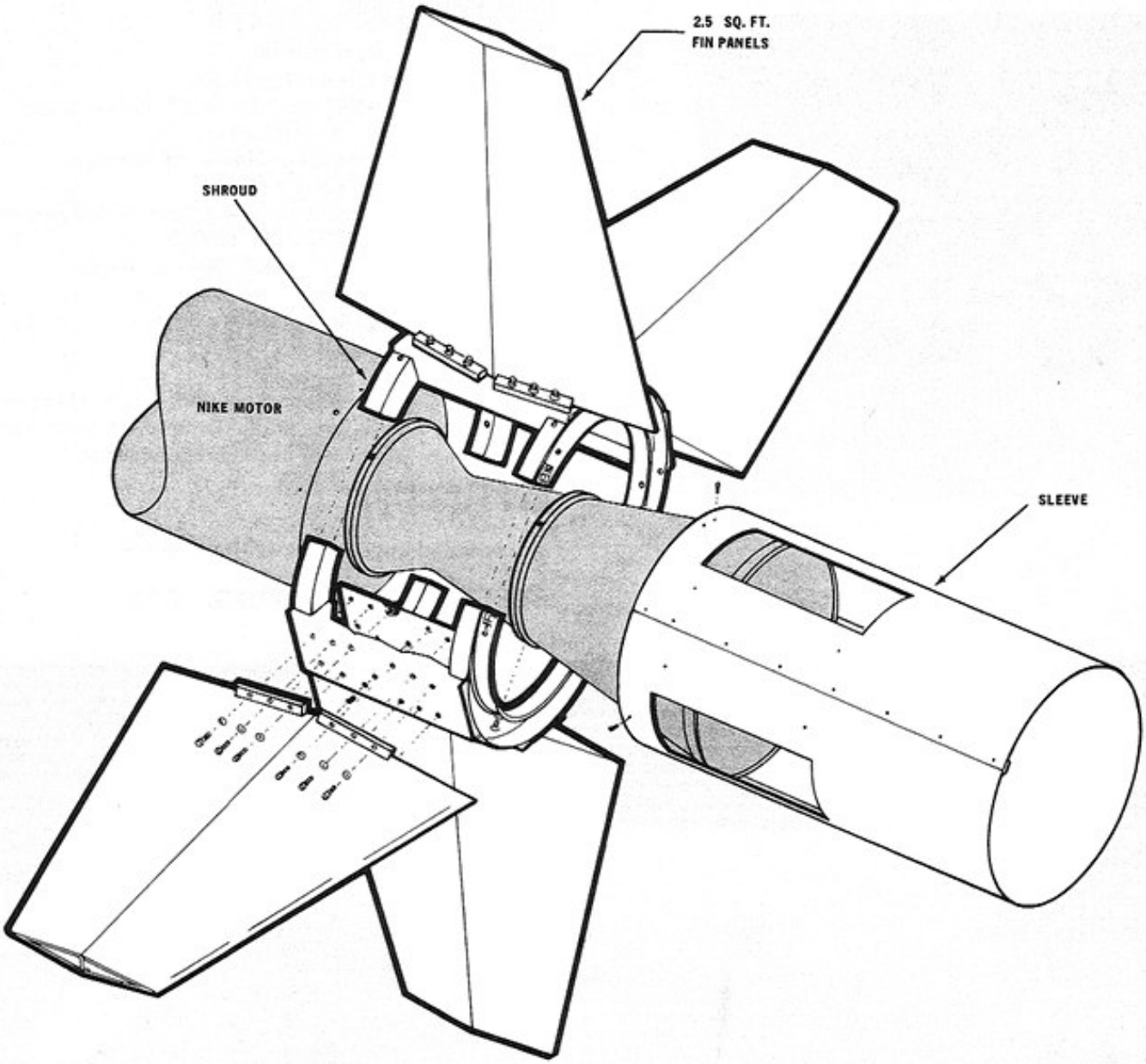
Size: 2.5 sq. ft. panel area/fin
Incidence Adjustment: ±1° each fin
Fin Flatness: Maximum Twist ±3 arc min. (between tip and root chords)
Maximum Camber ±0.020 inch (any chord)
Maximum Bow ±0.050 inch (spanwise)
Structural Loading/Fin: Lift 2600 lbs
Axial 2009 lbs (drag & inertial)
Dynamic Pressure Limit: 11000 psf
Weight: 71 lbs (total assembly)
Aero-Heating: In the typical first and second-stage application the fin leading edge does not encounter detrimental temperature conditions. When used in an environment where aeroheating is excessive, the fins can be supplied with sufficient thermal protection at a small additional cost.

APPLICATION

First Stage NIKE
Second Stage NIKE with NIKE or Honest John first stage

REFERENCE DRAWING: 16151

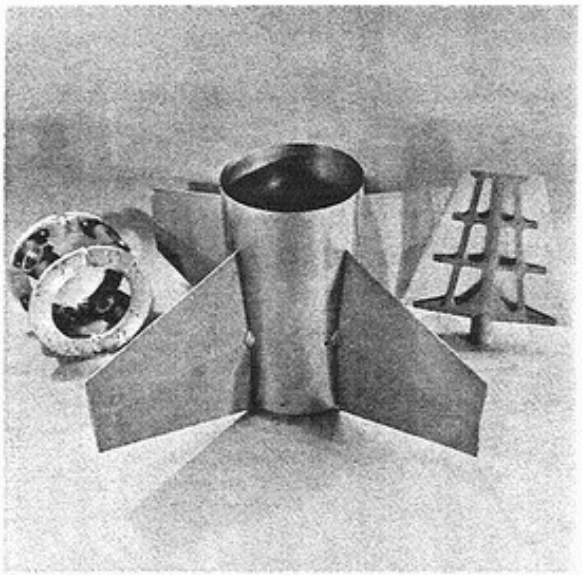
LIGHTWEIGHT STANDARD FIN INSTALLATION



STANDARD FIN (2.5 SQ.FT.)

The special capacity of the Standard Fin assembly to perform in the high temperature environments of upper stage applications is well proven. The construction of the fin is a cast magnesium skeleton with either aluminum or magnesium panels. Additional thermal protection can be provided by Inconel leading edge cuffs. The shroud is a ring structure with cast sockets to accept the fin shaft. An easy, secure, locking incidence adjustment mechanism is incorporated in the assembly. A unique feature is the compatibility of the Standard Fin panel to the military NIKE and TERRIER shroud assemblies.

In addition to the upper stage application, this fin has been widely used on first stages.



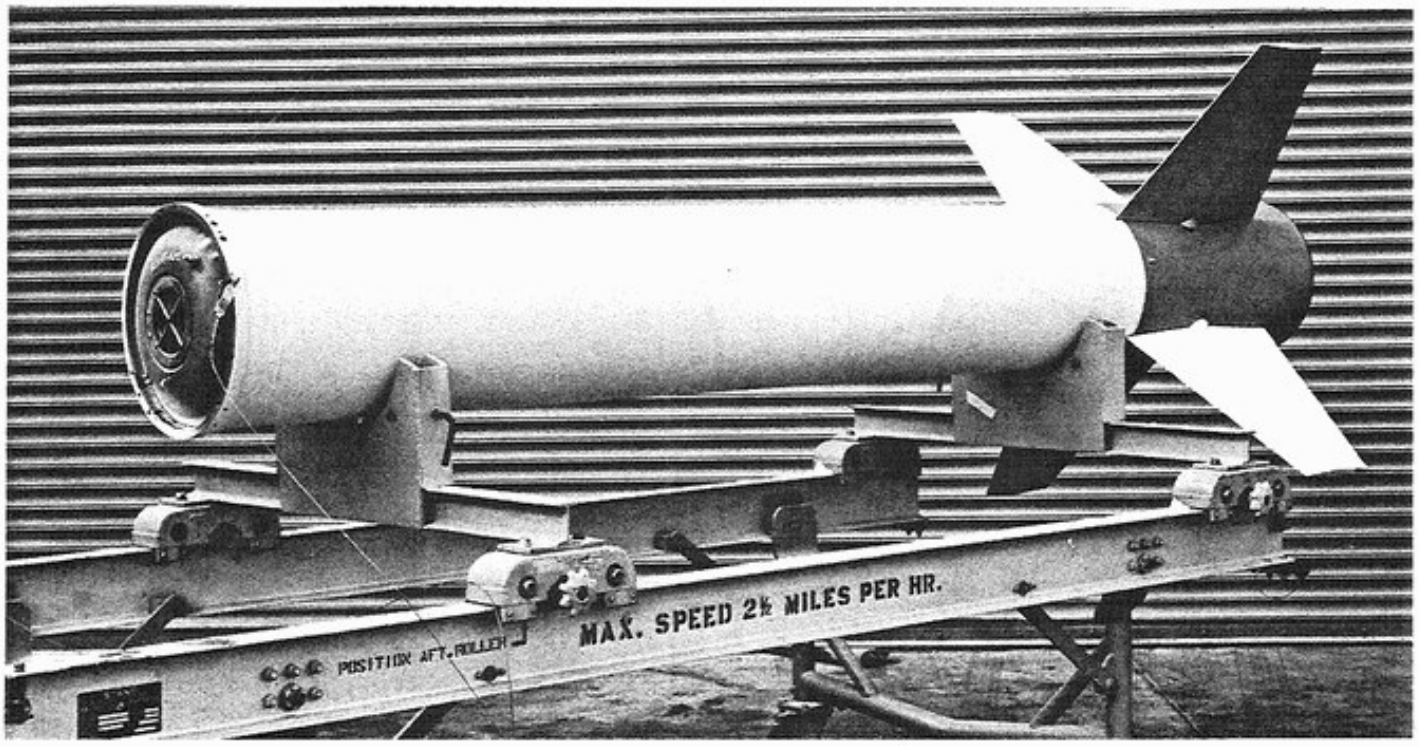
ENGINEERING FEATURES

Size: 2.5 sq. ft. panel area/fin
Incidence Adjustment: ±2°each fin
Fin Flatness: Maximum Twist ±3 arc min.(between tip and root chord)
Maximum Camber ±0.020 inch (any chord)
Maximum Bow ±0.050 inch (spanwise)
Structural Loading/Fin: Lift 2600 lbs
Axial 1900 lbs (drag & inertial)
Dynamic Pressure Limit: 11, 000 psf
Weight: 95 lbs nominal
Aero-Heating:
Various panel coverings and leading edge cuffs are available to meet most upper stage aero-heating requirements.

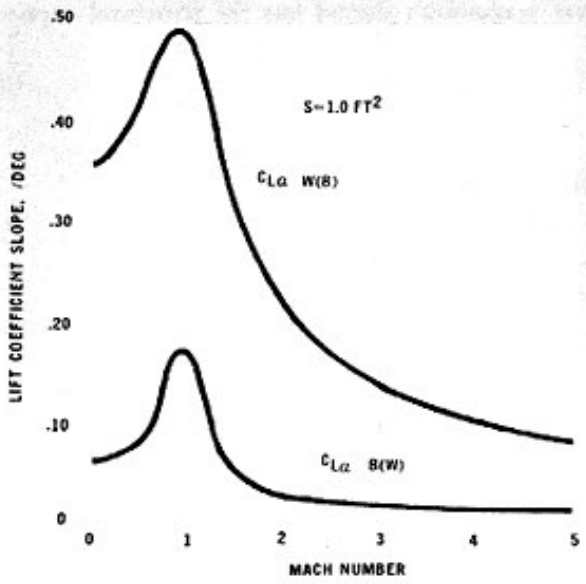
APPLICATION

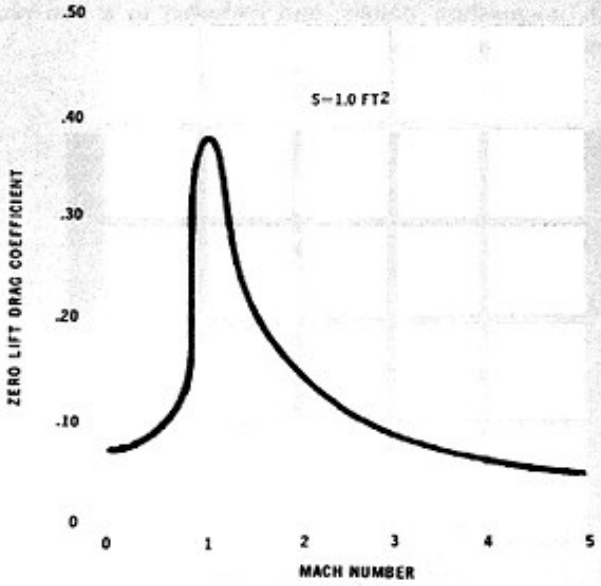
All boost and upper stages of NIKE motors.

REFERENCE DRAWING: 1013



FOR 16151 AND 1013 STANDARD CONFIGURATION





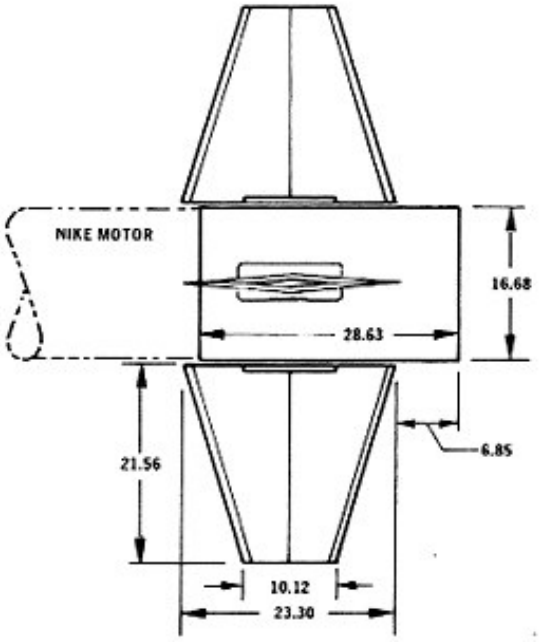
C_{L_α} VS. MACH NO.

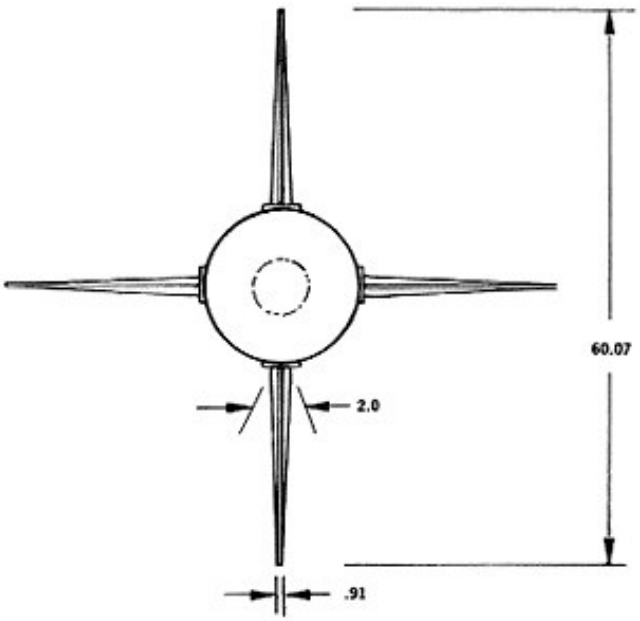
The above graph depicts the component lift curve slope for two fins mounted on the body. The upper curve presents fin lift in presence of body and the lower curve describes lift on the body due to fins.

C_{DO} VS. MACH NO.

The above graph depicts assembly component drag at zero lift. The parameter is the summation of wave and base pressure drag acting on the four fins and shroud. Skin friction is neglected.

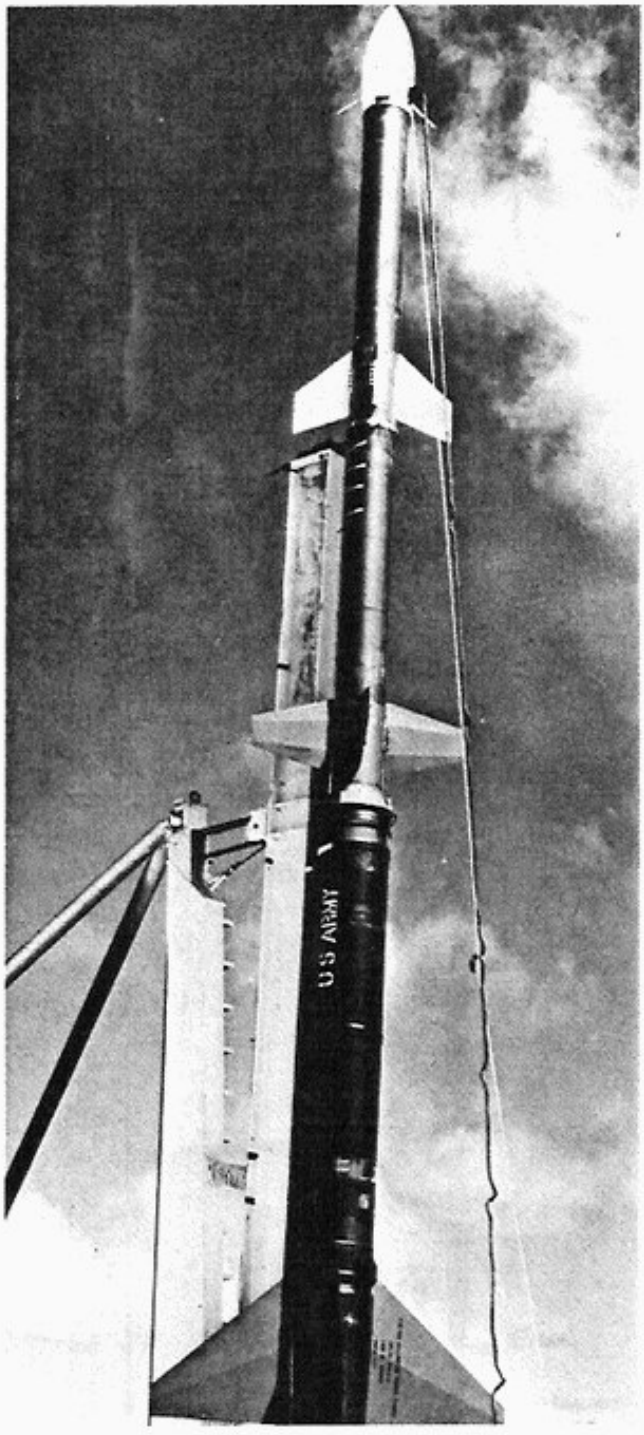
FOR 16151 AND 1013 STANDARD CONFIGURATION





DOUBLE SWEPT WEDGE FIN

With certain vehicle configurations and mission requirements aerodynamic instability may become a problem. For example, stability can be critical on the third stage of an Honest John-Nike-Nike vehicle with light payloads. To minimize this instability the highly efficient, double swept, single wedge fin is available to provide a large aft movement of the center of pressure at very low assembly weight. The low wedge angle design minimizes drag while yielding high lift forces in the near-hypersonic region. The fin, constructed of a cast magnesium frame, covered with magnesium panels, and mounted to a two piece cast magnesium shroud has the structural capacity to accommodate large flight loads.



ENGINEERING FEATURES

Size: 2.74 sq. ft. panel area/fin
Incidence Adjustment: ±2°/fin
Fin Flatness: Maximum Twist ±10 arc min.(between tip and root chord)
Maximum Camber ±0.020 inch (any chord)
Maximum Bow ±0.050 inch (spanwise)
Structural Loading/Fin: 2,500 lbs. lift nominal
Dynamic Pressure Limit: 10,000 psf
Weight: 80 lbs. total assembly
Aero-Heating:

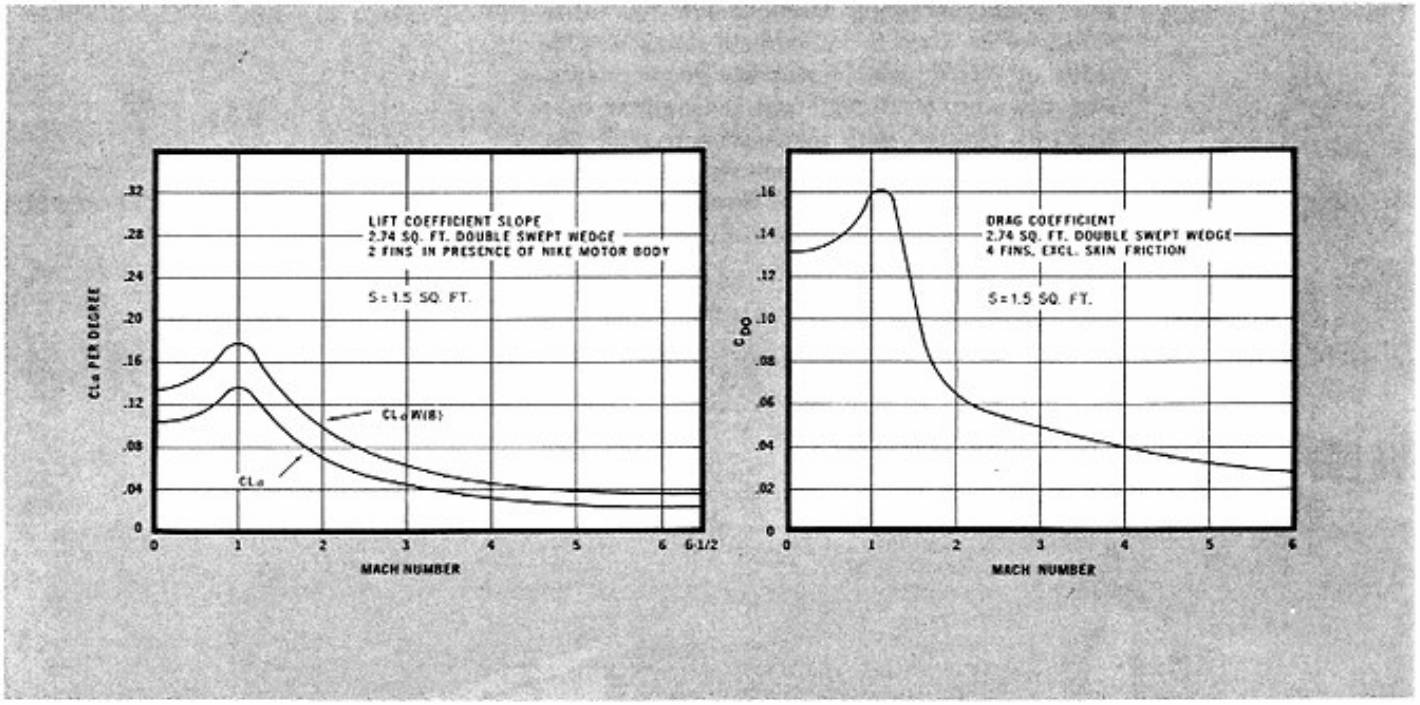
A stainless steel leading edge cuff is provided with the assembly. For severe thermal environments a selection of ablative and non-ablative panel coverings is available.

APPLICATION

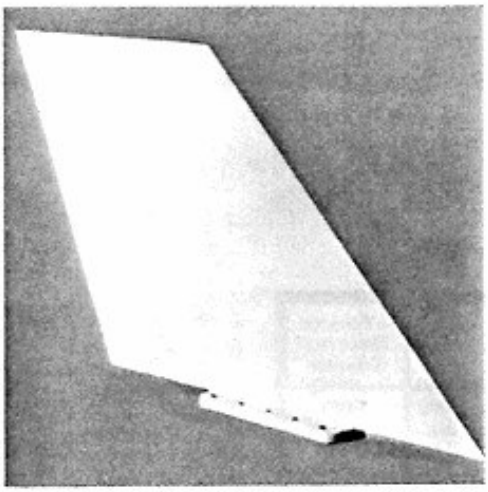
Designed for all NIKE stages. With different shroud assemblies the fin is adaptable to other motors such as TX-77 Lance.

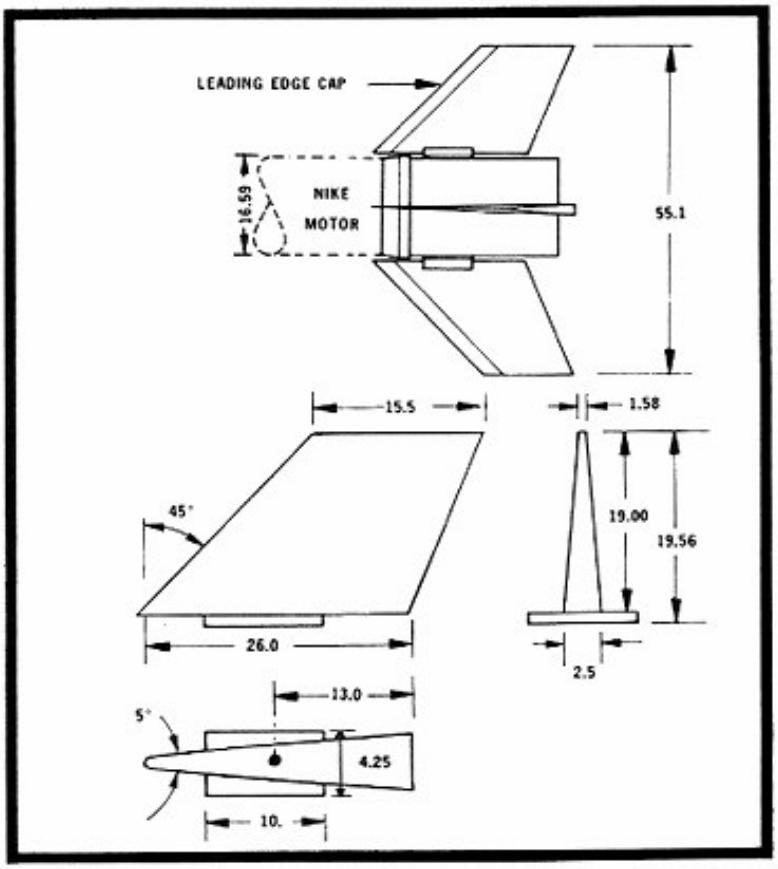
REFERENCE DRAWING: 14811

AERODYNAMIC DATA



ENVELOPE DATA

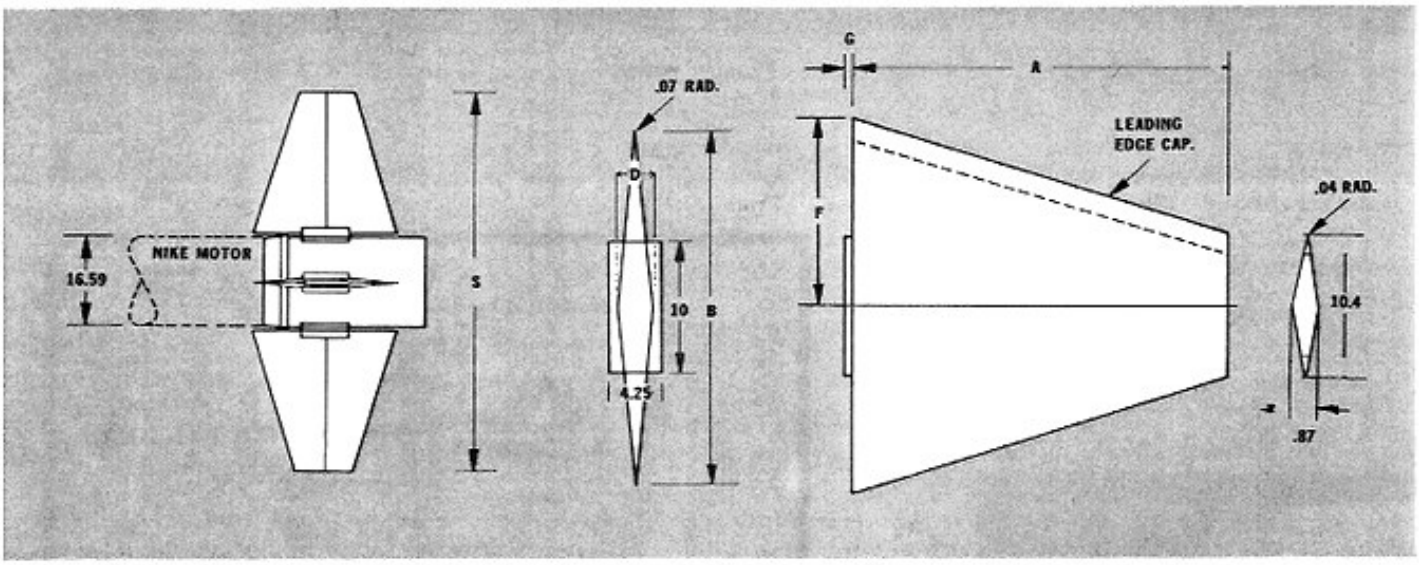




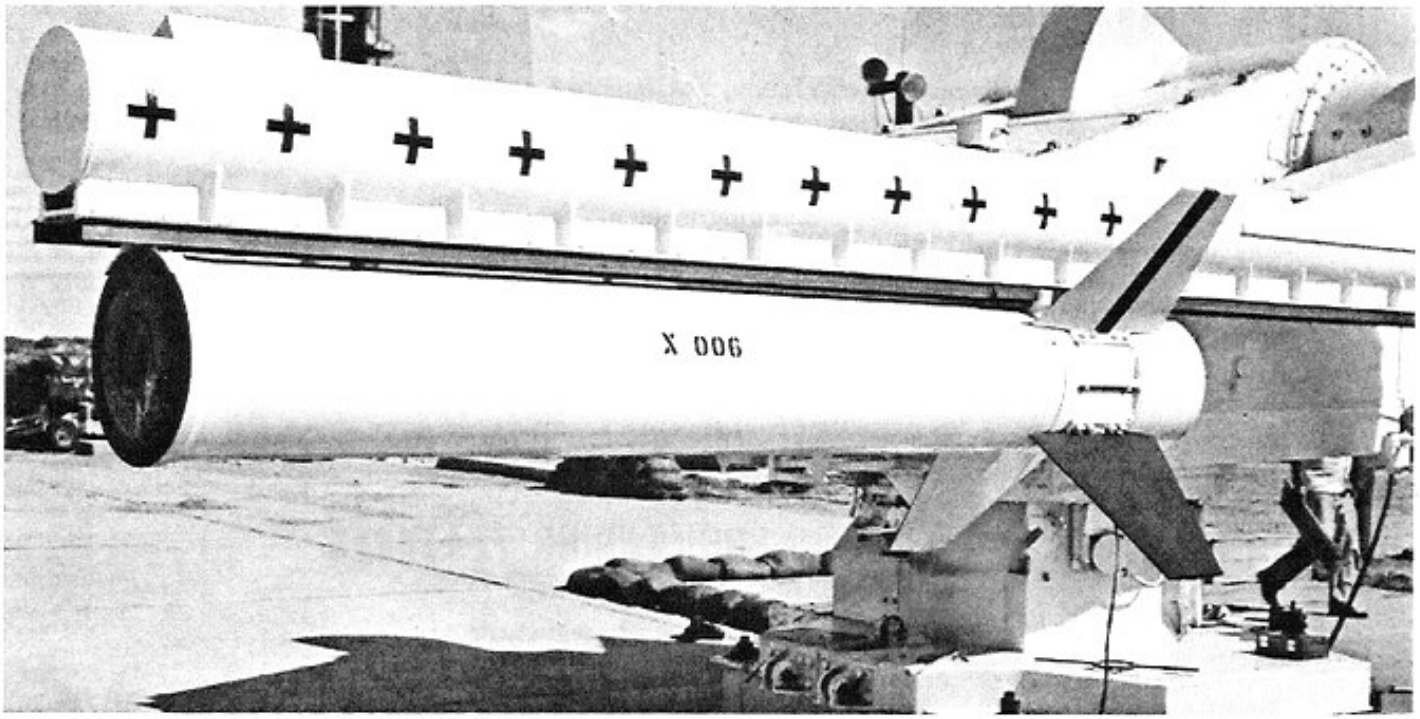
HEAVY-DUTY DIAMOND FIN

These fins are especially constructed for rugged application requiring large flight load capability and severe operating environment. An entire family of fin sizes is available to satisfy a wide range of NIKE vehicle stability requirements. The fins are a strong, cast magnesium core structure covered with magnesium panels. The assembly includes a two-piece shroud and aerodynamic nozzle fairing. Other shroud designs are available to service particular requirements.

ENVELOPE DATA



Panel Area Sq. Ft.	A	B	D	F	G	S	Reference Drawing Number
2.5	21.30	23.47	1.87	11.56	.56	59.66	15002
2.75	22.80	24.41	1.95	12.02	.56	67.66	17027
3.0	24.30	25.33	2.01	12.50	.62	65.78	16640
3.5	27.00	27.08	2.14	13.36	.62	71.18	15426



ENGINEERING FEATURES

Incidence Adjustment: ±2° each fin

Fin Flatness: Maximum Twist ±3 arc min (between tip and root chord)
Maximum Camber ±0.020 inch (any chord)
Maximum Bow ±0.050 inch (spanwise)

Aero-Heating: Inconel or stainless steel leading edge cuff, provided for thermal protection. Selection of panel coverings available for severe thermal environments.

See adjacent charts for size selection, loading limits, assembly weights, and reference drawing numbers.

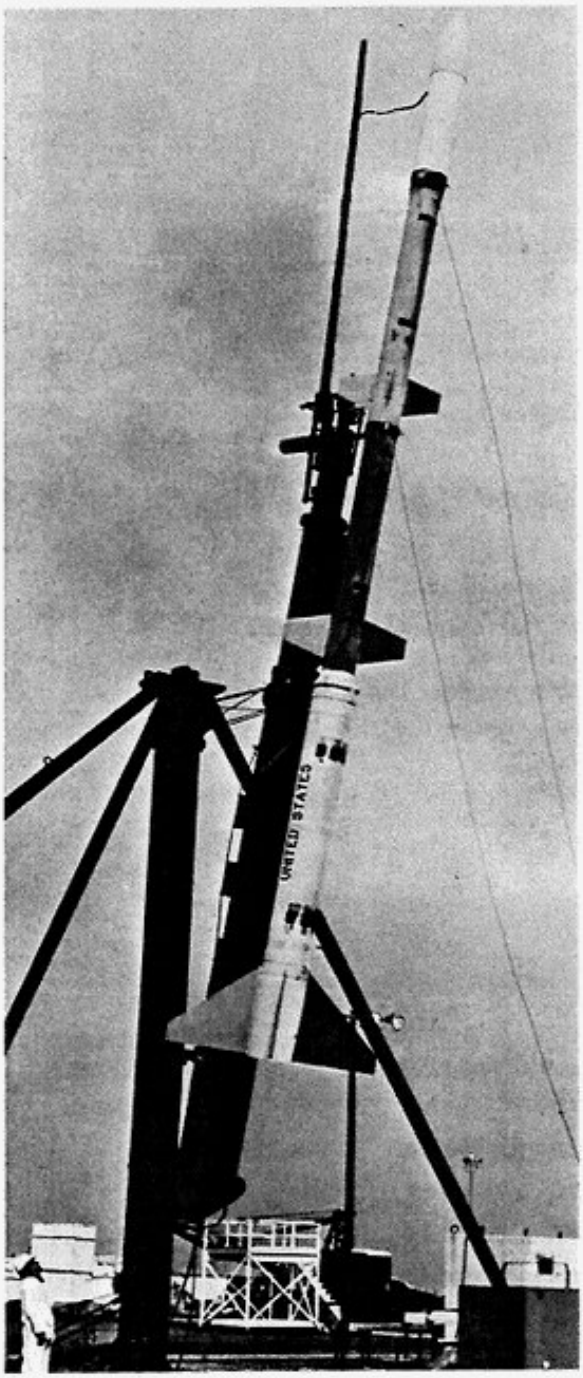
PANEL AREA SQ. FT.	LIFT LOAD (LBS.)		DYNAMIC PRESSURE LIMIT PSF	ASSY. WEIGHT LBS.
	NOMINAL	LIMIT		
2.5	2500	3100	11000	105
2.75	2500	3100	12000	120
3.0	2500	3500	20000	140
3.5	2500	3500	20000	160

MODIFIED DIAMOND FIN

Although similar to the standard diamond configuration, the modified diamond style offers an improvement in drag performance by virtue of a narrower frontal area. The two styles are often used interchangeably in vehicle configurations.

Designed to utilize a one piece hollow magnesium casting to form the complete fin, the modified diamond provides outstanding load carrying ability. This design can be manufactured in sizes other than those described as required. The largest fin made to this design was 12 sq. ft. In tests the modified diamond has a lift load capacity exceeding 8,000 lbs. without failure.

Since the development of this fin design for the Javelin vehicle, it has successfully performed on many other vehicles.



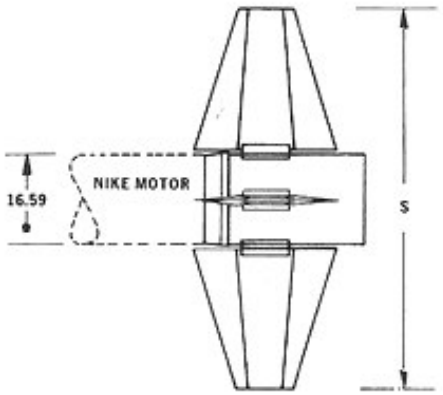
ENGINEERING FEATURES

Size: (See adjacent chart).
Incidence Adjustment: ±2° each fin.
Fin Flatners: Maximum Twist ±15 arc min.(between tip and root chords.)
Maximum Camber ±0.030 inch (any chord)
Maximum Bow ±0.100 inch (spanwise)
Structural Loading/Fin: 2500 lbs. nominal lift
5000 lbs. maximum lift.
Dynamic Pressure Limit: In excess of 12,000 psf.
Weight: (See adjacent chart)
Aero-Heating: Configurations have been built to provide panel protection with ablative coatings and fiberglass insulated stainless steel shields. Leading edge cuffs of Inconel or stainless steel can be added.

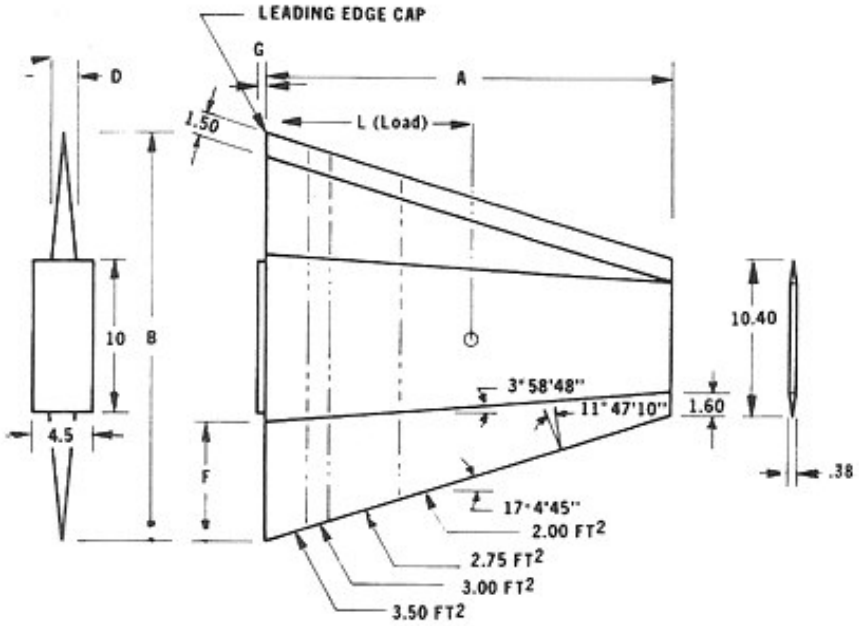
APPLICATION

All NIKE stages.

ENVELOPE DATA

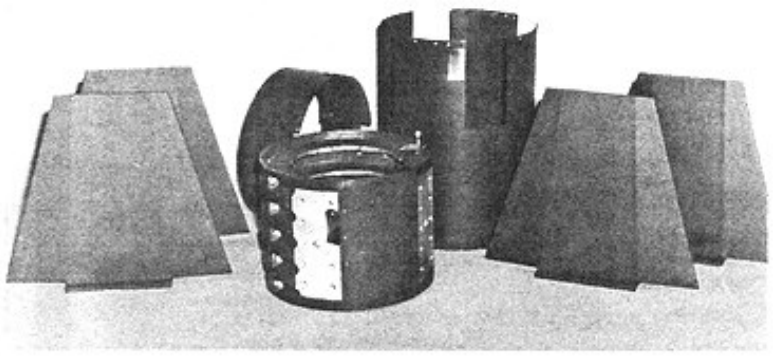


ASSEMBLY



FIN DETAILS

PANEL AREA SQ. FT.	A	B	D	F	G	S	ASSY. WEIGHT LBS.	REF. DWG. NO.
2.0	18.10	21.52	1.30	5.90	.56	53.26	93.2	14754
2.75	22.80	24.41	1.45	7.02	.56	62.66	101.2	16145



LAUNCH VEHICLE ENGINEERING

The component fin and shroud assemblies described in this book are a result of applied engineering providing sounding rocket systems to meet mission requirements.

Atlantic Research can apply these proven components to vehicle combinations to satisfy new missions at reasonable cost.

Atlantic Research can design and manufacture aerodynamic and structural components for flight vehicles and qualifies as a competent source for vehicle and missile subsystems.

For further information contact:

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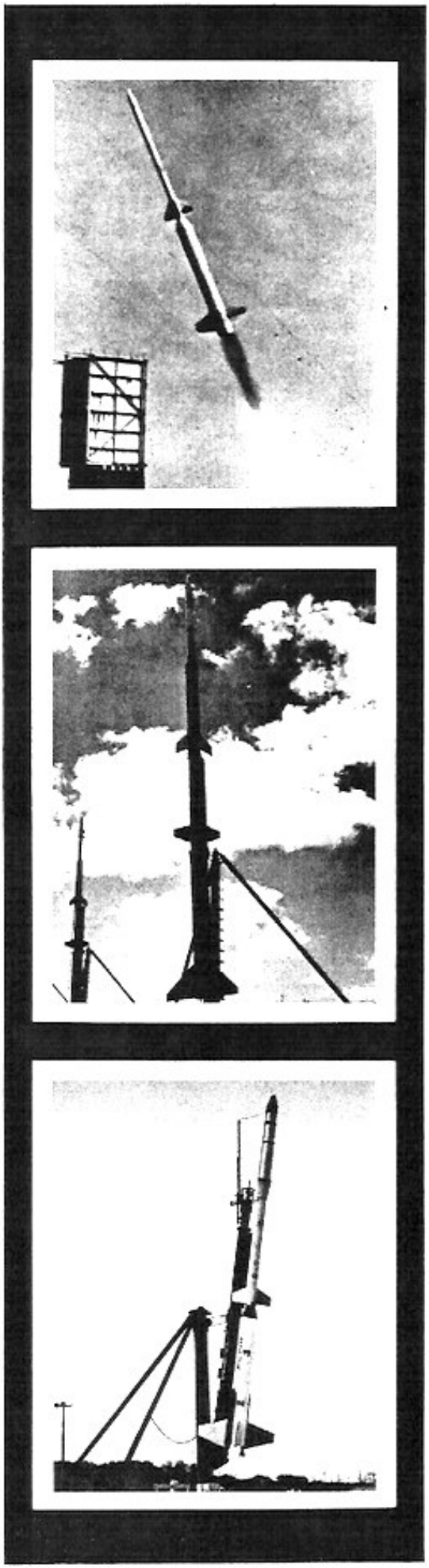
Our family of proven test vehicles includes:

Nike-Cajun
Nike-Apache
Terrier-Apache
Honest John-Nike
Honest John-Lance
Honest John-Nike-Nike-X248 (Javelin D-4)
Sergeant-Lance-Lance-X248 (Journeyman D-8)
Honest John-Nike-Nike
Castor-X254 (SWIK)
Castor-X261 (Arpat booster)
Castor-X259-23KS11000 (Jason II)
Trailblazer II, (4 stage re-entry test vehicle)
Athena, (4 stage, guided re-entry test vehicle)

Top photo: Nike-Apache

Middle photo: Honest John-Nike-Nike

Bottom photo: Trailblazer II



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MISSILE SYSTEMS DIVISION