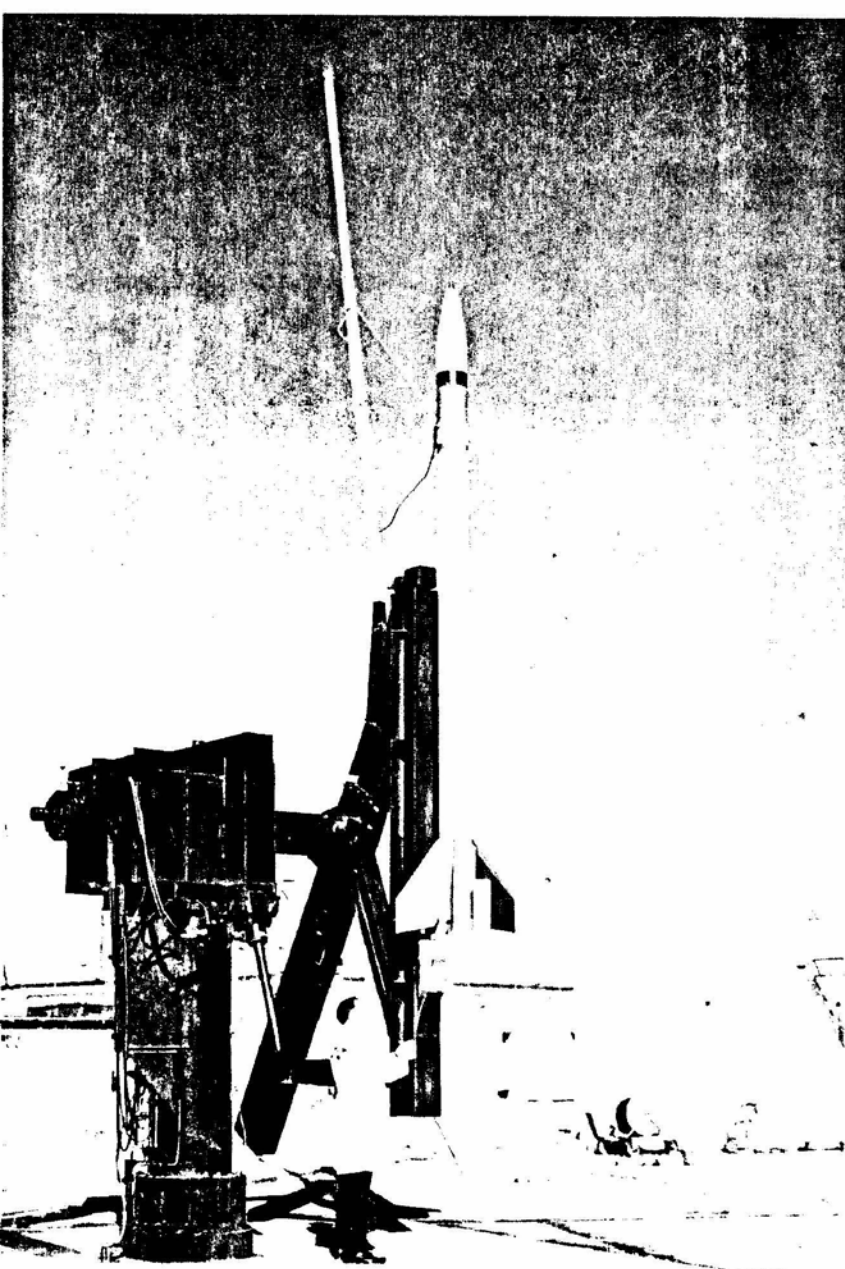


DETAILED SCALE PLANS

D-REGION TOMAHAWK

by Howard Kuhn



Overall view of the D-Region Tomahawk, NASA Flight No. 12.08GT, on the launcher ready for flight. Note that the fin to the right is painted black while the others are red. The D-Region carried no visible markings or insignia. (NASA Photo W68-34)

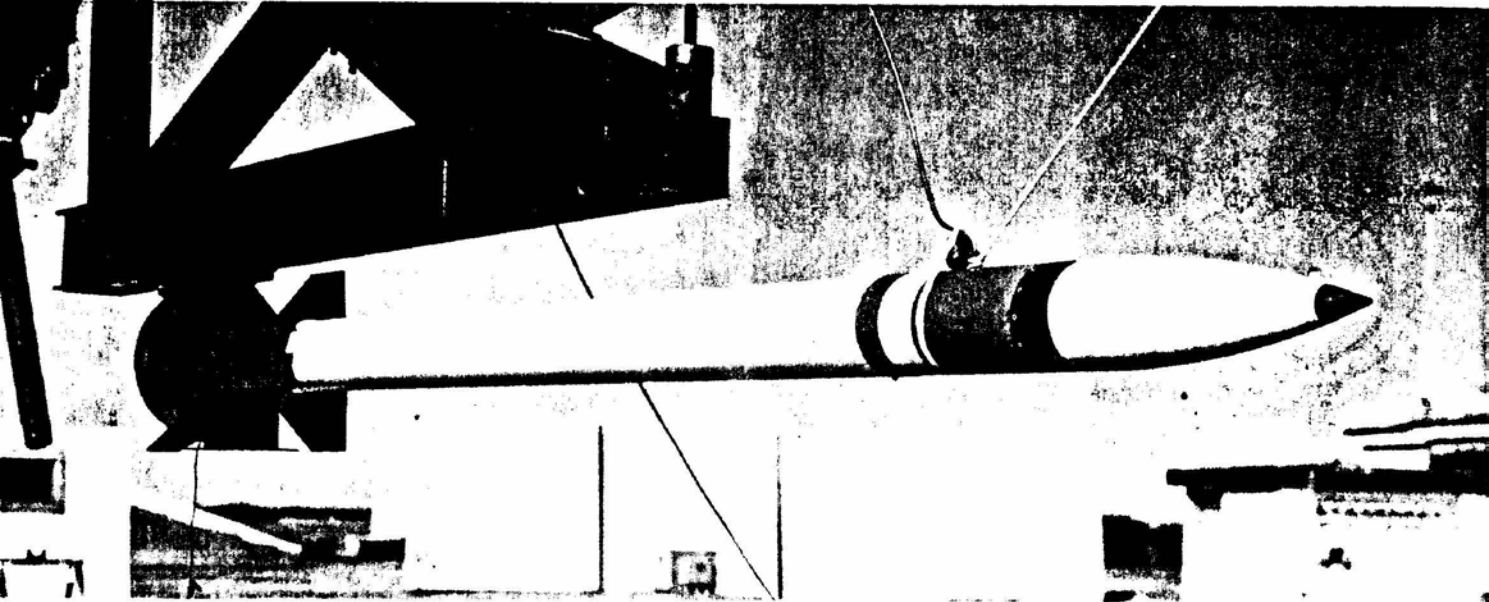
The "D" Region Tomahawk is a medium performance member of the Tomahawk Sounding Rocket family designed by Astro-Met of Thiokol Chemical Corporation. The single-stage Tomahawk is fin stabilized, uses the basic TE-M-416 Tomahawk solid propellant motor and attains its special performance characteristics through a controlled drag design. Normal trajectory data are based on a sea level launch at an initial launch angle of 80 degrees and a gross payload weight of 60 pounds.

The basic medium performance (MP) Tomahawk is designed for the specific capability of delivering an 80 pound gross payload to an apogee altitude of 110 kilometers. However, a simple configuration change from a 3:1 ogive nose cone to a low drag shape such as a 5:1 ogive nose cone would result in an altitude increase of approximately 70,000 feet, or conversely, would permit achieving the nominal apogee altitude with an increase in payload weight of 35 to 40 pounds, thus providing a significant payload growth capability for a 100 kilometer altitude range. A reduction in apogee altitude of approximately 1,800 feet will occur for each additional pound of system weight, and a 42,000 foot reduction in altitude will occur for each 10 percent increase in drag.

NASA D-REGION TOMAHAWK

The "D" region Tomahawk, NASA Flight No. 12.08,GT, was primarily a test flight to demonstrate vehicle flight characteristics before acceptance by NASA as a standard NASA sounding rocket. The object of the test flight was to determine vehicle performance and establish the payload environment during flight. To accomplish these objectives, the payload carried three accelerometers, two vibration transducers, one stable platform to measure vehicle attitude, ten temperature transducers to measure temperature environment of the payload, one pressure transducer to measure chamber pressure on the TE-M-416 rocket motor, and associated electronics designed to transmit data to a ground station.

Vehicle No. 12.08GT was launched from Wallops Island, Virginia, at 1900 Z 5 February 1968, and reached a peak altitude of 118.5 KM (389,927 feet) in 160.0 seconds. An altitude of 380,000 feet was predicted. Burnout occurred 9.5 seconds after lift-off at an altitude of 27,456 feet and a velocity of 6,067 feet/second. Impact was 318,185 feet at an azimuth of 110 degrees from the launch site after a flight of 5 minutes and 27 seconds. The launcher was set at an effective angle of 116.30 degrees azimuth from true north and 80.48



Right side view of NASA Flight 12.08GT. Note that the screws on the payload section are unpainted. The dark cable from the payload is the umbilical, while the lighter colored line is a rope tied to the umbilical connector. (NASA Photo W68-32)

degrees elevation above horizontal. The vehicle performed as predicted with all instrumentation operating to impact. The rocket was recommended for acceptance in the NASA sounding rocket stable.

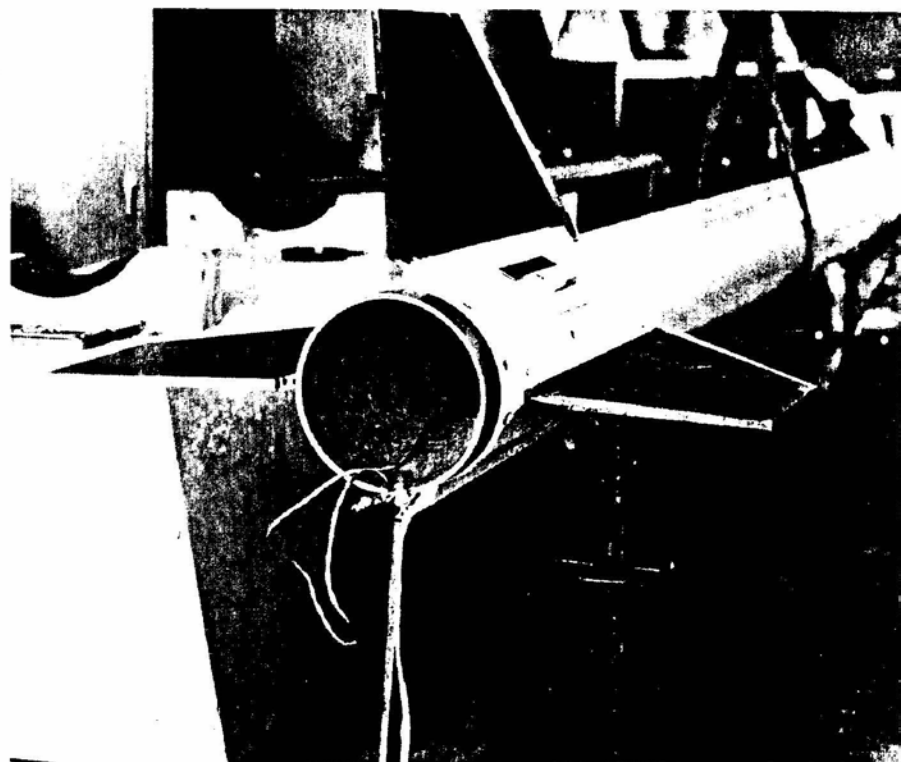
DESCRIPTION

The D-Region Tomahawk was a single-stage rocket based on the Thiokol Chemical Corporation TE-M-416 solid propellant rocket motor. Vehicle stabilization was provided by four fixed incidence fins each having an area of 222 square inches. The payload weighed 82.25 pounds and was an ogive-cylinder configuration. Both the motor and payload were 9 inches in diameter. The launch weight was 622.3 pounds. The weight after burnout was 223.1 pounds. The TE-M-416 motor utilized solid propellant with a sea level impulse of 93,840 pounds/second. It was ignited by two pyrogen-type igniter squibs located at the head of the motor. The ignition leads extended from the igniter through the perforated solid propellant grain and out the nozzle to the firing circuit in the blockhouse. These leads burn up after motor ignition.

The tail fins were from 6061-T6 aluminum sheet. The fin structure was protected from high aerodynamic heating by an asbestos phenolic leading edge cuff and silicone rubber surface coating. The fins were retained to the support shroud over the entire fin root by a locking bracket and sixteen No. 10 bolts. The leading edge was swept 55 degrees and the fin had a total of 222 square inches.

The fin-to-motor attach shroud was a solid alluminum shell structure having a minimum wall thickness of .10 inch. The fins were attached, preset, to this unit at the factory. The shroud with fins attached was slipped over the motor at the nozzle end and was retained by twenty-eight 1/4 inch flat head allen bolts.

The payload consisted of diagnostic instrumentation required to obtain data relative to acceleration, vibration, angular position and rate, motor pressure, and payload temperature. The total length was 52 inches with a maximum diameter of 9 inches. The overall configuration consisted of a 3:1 ogive which is attached to a cylindrical housing having a length of 24.50 inches. The nose had an asbestos phenolic nose tip epoxied to a S/C fused silica 3:1 ogive nose cone which in turn is epoxied to an asbestos phenolic attitude gyro cover. This assembly is attached to a splice ring on the telemetry housing by 12 1/4 inch flat head allen bolts.



Rear view of the partially assembled D-Region in the shop. The shape of the fin shroud is clearly shown. In this photo the shroud attachment bolts have not yet been painted. (NASA Photo W68-14)



Left side view of NASA Flight 12.08GT prior to installation of the payload section. Note that the bolt heads on the fin shroud have been painted white. The color version of this photograph clearly shows that the trailing edge of each fin is painted red. (NASA Photo W 68-16)

This ring is then attached to the aluminum telemetry housing by 12 ¼ inch flat head allen bolts. This housing attaches directly to the forward part of the aluminum antenna housing with 12 ¼ inch flat head allen bolts. A special aluminum splice ring attaches the antenna housing to the rocket motor with two sets of 24 each ¼ inch flat head allen bolts.

The rocket motor was a Thiokol TE-M-416 solid propellant type PBAA with a total impulse of 93,846 pound/seconds. The nozzle was constructed of graphite and silica phenolic. The motor casing was made from 7075-T6 aluminum with a diameter of 9 inches and overall casing length of 141.085 inches.

The rocket was launched from a special zero length launcher attached to the beam of a standard Wallops Island launcher with 3/8 inch diameter bolts. Basically, the zero length launcher consists of a ring with mounting flanges on one side and an I beam to support the rocket diametrically opposite on the other side. The rear of the motor casing slips into an opening in the ring at the same time the launch lug on the rocket shroud slips into an attachment on the I beam. This supports the entire rocket from the rear. To insure a good fit into the ring the rocket motor casing from the rear of the shroud is unpainted. The exhaust gasses blow through the opening in the launch ring upon ignition to minimize damage to the launcher.

FLIGHT INFORMATION SUMMARY
NASA FLIGHT NO. 12.08 GT

Weights:

Launch Weight: 622.3 lbs.
Payload Weight: 82.25 lbs.
Burnout Weight: 223.1 lbs.

Performance:

Burnout Altitude: 27,456 ft.

Burnout Velocity: 6,067 ft/sec.
Burnout Time: 9.5 sec.
Apogee Altitude: 387,927 ft.
Apogee Time: 160.0 sec.
Impact Range: 318,185 ft.
Impact Time: 337 sec.

Color Data:

Nose Tip: Flat Phenolic Brown
Nose Cone: Flat White
Attitude Gyro Cover: Flat Phenolic Brown
Telemetry Housing: Flat Bright Red
Small Ring: Natural Aluminum
Antenna Housing Cover: Flat White
Rocket Motor:
1" from top: Flat Bright Red
Body: Flat White
Rear of Shroud: Natural Aluminum
Shroud and Launch Lug: Flat White
Fin Locking Bracket: Flat White
3 Fins: Flat Black
1 Fin: Flat Bright Red
Rear of Fins: Flat Bright Red

DATA SOURCE

Thiokol Chemical Corporation, Contract No. NAS5-10444
NASA Flight requirements Plan, NASA 12.08 GT
NASA Sounding Rocket Post Flight Summary, NASA 12.08 GT
NASA report of Sounding Rocket Launching, Vehicle No. 12.08 GT
NASA Photographs: Color: W68-18, W68-19, W68-20, W68-21, W68-22, W68-23, W68-24, W68-39, W68-40, W68-44, W68-45.
Black and White: W68-10, W68-11, W68-12, W68-13, W68-14, W68-15, W68-16, W68-17, W68-30, W68-31, W68-32, W68-33, W68-34, W68-35, W68-38.
Thiokol Chemical Corporation Drawings: D00763, D00764, D00765, D00788, R00528, R00529, R00548, R00790, C00746.

NOTE TO MODELERS

An exact scale kit containing all parts, including a screw head forming tool, for construction of the D-Region Tomahawk is available from Competition Model Rockets, Box 7022D, Alexandria, Virginia. The kit sells for \$4.50 plus 25 cents for postage and handling. The kit includes complete, detailed instructions for construction of the fin shroud payload section, and screw heads.

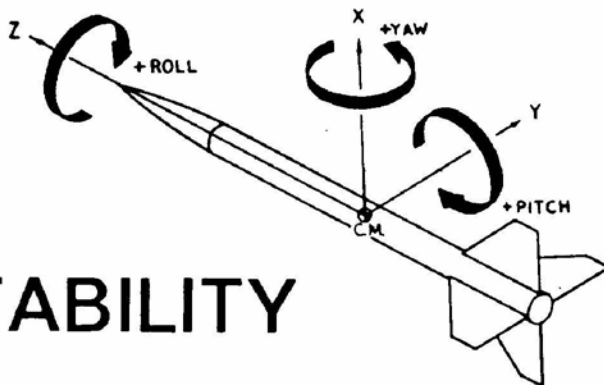
A complete scale data substantiation packet for the D-Region Tomahawk is available from Rocket Equipment Company, Dept. MR, 10 Mulberry Ave., Garden City, NY 11530. The packet includes a 16 page booklet, drawing, two black and white and one color photographs, and additional information for \$5.00 post paid. A list of additional D-Region photographs is also available.

TECHNICAL REPORT:

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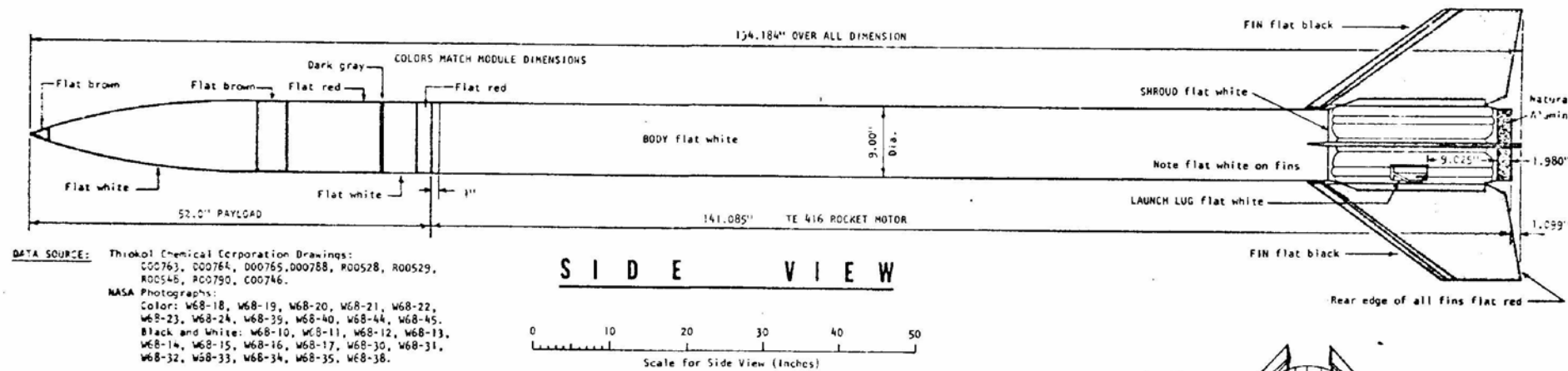
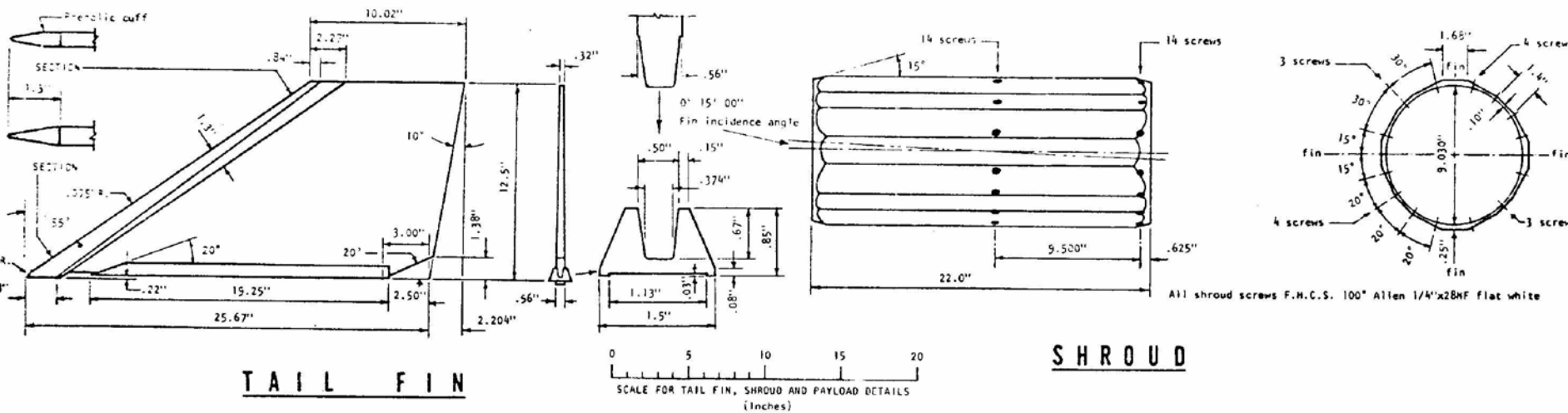
BY GORDON K. MANDELL



32 PAGES, ILLUSTRATED

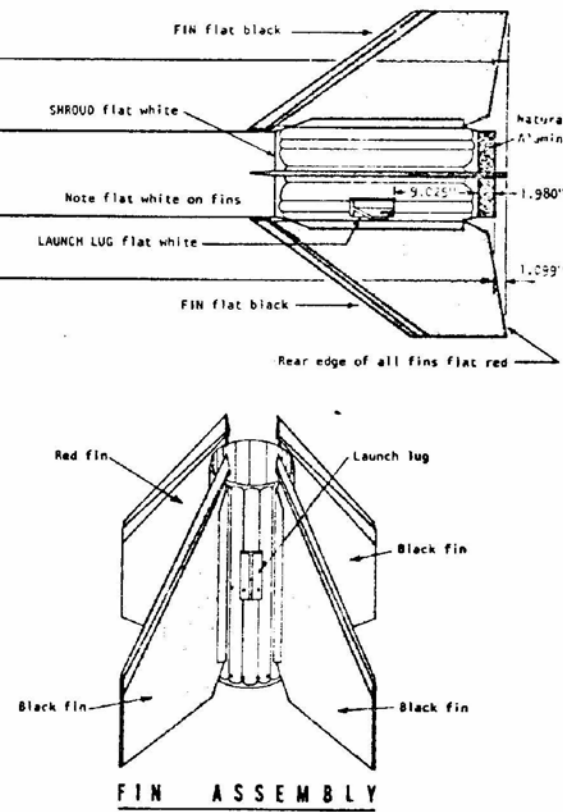
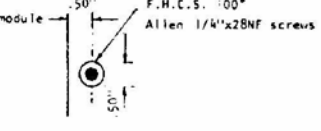
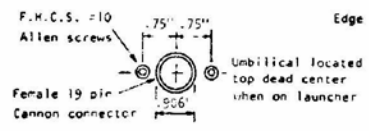
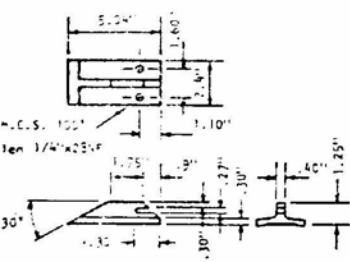
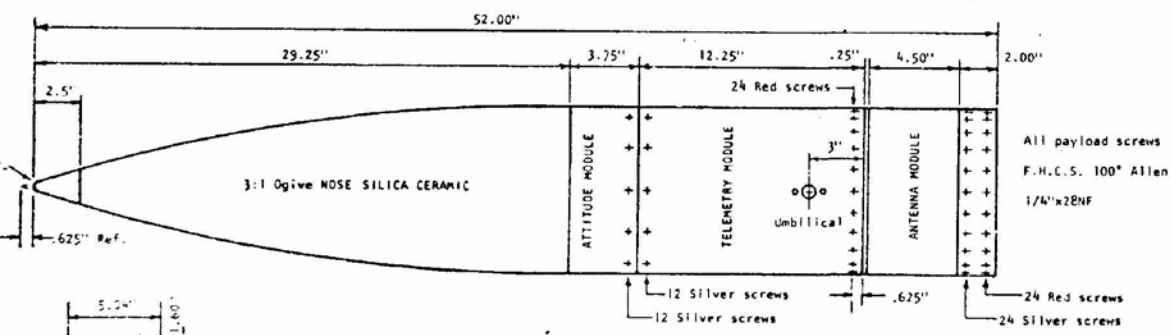
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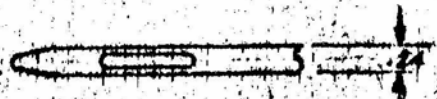
DATA SOURCE: Thiokol Chemical Corporation Drawings: C00763, C00764, C00765, C00788, R00528, R00529, R00548, R00790, C00746.

NASA Photographs:
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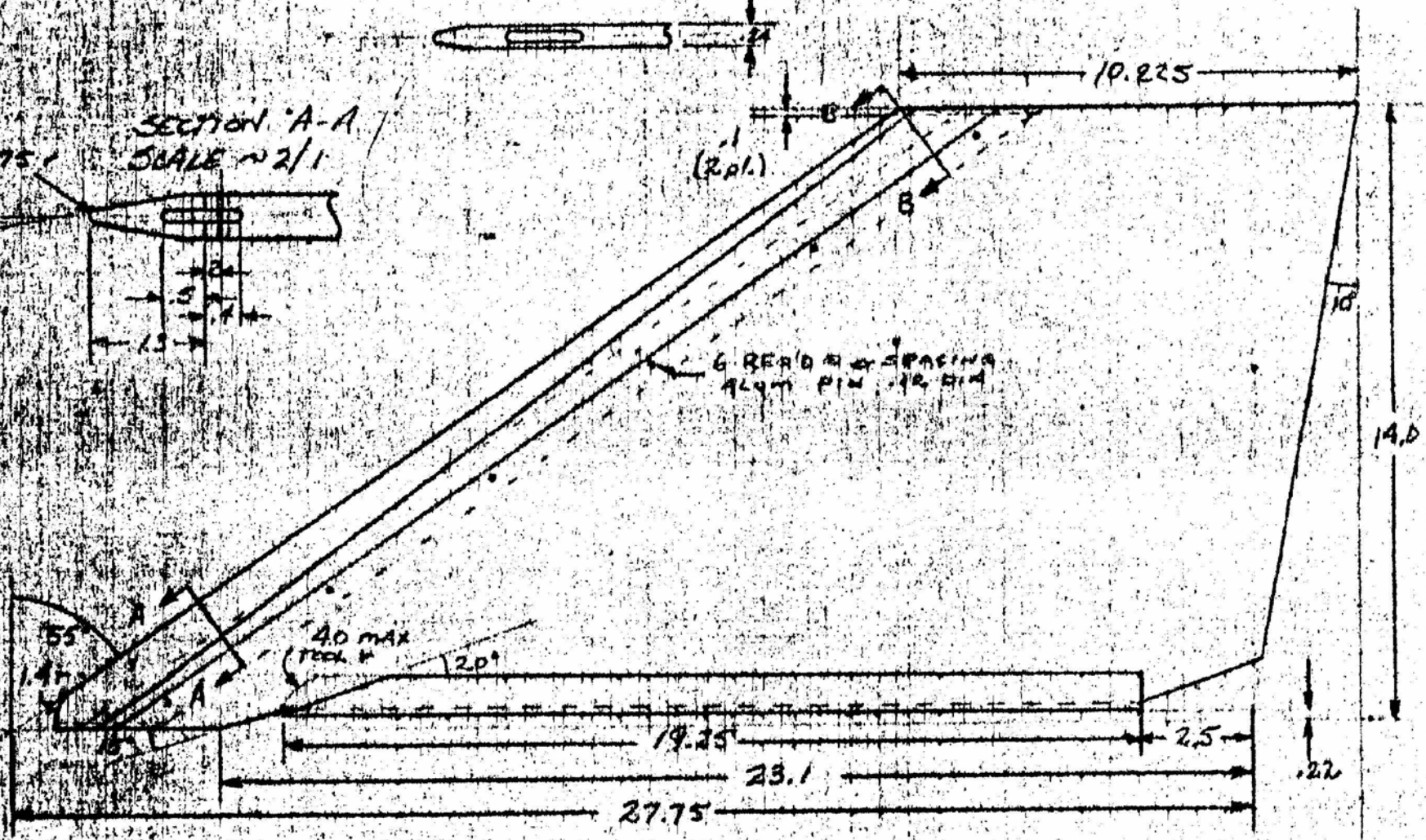


D-REGION TOMAHAWK
 NASA FLIGHT No.12.08 GT
 Drawn by HRR

SECTION B-B
SCALE ~2/1



SECTION A-A
SCALE ~2/1

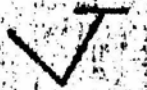


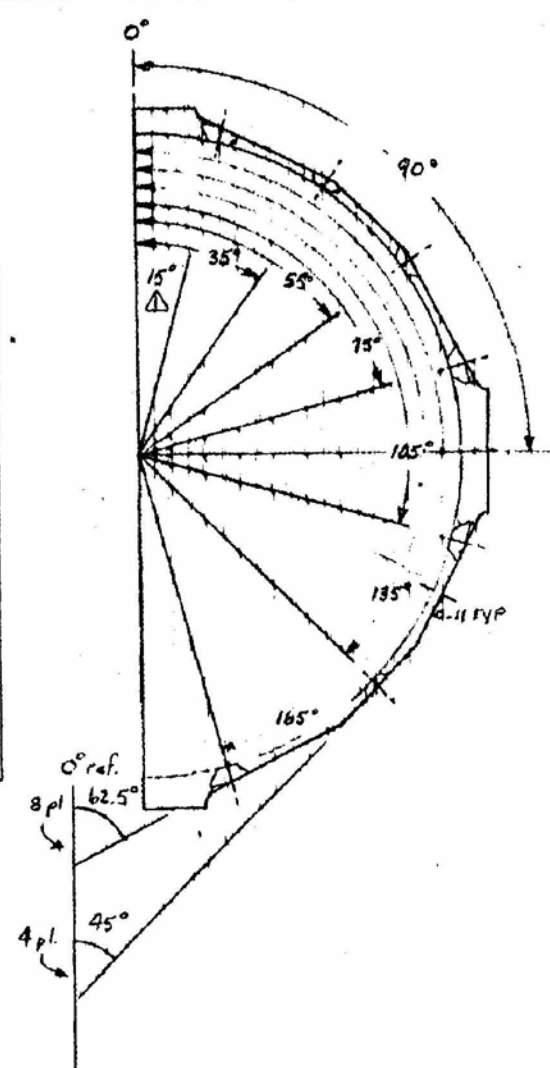
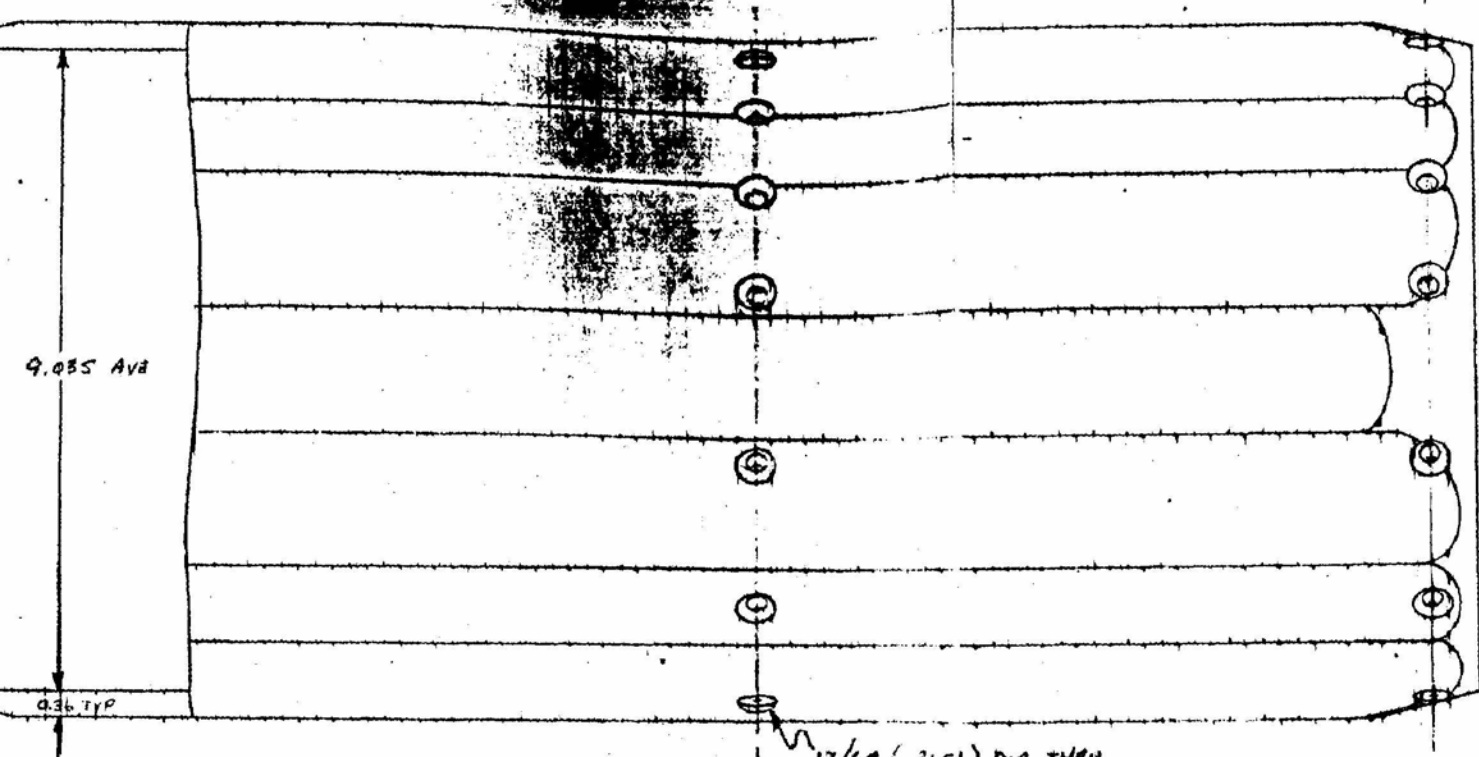
DATE	LET.	REVISION	BY	DR.	JAB	8/4/80
UNIT OR PROJECT	SCALE	MATERIAL	HEAT TREAT	DES.		
ASSEMBLY	PAO	~1/4		CHK.		
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Wallops Flight Center				AP.		
Wallops Island, Virginia 23177						
TOMAHAWK FIN PANEL (266 IN ²)		EST. FIN. WEIGHT	A. NOT DODED (2)			

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FRACTIONAL DIMENSIONS & .010
DECIMAL DIMENSIONS & .005

PLACE FINISH IN INCHES RMS SHOWN OTHERWISE





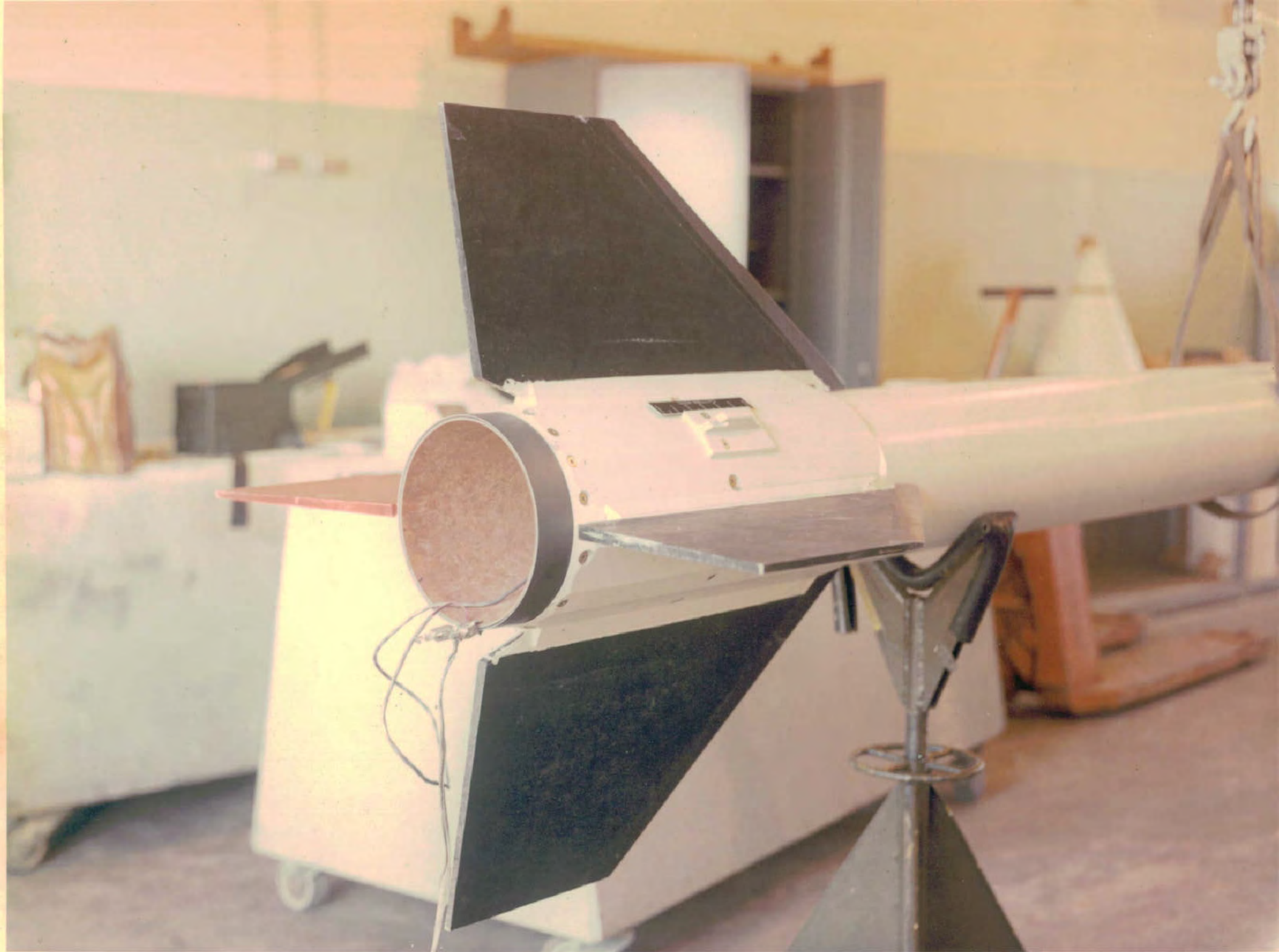
17/64 (2.25) DIA THRU
CSK 100° TO DEPTH SHOWN
14 HOLES, 2 PLACES

ADD 180° TO DEGREES ROTATION
FOR OPPOSITE SIDE HOLE LOCATION,
(2 PLACES EACH LOCATION)

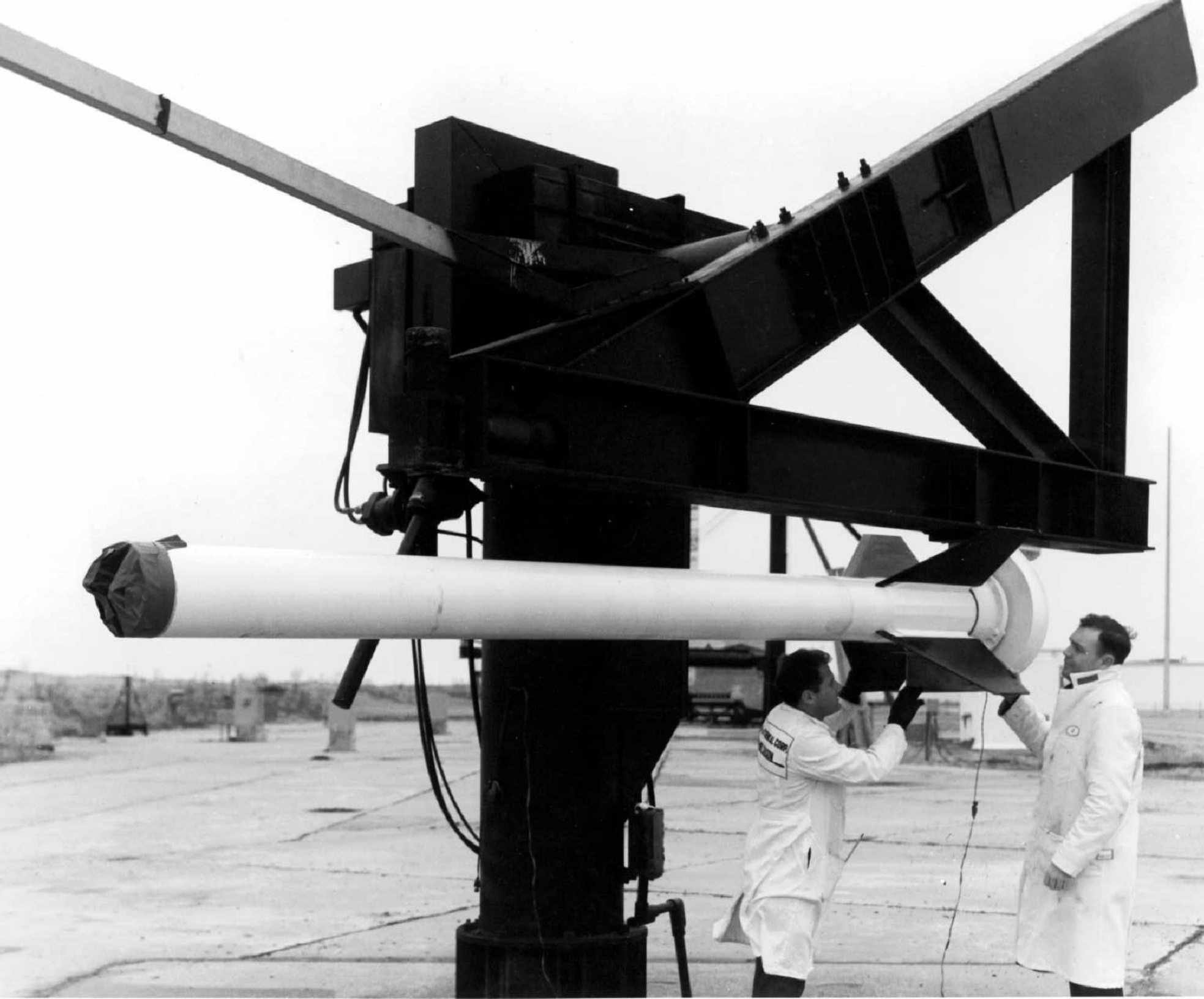
REVISION	BY	UNIT OR PROJECT	SCALE	MATERIAL	HEAT TREAT	DR	JFB	7/24/80
Release to Nat'l Ass'n of Rocketry	PAO	PAO	1/2	ALUMINUM 6061-T6		DES.		
		NEXT ASSEMBLY		NATIONAL AERONAUTICS AND SPACE ADMINISTRATION Wallops Flight Center Wallops Island, Virginia 23337		CHK		
		TOLERANCE ON DIMENSIONS UNLESS SHOWN OTHERWISE	FRACTIONAL DIMENSIONS ± 0.10			GL		
		ANGULAR ±	DECIMAL DIMENSIONS ± 0.05			AP		
		SURFACE FINISH IN MICROINCHES RMS UNLESS SHOWN OTHERWISE	EST FIN WEIGHT	TOMAHAWK FIN SHROUD - 266 in ² FINs		B - NOT CODED (6)		





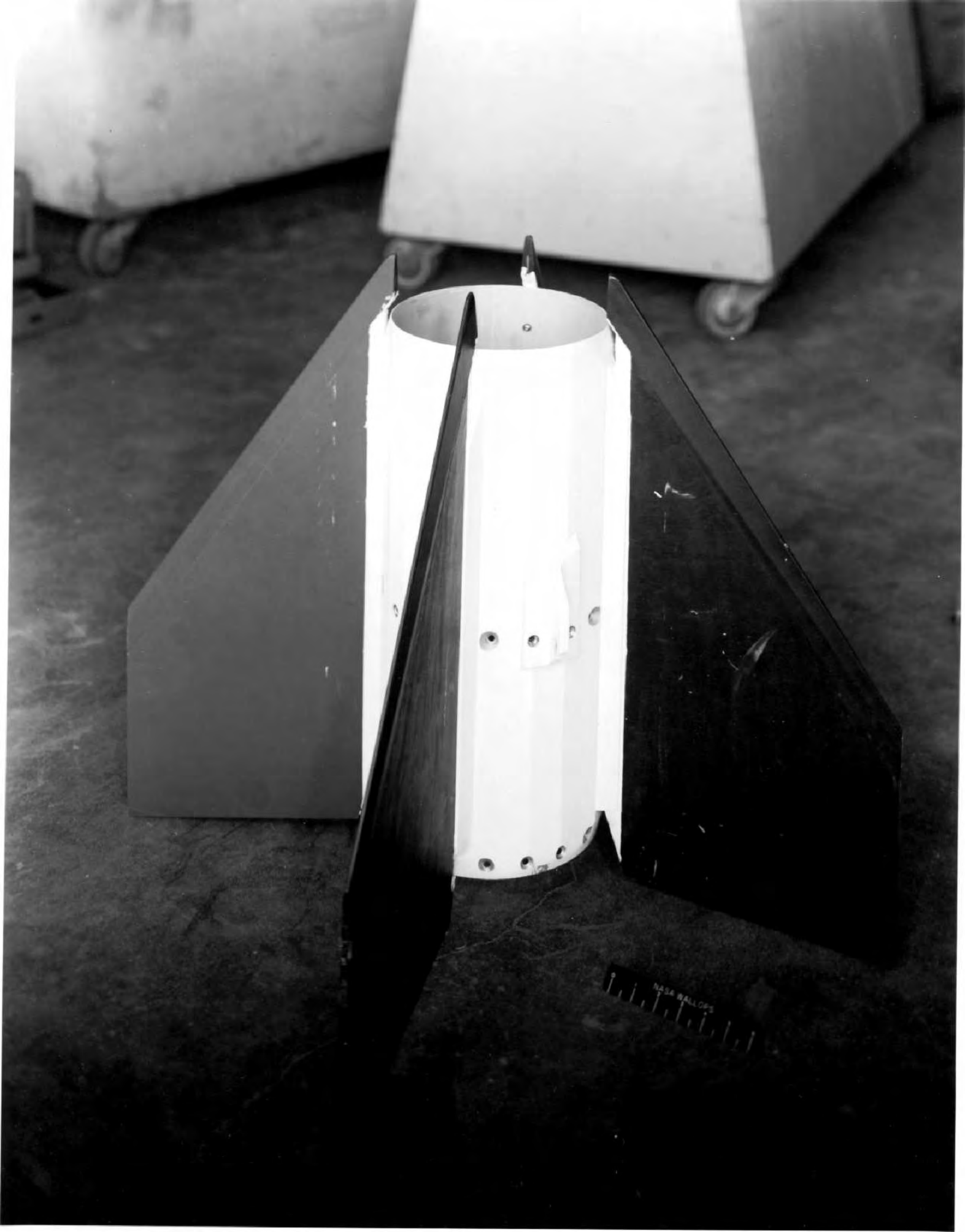


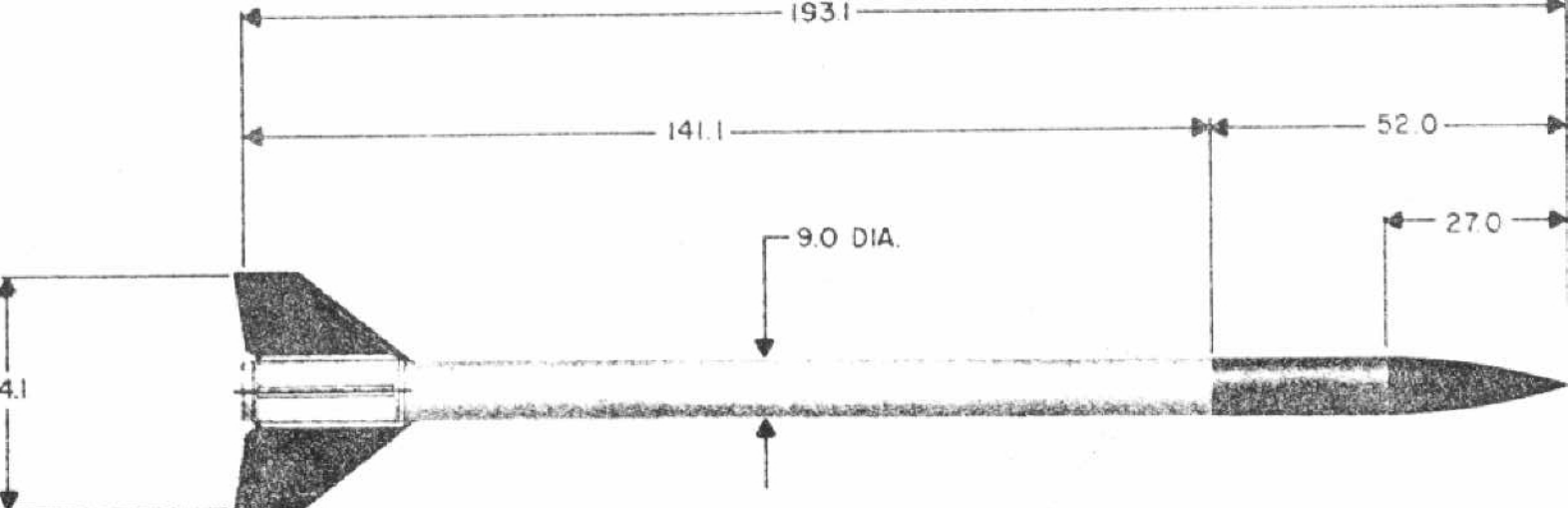






NASA W 68-43



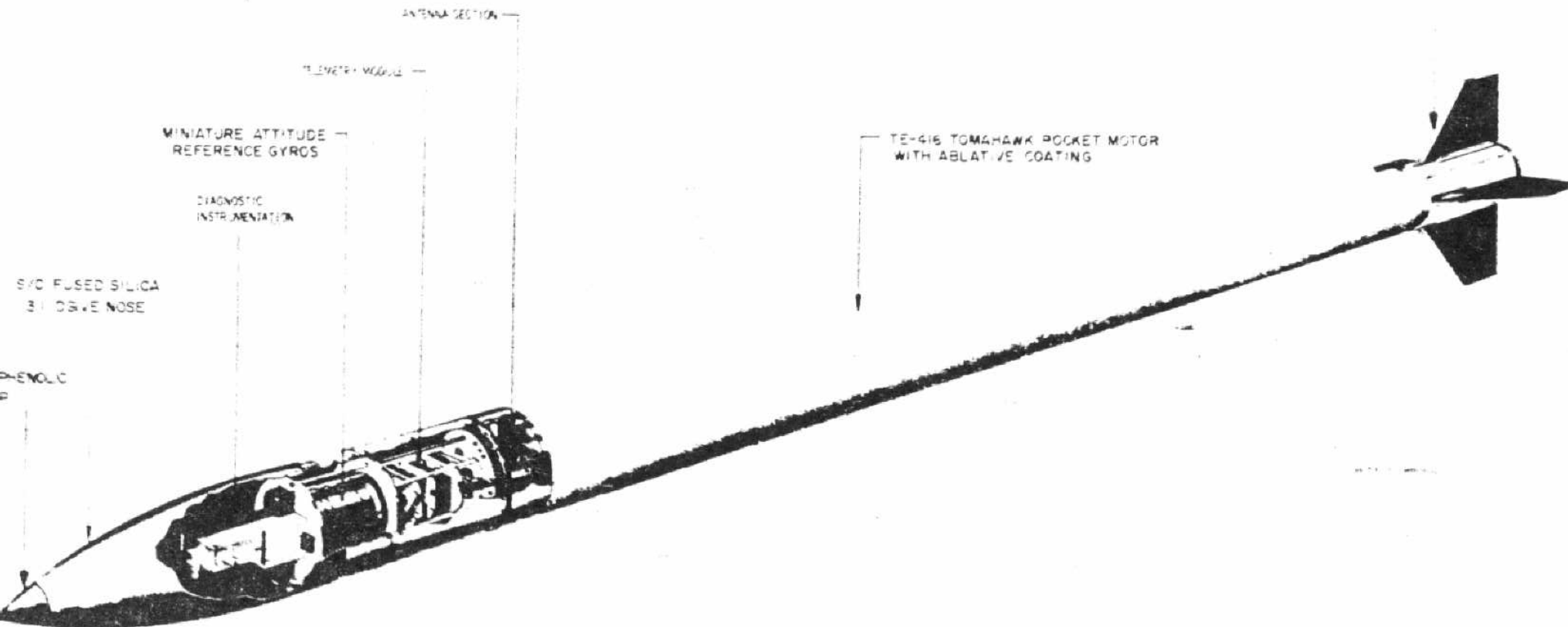


WEIGHT TABLE

LAUNCH WEIGHT	622.3 LBS.
WEIGHT AFTER TOMAHAWK BURNOUT	223.1 LBS.
GROSS PAYLOAD WEIGHT	80.0 LBS.

D-REGION TOMAHAWK

Figure 6A



**D-REGION TOMAHAWK
WITH DIAGNOSTIC PAYLOAD**

Figure 6B

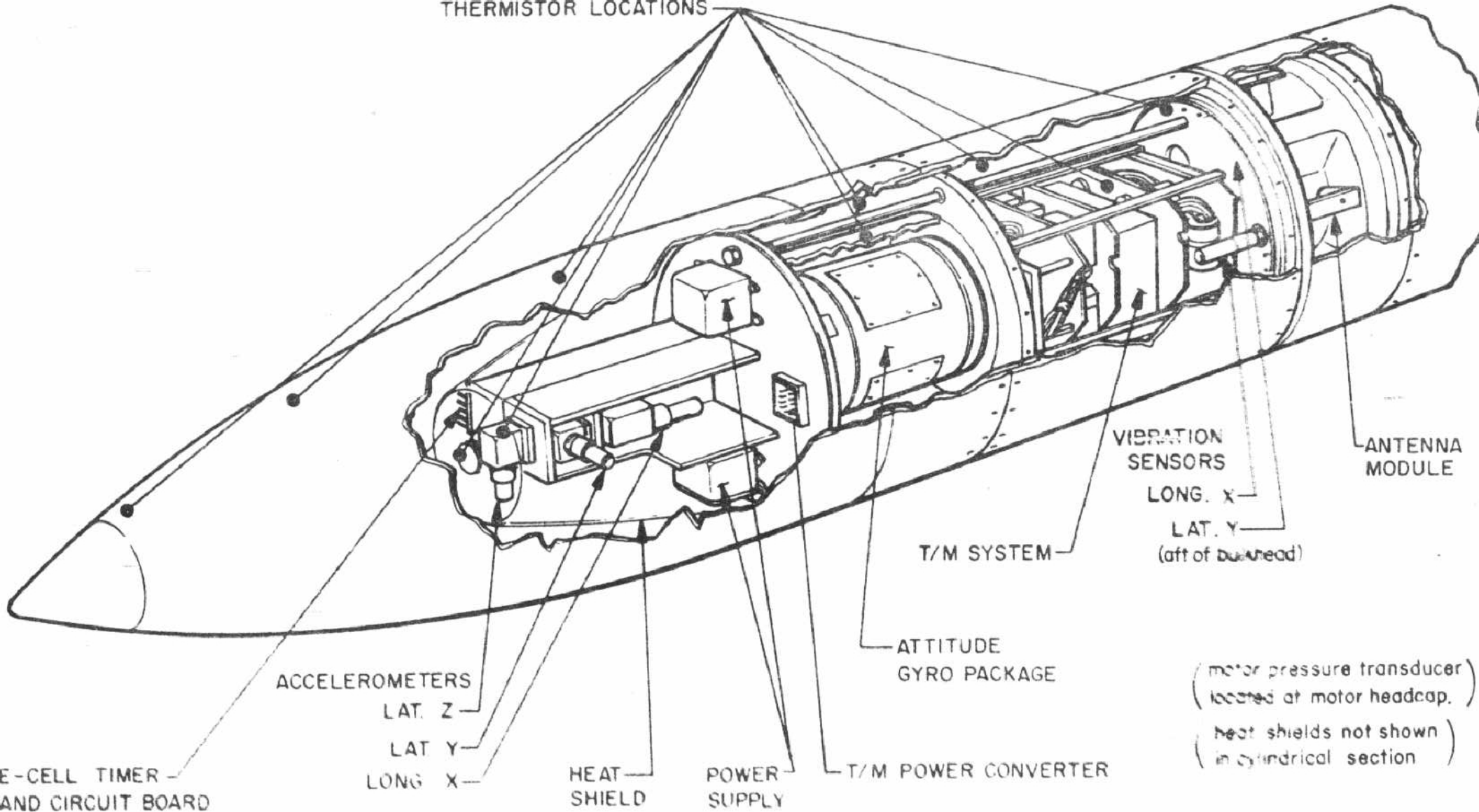


Figure 6C

D REGION TOMAHAWK DIAGNOSTIC PAYLOAD INSTRUMENTATION

