

I.Q.S.Y. Tomahawk

Sounding Rocket

INTRODUCTION

The original full-size TOMAHAWK was developed by the Astro-Met Division of the Thiokol Chemical Corporation as a small inexpensive single-stage sounding rocket. Measuring 9" in diameter by 16½ feet long, and weighing 585 pounds at lift-off, the Tomahawk's 11,000 lb. thrust motor is capable of pushing 44 pounds of scientific instruments into the D and E Regions of the ionosphere (35-65 miles). The first I.Q.S.Y. (International Quiet Sun Year) TOMAHAWK was flown at Tonopah, Nevada on June 12, 1963. The fourth and final development version of TOMAHAWK was launched from N.A.S.A. Wallops Station, Virginia, and it is this #4 Wallops bird which we have scaled down into an operating model.

"Sounding", as applied to rockets, means to investigate or examine. A "sounding rocket" is a meteorological rocket used to gather atmospheric data such as temperature, pressure, radiation, and wind velocity. Sensitive instruments within the nose cone and payload compartment are exposed to the upper atmosphere for purposes of measuring the above mentioned objects of study. This information is sometimes recorded within the rocket itself, but is most often telemetered back to Earth by means of radio transmitters within the payload compartment.

Based on the exact scale of 1-9.91, the new TOMAHAWK is easy-to-build, and is an excellent beginner scale model. The payload capsule included with this kit is a bonus extra, not found in the actual full-size TOMAHAWK. Use this capsule to carry your payloads, such as crickets, beetles, ants, and other insects to high altitudes and return them safely by parachute. When properly assembled, the TOMAHAWK will give you many educational and thrilling flights.

ASSEMBLY INSTRUCTIONS

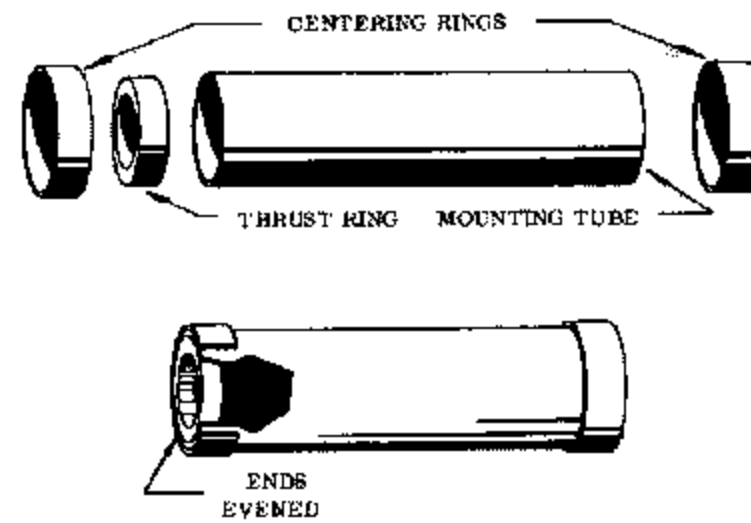
In addition to the parts supplied, you will need the following items to assemble this kit:

- Modeling knife with sharp blade
- White glue or Centuri Superbond
- Fine Sandpaper - Scissors - Ruler
- Pencil with sharp point - Straight pins
- Paint for finishing - - preferably spray type

STEP 1 ASSEMBLE ENGINE MOUNT

The engine mount consists of one mounting tube, two Centering Rings and one Thrust Ring. Assemble these parts with white glue or Centuri Superbond as shown in Detail A.

First, glue on both centering rings even with the ends of the mounting tube. Next, glue the thrust ring inside the forward end of the mounting tube, with the end of the ring even with the end of the tube.



DETAIL A

I.Q.S.Y.
TOMAHAWK
SOUNDING ROCKET
with
Payload Capsule

- AUTHENTIC MARKINGS
- HI ALTITUDE FLIGHTS
- PARACHUTE RECOVERY
- ACCURATE SCALE

1/10th
SCALE MODEL

RECOMMENDED
ENGINES

½A6-2	B14-6
A5-4	C6-7
B6-6	

Scale Detail
by
G. Harry Stine

SPECIFICATIONS

Length 20"
Diameter908"
Net Wt. 1.15 oz.

\$225

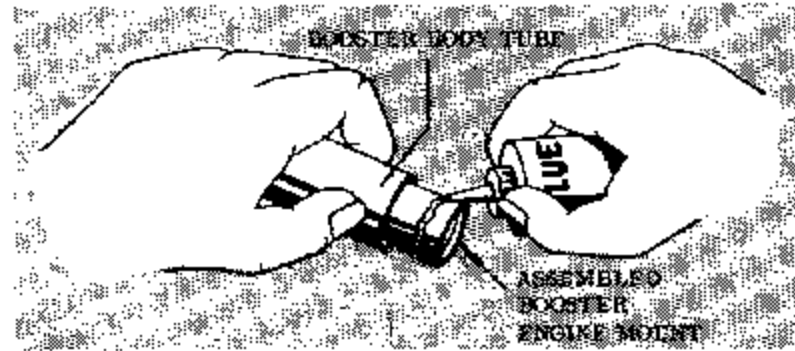
Cat. No. KC-40

Easy-to-build Scale Model. Excellently proportioned. Top point winner at NARAM-9. Exact scale detail and assembly instructions provided. Flights over 1200 ft. with 'B' engine. Recovers safely with colorful 16" parachute.

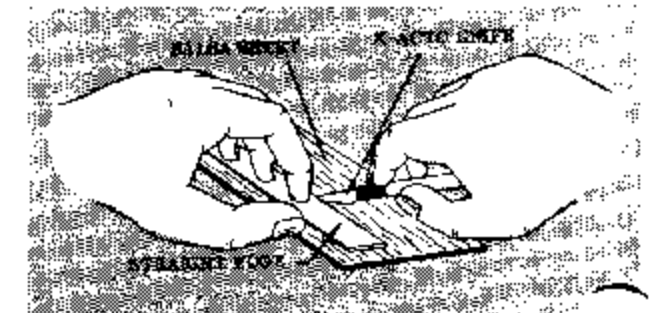
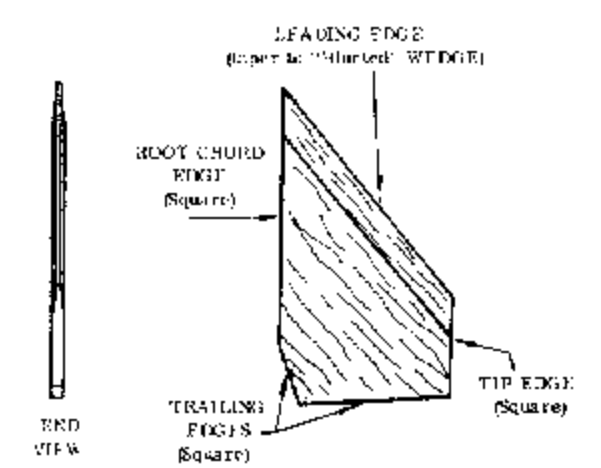
STEP 2 INSTALL ENGINE MOUNT

After the mount has completely dried, glue it into the body tube in the following manner:

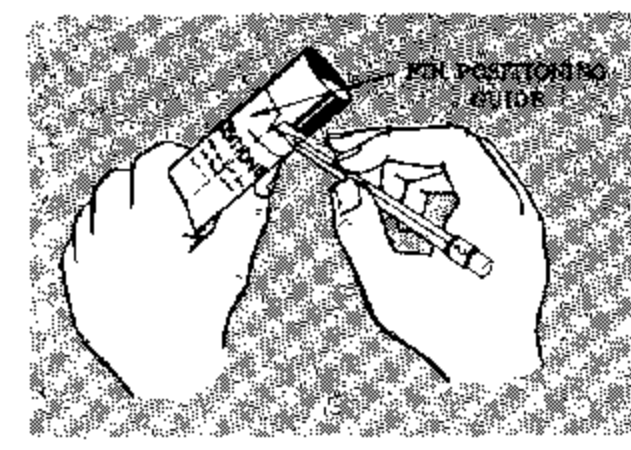
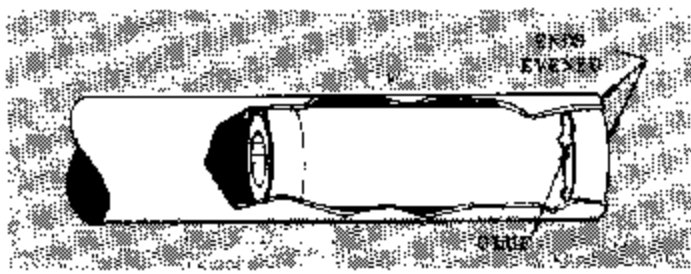
Insert the assembled mount, thrust ring end first, part way into the sustainer body tube. As shown in Detail B-1 apply a heavy ring of glue around the forward edge of the rear centering ring; and push the mount forward until the back end of the mounting tube is even with the end of the body tube as shown in Detail B-2.



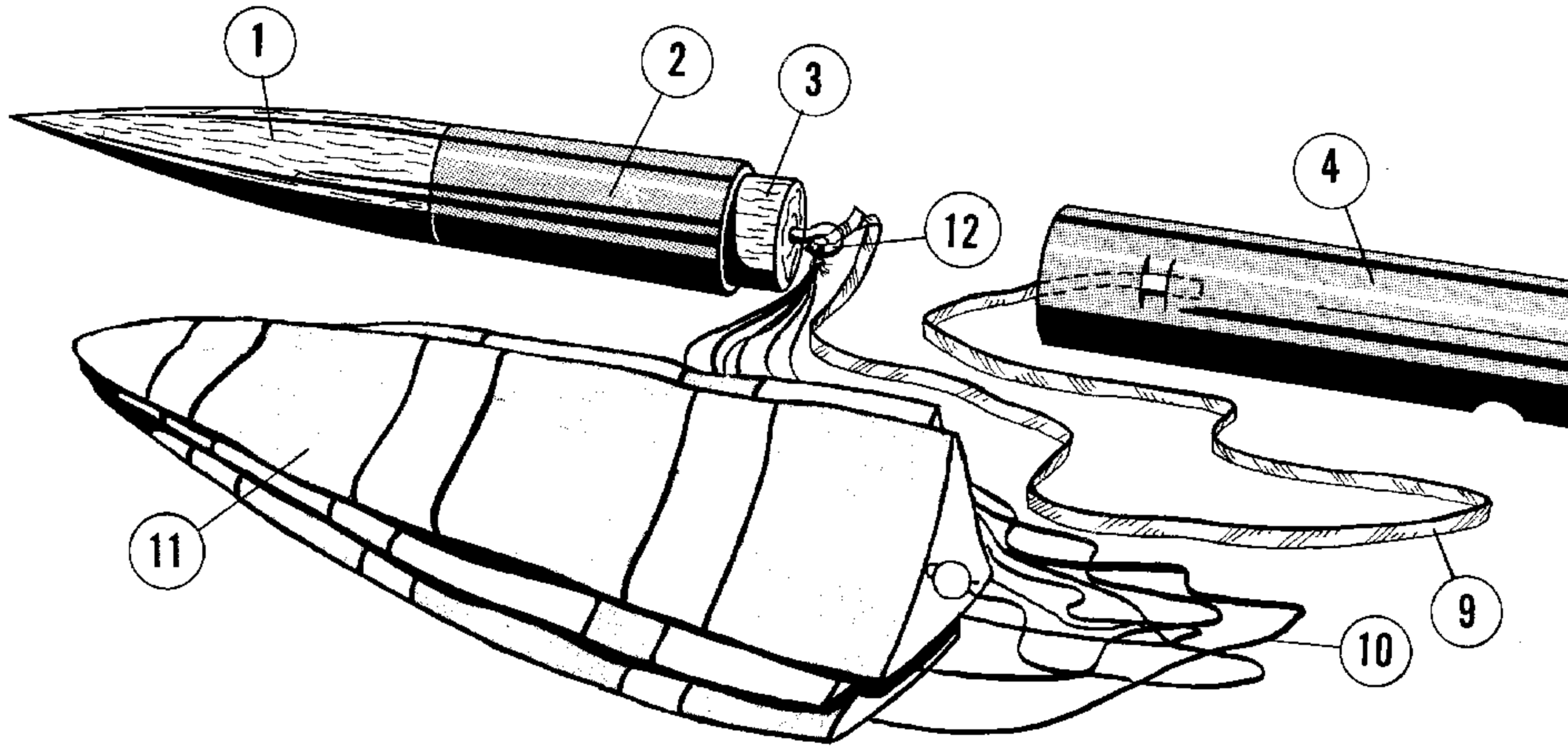
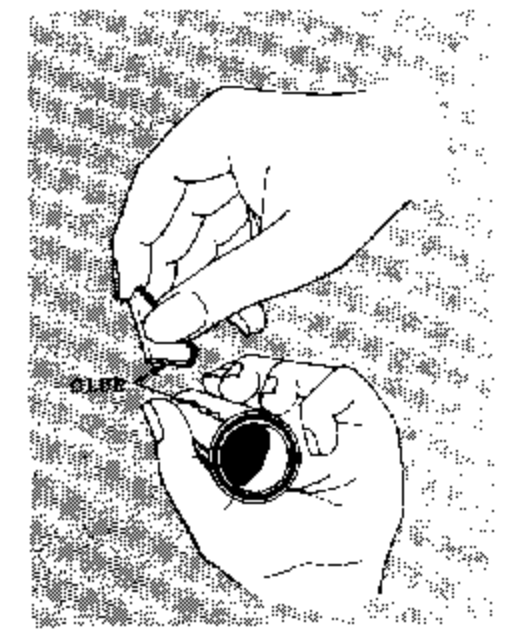
DETAIL B-1



DETAIL B-2



DETAILS C-1 - C-4

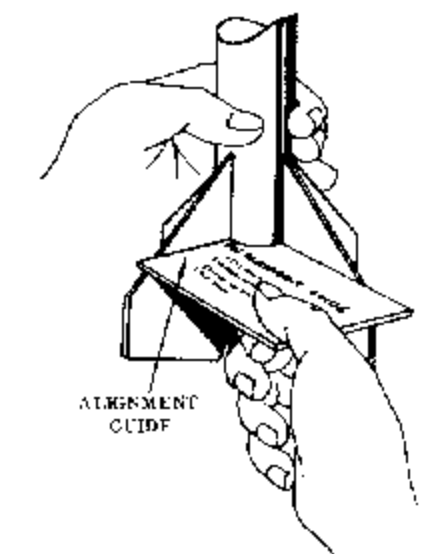
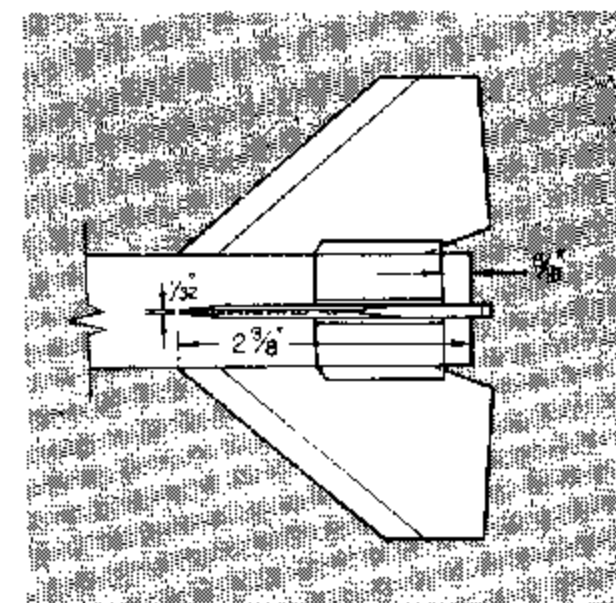


STEP 3 ATTACH STABILIZER FINS TO BODY

Prepare and attach the fins in the following manner:

Carefully cut out all the indicated fins from the balsa sheet with a sharp modeling knife. Using a metal straight edge to guide your modeling knife will greatly improve cutting accuracy. (See Detail C-2.) Using fine sandpaper, sand each fin as shown in Detail C-1. Taper the leading edge to a "blunted wedge", square the trailing and tip edges, and square the "root chord". Also lightly sand both sides of each fin.

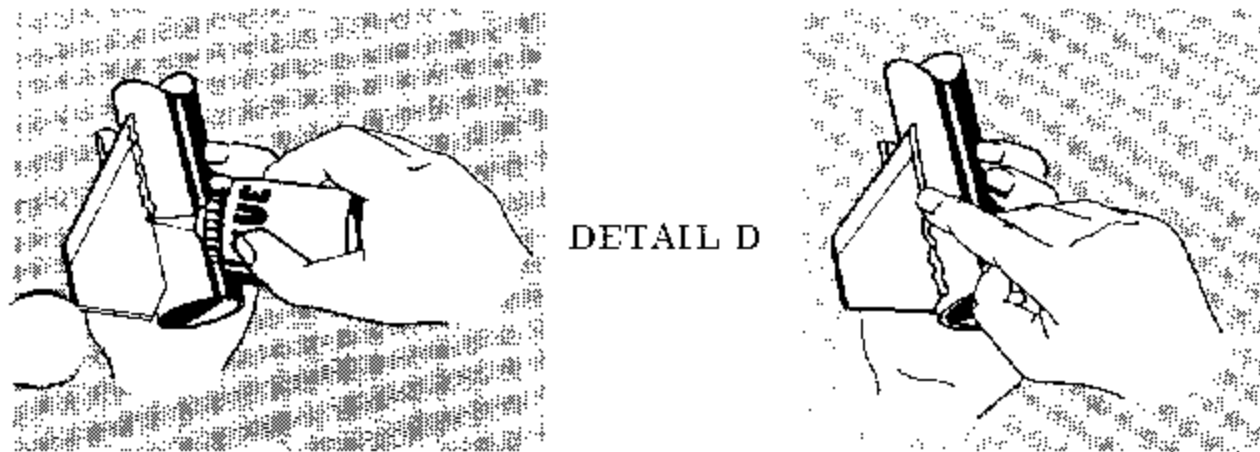
Cut out the paper Fin Positioning Guide, wrap it around the body tube base and mark the fin locations with a pen or pencil. At the same time, place a pencil mark across each of the first four marks 2-3/8" from the aft end of the body tube. Apply glue sparingly to each fin root chord edge, one at a time, and also along the body tube where fin is to be attached. When glue has begun to set, place fin in position on the body tube so that the forward end of fin just touches the 2-3/8" mark (See Detail C-3). Stand the tube on its top end and allow glue to dry. With the Fin Alignment Guide, check the angle between fins before glue has set. (Should be 90°).



DETAILS C-5 & C-6

STEP 4 APPLY GLUE FILLETS TO FIN JOINTS

For increased fin joint strength, run a fillet of the same glue along each fin/tube joint, after the initial glueing has thoroughly dried. Wipe off any excess glue and smooth out the fillet as shown in Detail D.



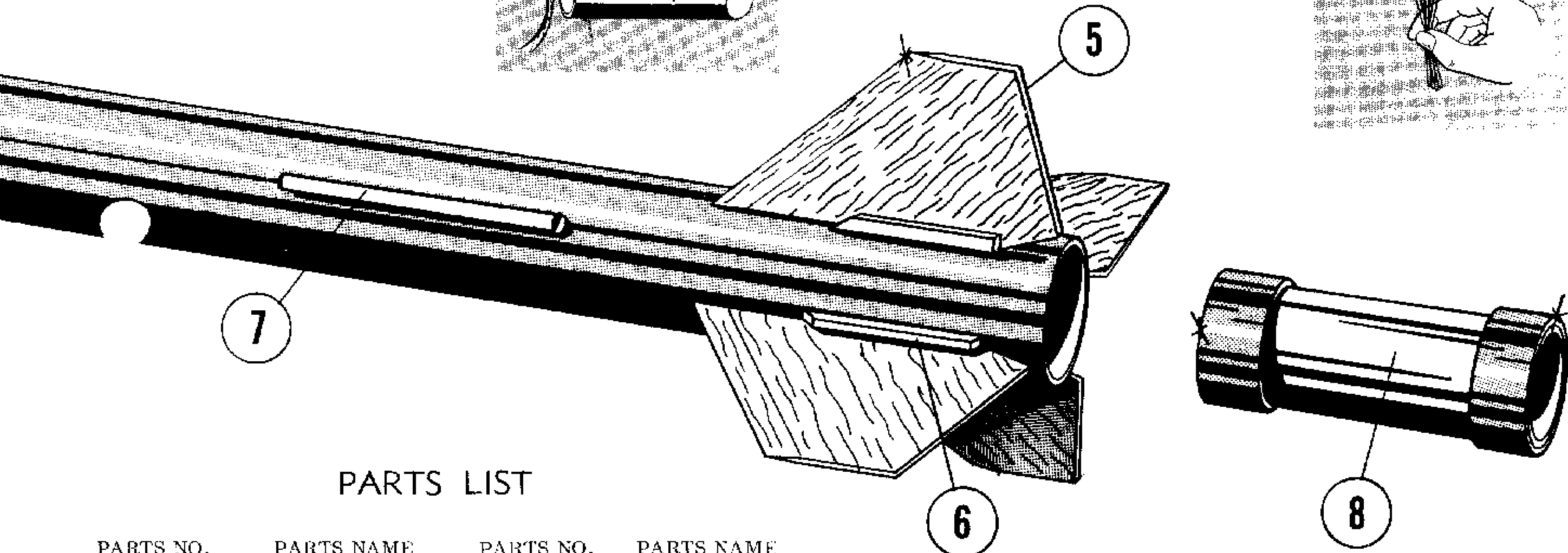
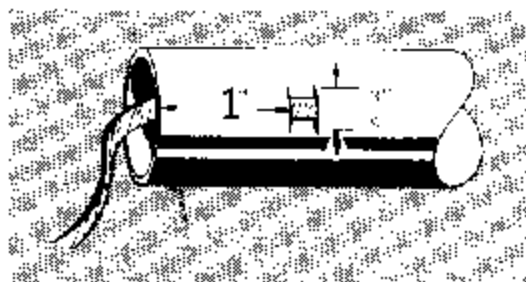
DETAIL D

STEP 5 ATTACH LAUNCH LUG & SHOCK CORD

Attach one end of the rubber shock cord to the body tube as shown. Cut two slits, about 3/8" long and 3/8" apart, in the body tube one inch down from the top end. Insert one end of the rubber cord into the tube from the top end, and depress the tube paper between the slits. Bring the cord out through the first slit, and back into the body tube through the second slit. Apply glue to the connection to form a strong bond and press paper back into place.

Thread the screw eye into the balsa connector base, and then unscrew the eye. Squirt glue into the resulting hole and re-thread the eye into the base. Now tie the shroud ends to the screw eye together with the rubber shock cord as shown in the Assembly Drawing.

Glue launch lug to side of body tube as shown in Main Assembly drawing.

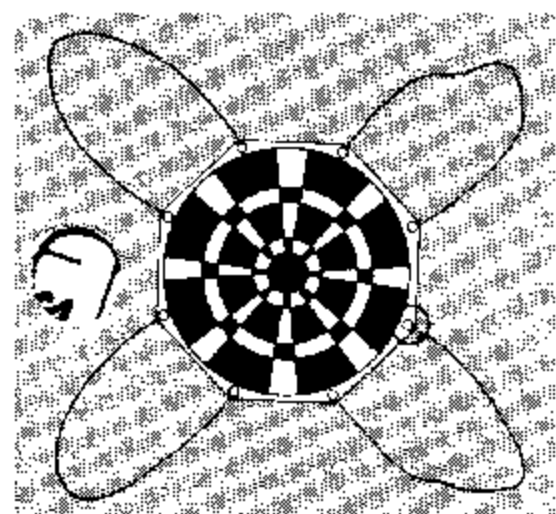


PARTS LIST

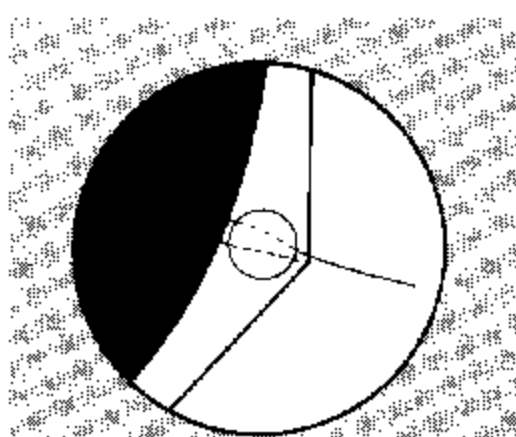
PARTS NO.	PARTS NAME	PARTS NO.	PARTS NAME
1	NOSE CONE	7	LAUNCH LUG
2	PAYLOAD CAPSULE	8	ENGINE MOUNT
3	BALSA CONNECTOR	9	SHOCK CORD
4	BODY TUBE	10	SHROUD LINES
5	STABILIZER FINS	11	PARACHUTE
6	FIN TABS	12	SCREW EYE

STEP 6 ASSEMBLE AND ATTACH PARACHUTE

1) Cut out plastic canopy carefully, following dashed lines. Cut shroud line into four (25") lengths.

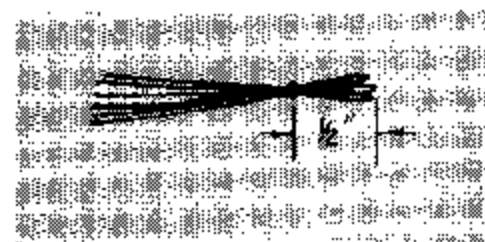


DETAIL F-1

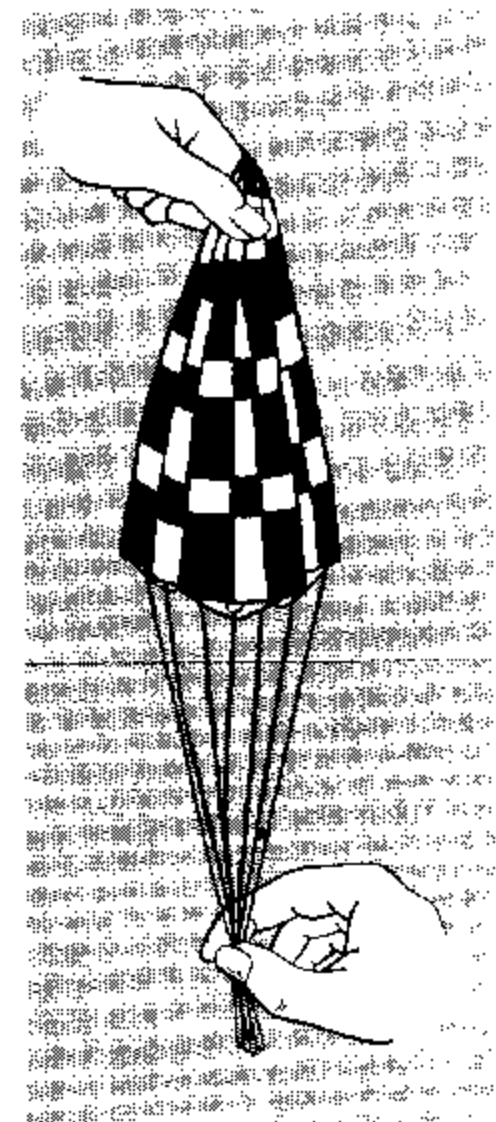


2) As shown in the detail illustration, form a 1/2" loop in end of shroud line, place loop over indicated dot, and position tape disc over loop. Press disc firmly onto plastic. Attach free end of shroud to adjacent dot. Repeat for all shroud lines as shown in Detail F-1.

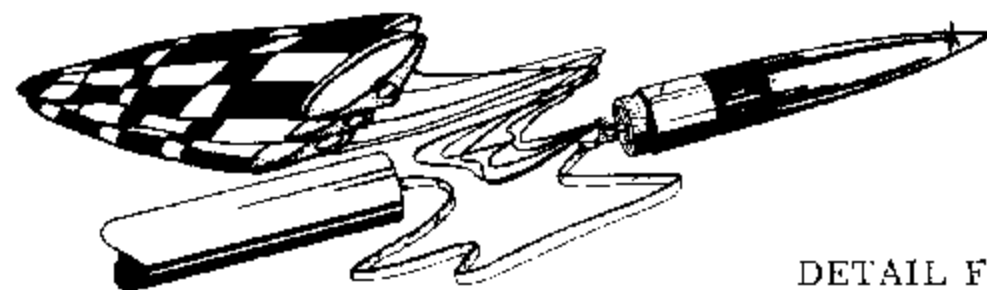
3) Hold canopy at its center, printed side out. Pull all lines together and even up ends. Tie all lines together with a single knot near the end.



DETAIL F-2



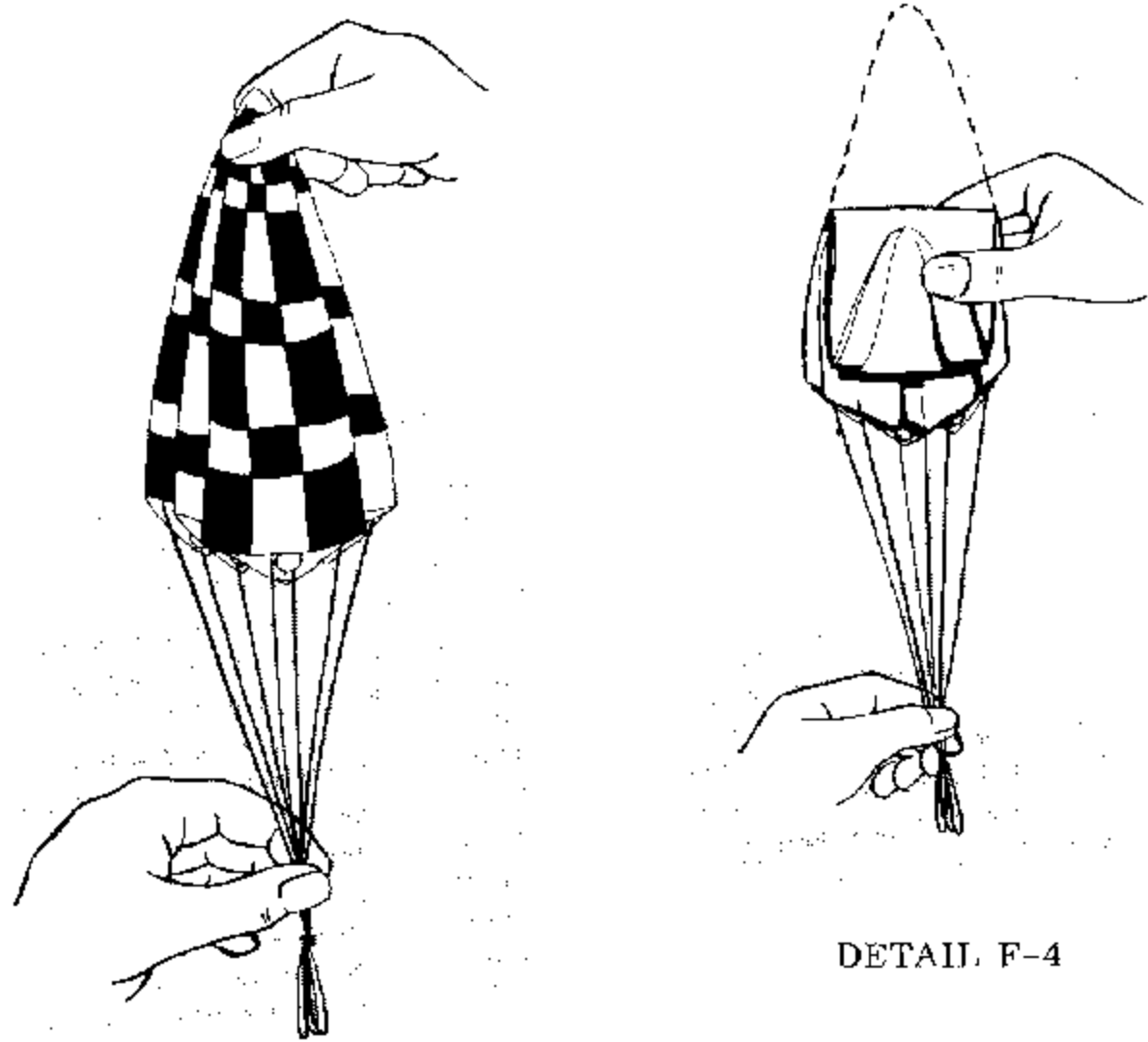
Tie shroud lines to nose cone screw eye as shown in Detail F-3.



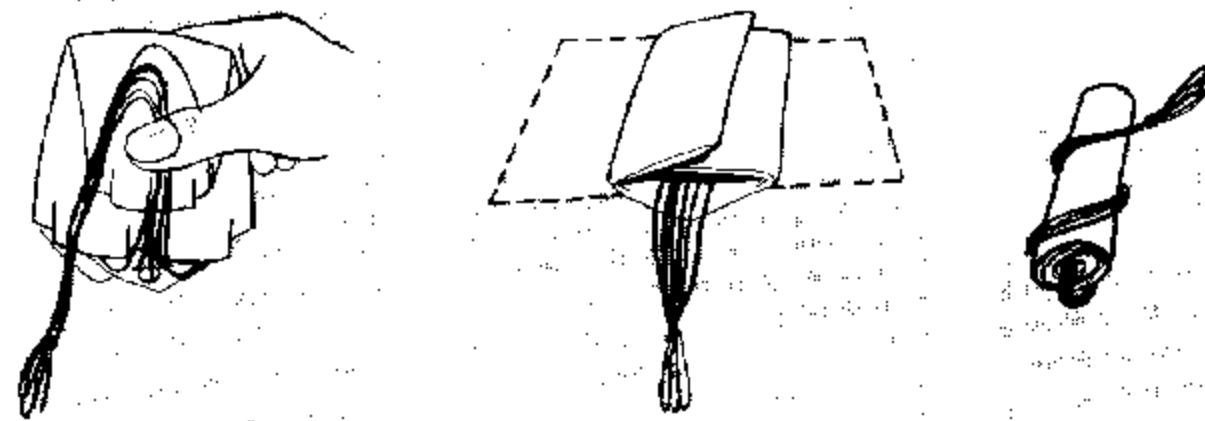
DETAIL F-3

Hold canopy at its center and flatten out pleats. Fold canopy and shroud lines as shown in Detail F-4.

Fold the chute temporarily, insert into the top of the body tube, and place capsule on tube.



DETAIL F-4



STEP 7 PREPARING THE PAYLOAD

The TOMAHAWK is capable of carrying a maximum payload weight of one ounce when powered by either a B14-5 or C6-5 engine, and a maximum weight of $\frac{1}{2}$ ounce when powered by an A5-4 engine. Extremely fragile payloads should be packed in cotton or foam rubber. CAUTION: Do not overweight the capsule. Check your payload weight before launching. A $\frac{1}{2}$ A6-2 engine, which weighs about $\frac{1}{2}$ ounce can be used to compare with your payload.

To prevent the payload from falling out during the chute ejection and recovery phase, glue one half of the balsa connector into the capsule tube. The nose cone should fit tightly into the opposite end of the capsule tube. If the fit is loose, build up with scotch tape.

The connector end of the capsule should slip snugly but not tightly into the body tube. If the fit is loose, build it up with tape. If the fit is too tight, sand the connector down slightly until just snug.

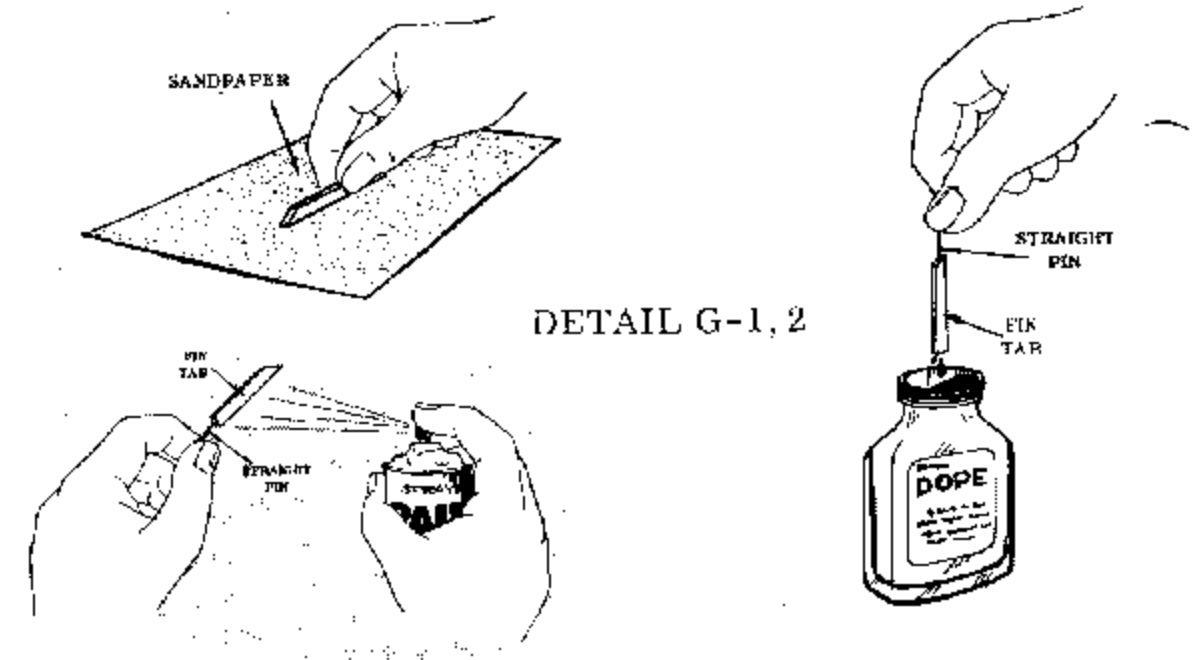
STEP 8 FINISHING THE TOMAHAWK

To obtain maximum altitude flights, all model rockets should be painted to a gloss finish. First, the grain texture of the nose cone and fins should be filled in with several coats of balsa filler. Sand smooth between applications. The body tube does not require this treatment. Finish entire model with a lightweight paint such as spray dope or laquerized enamel. To aid in tracking, use bright colors such as white, yellow, orange, or red. Fluorescent colors are quite easy to spot at high altitudes. Exact scale detail coloring and markings are shown on the "Scale Substantiation Data" sheet included with this kit. For those wishing to add additional markings for improved visibility in flight, apply the roll pattern decal included with this kit.

STEP 9 ATTACH SCALE FIN TABS

The Fin Tabs shown in the Assembly Drawing and in Detail G-1 should be attached after the entire rocket has been painted. Cut the 8 tabs from the printed balsa sheet and square up the ends and edges by sanding. Using a straight pin as a holder, finish each

tab by either dipping in paint or spray painting as shown in Detail G-2.



DETAIL G-1, 2

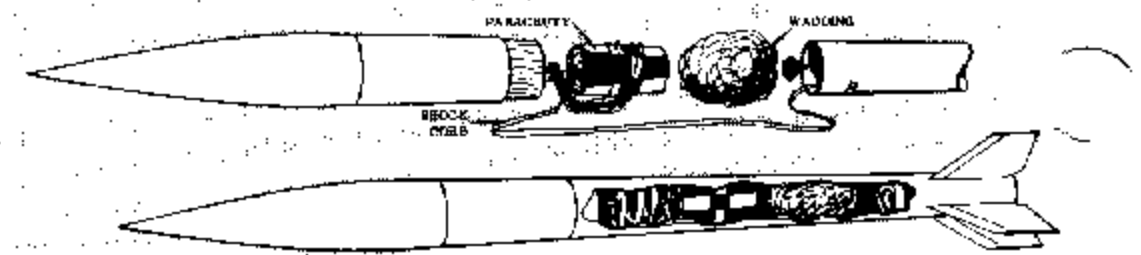
After paint has dried, glue tabs on both sides of each fin in the position shown in Detail G-4.



DETAIL G-4

STEP 10 PACKING THE PARACHUTE

Just before launching, insert flameproof cotton or wadding into the body tube, fold up the chute, insert into body tube with shock cord and place capsule in position. This will prevent the hot ejection gases from burning or melting the parachute.



STEP 11 LAUNCHING THE TOMAHAWK

The TOMAHAWK can be launched with any of the following engines:

$\frac{1}{2}$ A6-2 A5-4 B6-6 B14-6 C6-7

Maximum altitude flights are obtained with the B. 8-6 engine, while maximum acceleration is achieved using B 3-5 power.

Launch the TOMAHAWK from a $\frac{1}{8}$ " diameter x 36" long launching rod. Use electrical ignition only, as outlined in Centuri's Engine Operating Instructions. Choose a clear unobstructed launch site away from buildings, highways, and trees. Launch from the center of an open field measuring at least 300 feet on a side. Always give a short countdown to alert spectators before launching.

Upon ignition, the TOMAHAWK will rise under power, high into the sky, coast on to maximum altitude, eject its parachute, and return to Earth for many more flights.

An engine removal tool can be made by bending a right angle crook in the end of a piece of stiff piano wire. Insert the crooked end in through the nozzle of the spent engine, twist to one side, and pull.

For additional information concerning rocket engines, kits, ignition devices, launching equipment, or replacement parts, write to:

CENTURI ENGINEERING COMPANY

P. O. Box 1988 • Phoenix, Arizona 85001

I.Q.S.Y. TOMAHAWK

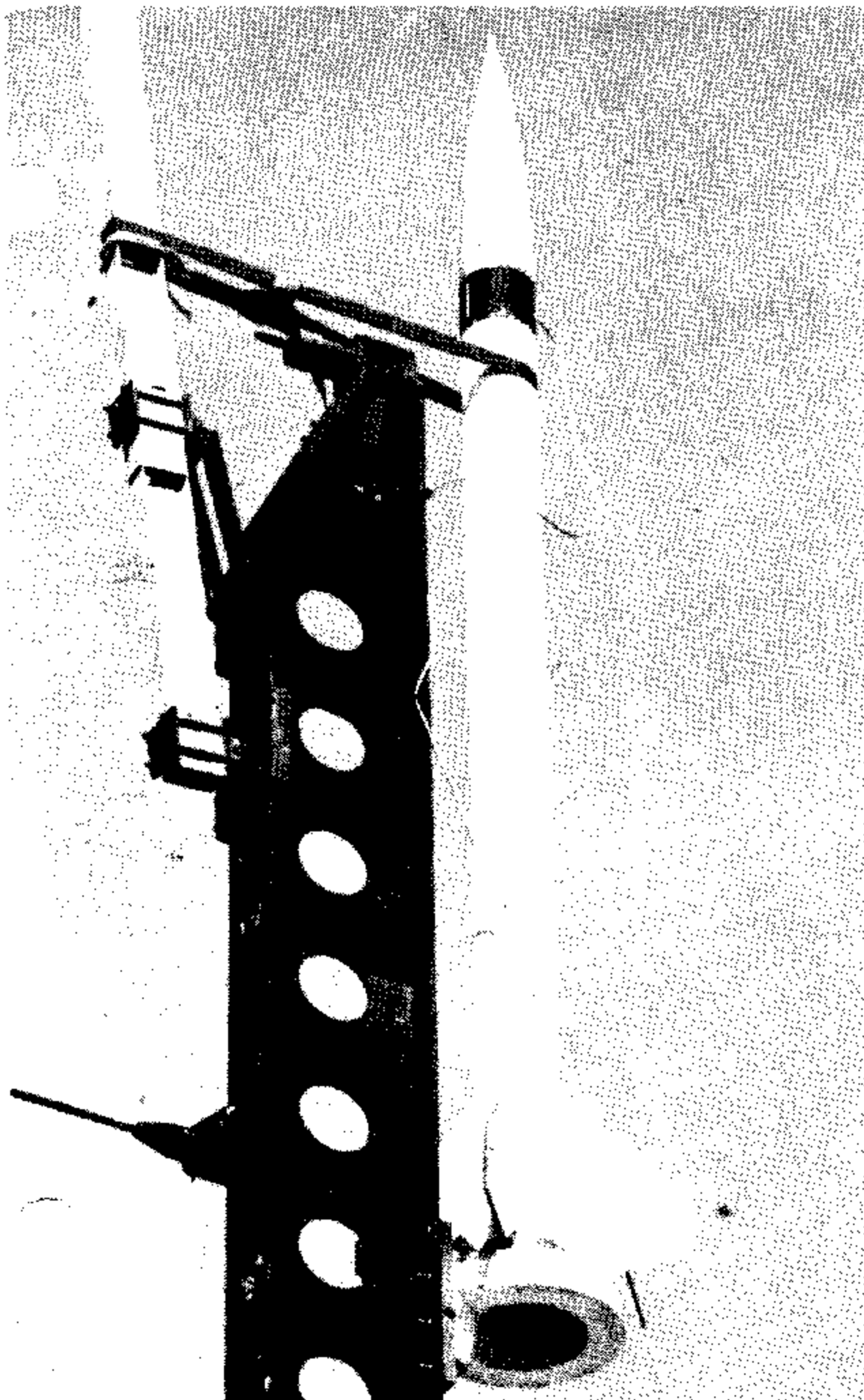
SPECIFICATIONS

NOMINAL WEIGHTS

Thiokol TE 416 Motor:	484.8 lb.
Tail Assembly:	47.9 lb.
Vehicle less payload:	44.0 lb.
Vehicle with payload and external insulation	584.5 lb.

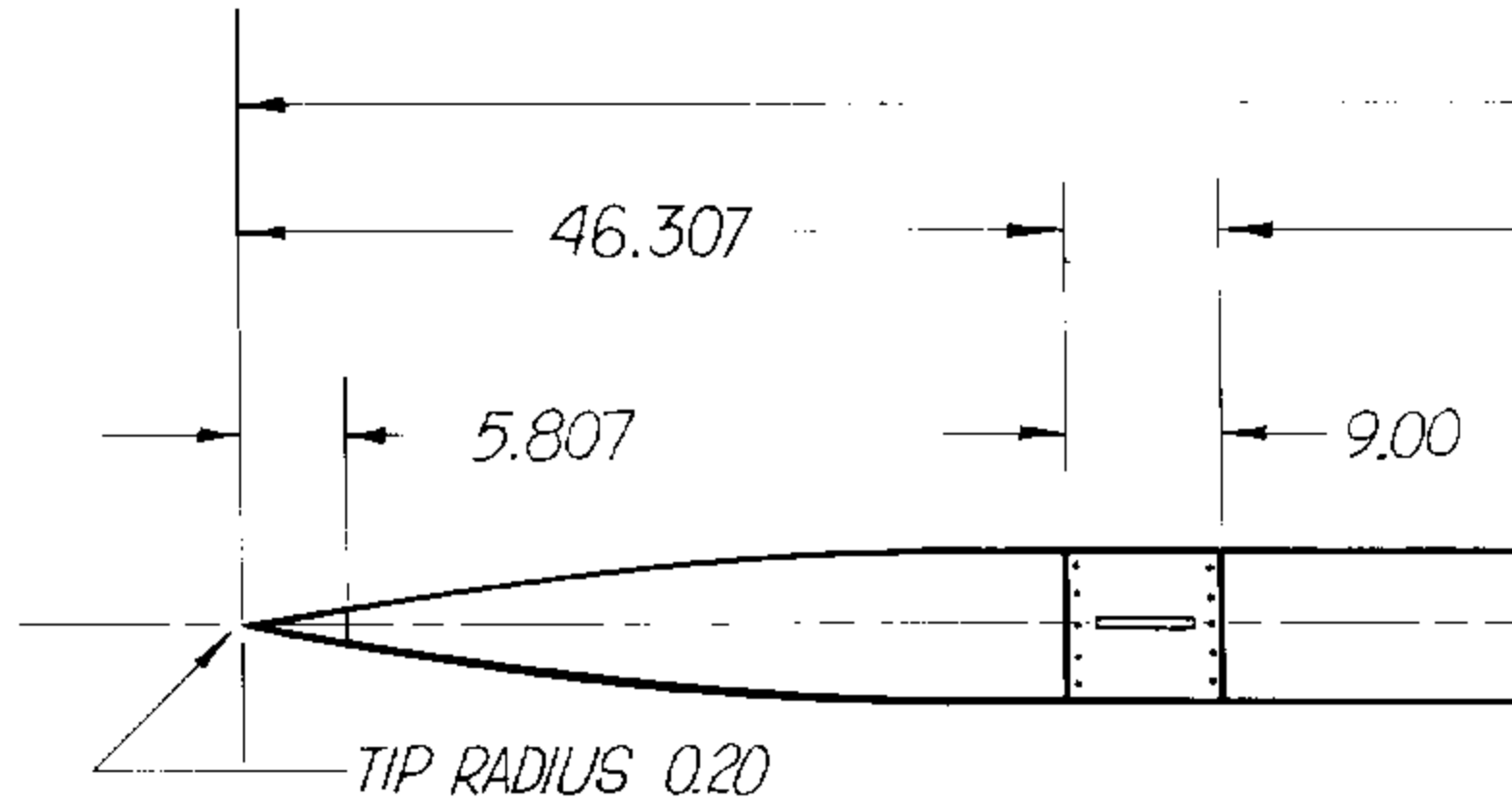
PROPULSION SYSTEM

Make:	Thiokol TE 416
Type:	Solid Propellant
Length:	141.085 in.
Diameter:	9.0 in.
Propellant:	Hydrocarbon - aluminum fuel and ammonium perchlorate oxidizer.
Nominal thrust:	10,970 lb.
Burning Time:	9.5 sec.
Total Impulse:	93,800 lb-sec.



SCALE SU

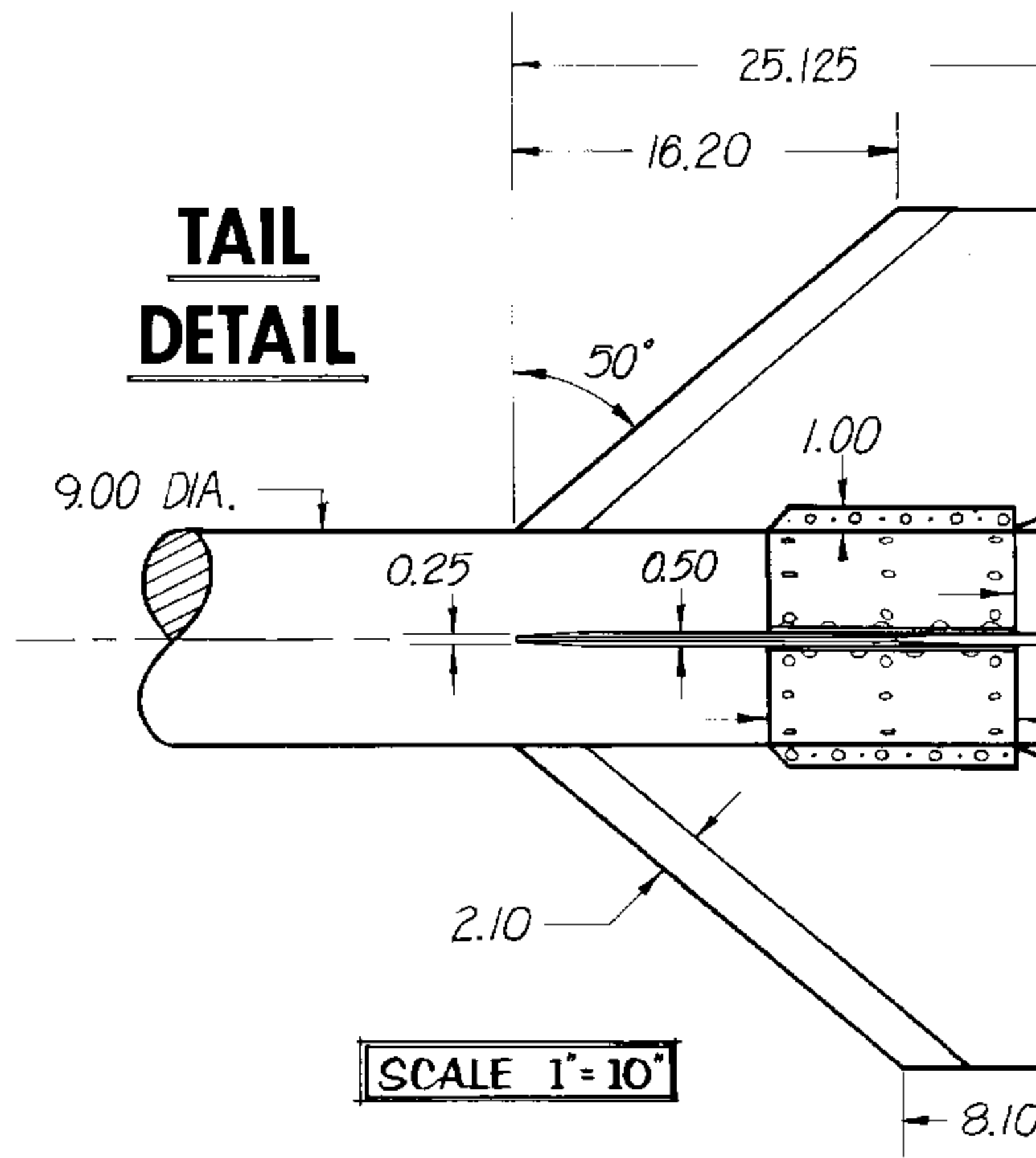
I.Q.S.Y.



SCALE 1" = 20"

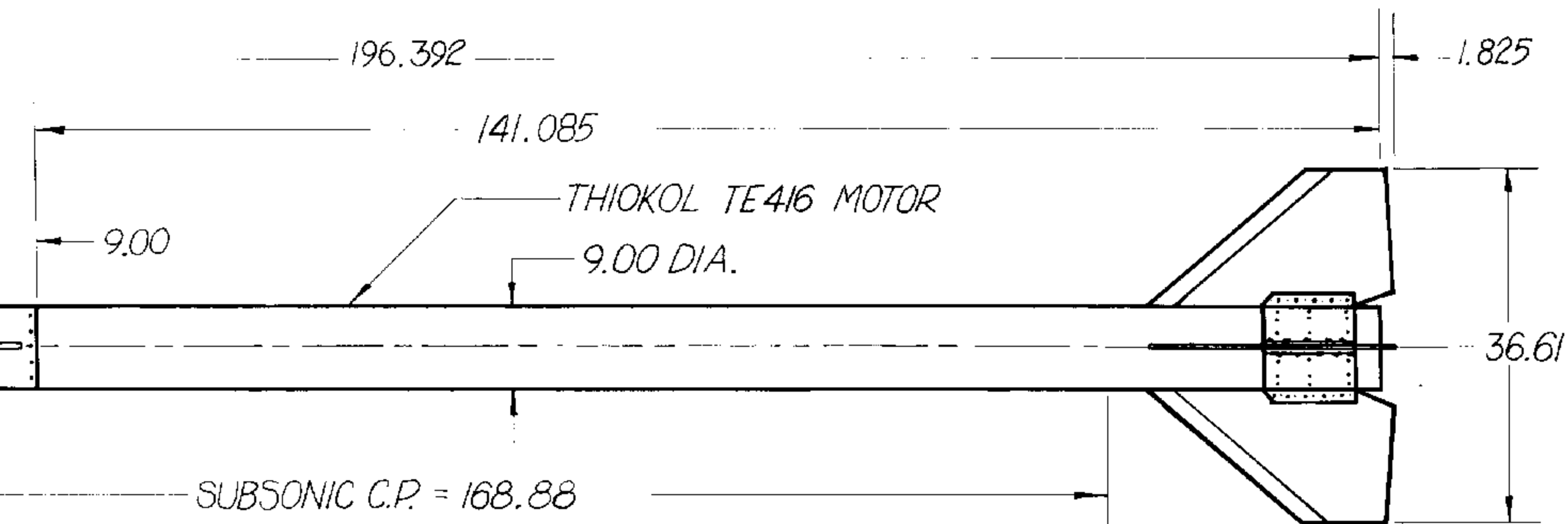
OV

TAIL DETAIL

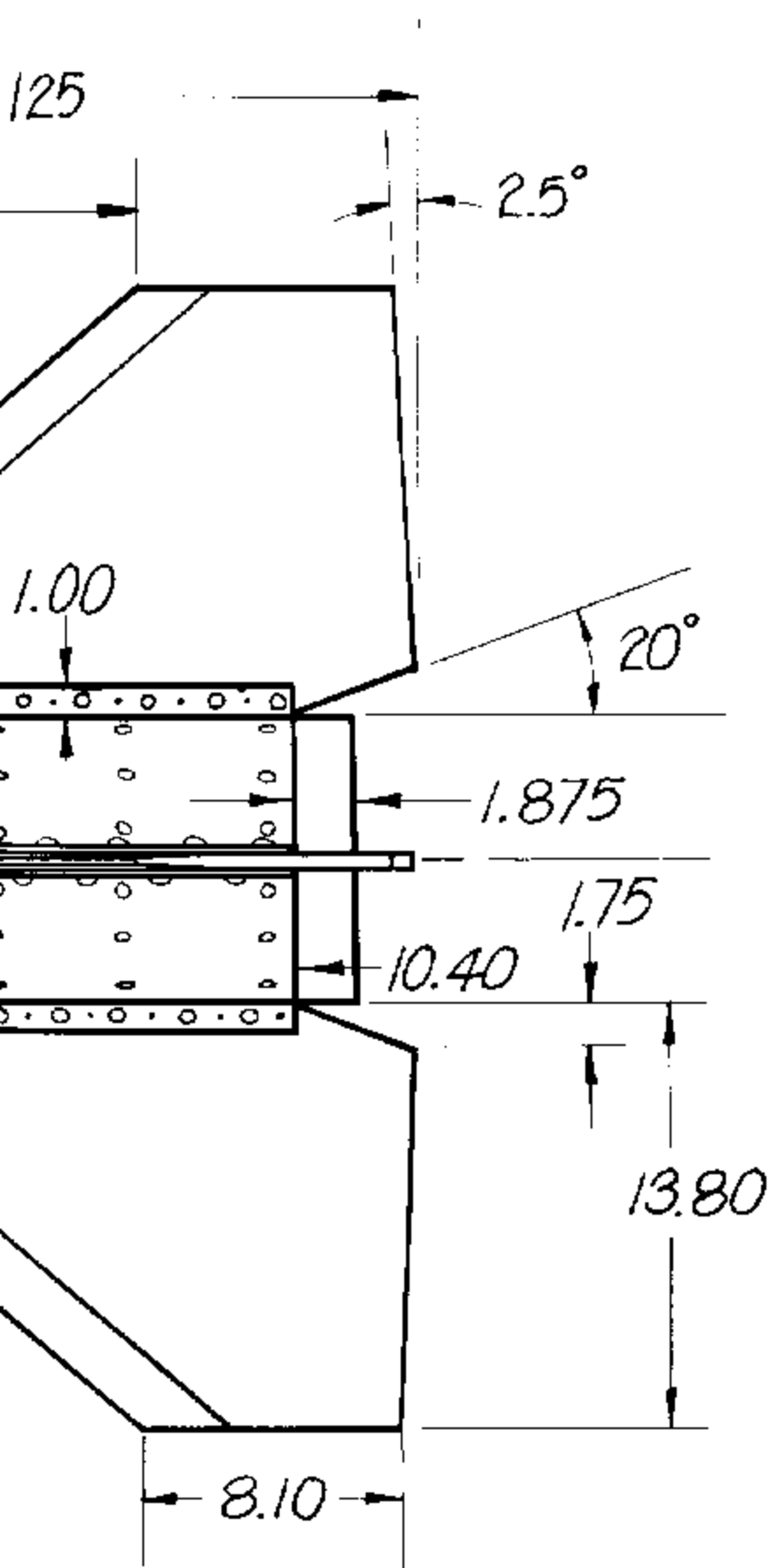


SCALE SUBSTANTIATION DATA

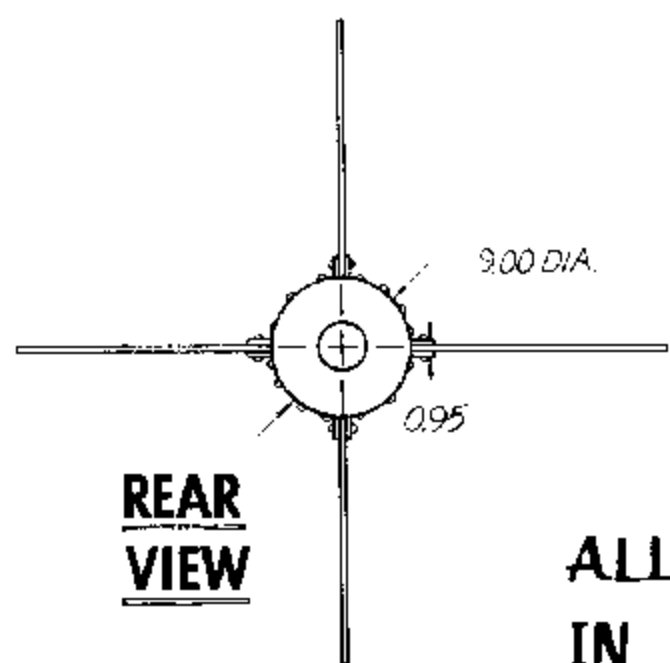
S.Y. TOMAHAWK



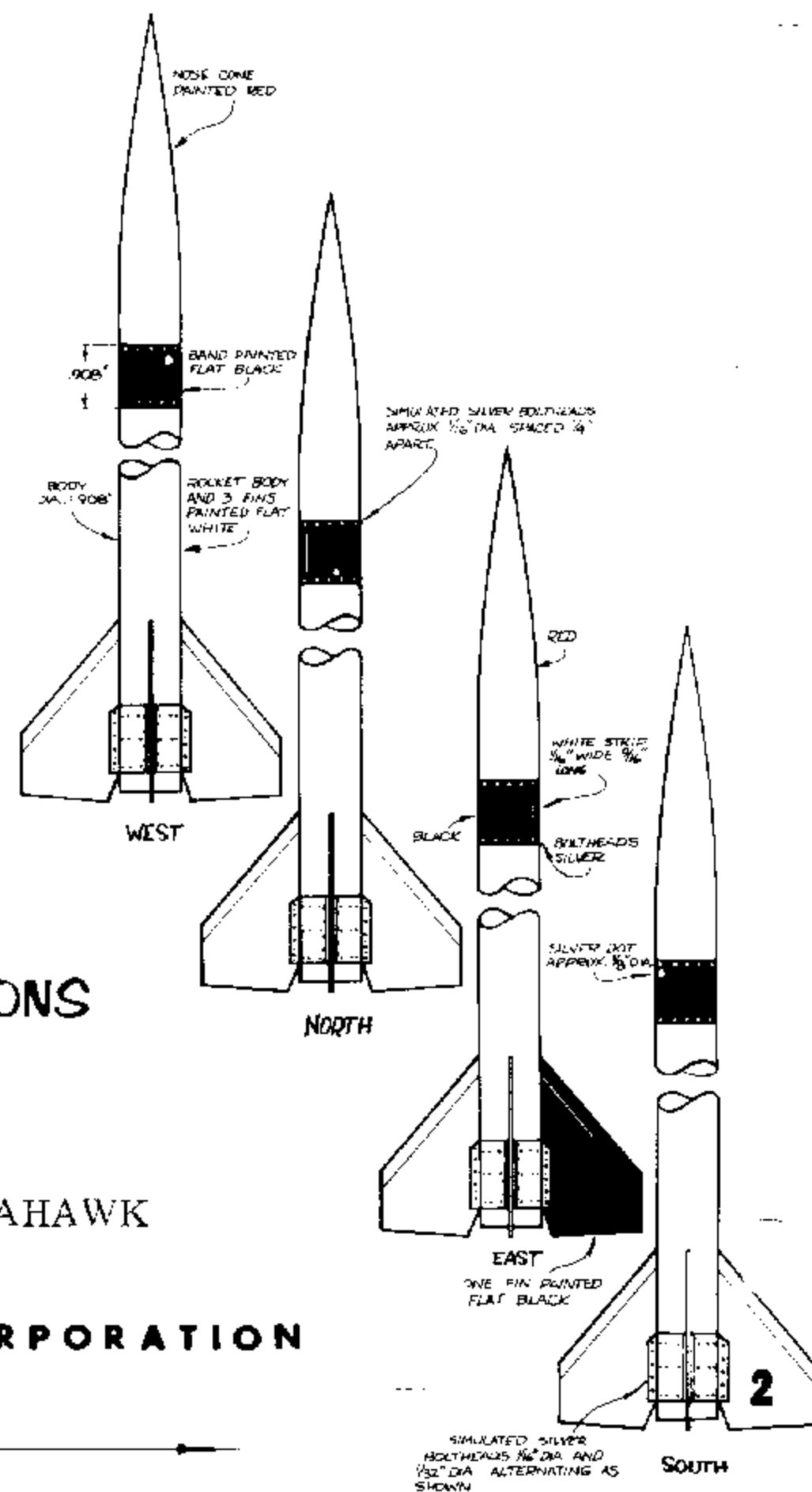
OVERALL SIDE VIEW



1/10th
Scale Model
MFG. BY



NOTE!
ALL DIMENSIONS
IN INCHES



ACTUAL FULL SCALE TOMAHAWK
MFG BY

Thiokol CHEMICAL CORPORATION
ASTRO-MET DIVISION