Recommended for ages 10 to adult. Adult supervision recommended for those under 12 years of age when flying model rockets.

1 MODEL KIT - Paint and glue not included.
1 MODELE REDUIT - Peinture et colle non comprises.

QUEST™

Shaping the future of model rocketry

DC-Y SPACE CLIPPER™

Flying Model Rocket

America's Newest Spaceship™

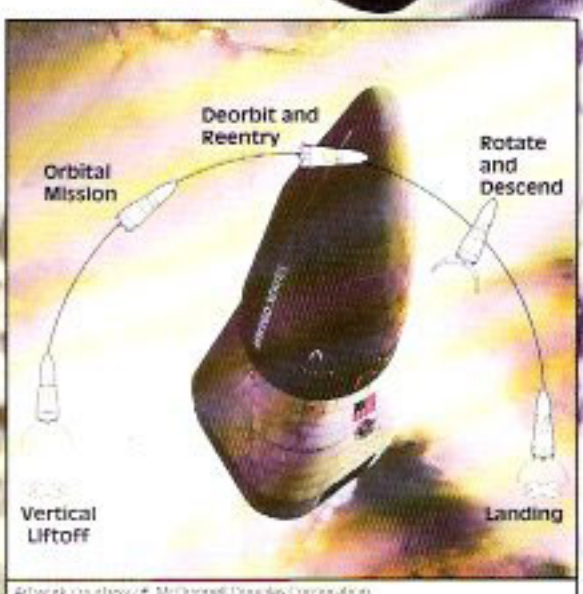
1/122nd Semi-scale flying model of the McDonnell Douglas DC-Y Delta Clipper, Single Stage to Orbit (SSTO) Vehicle

- Highly detailed AeroShroud™ features heat shield tiling, hatches, maneuvering flaps and directional thrusters.
- All parts are precolored—no painting required!
- Includes Quest's advanced design features for superior flight: Kevlar® Shock Cord System, Easy-Lock Motor Mount and Grippers™ Recovery System (see back panel).
- Special Space Clipper Tech Report explains this finless rocket's unique flight characteristics and provides details about the McDonnell Douglas DC-Y Delta Clipper System.

Estimated Maximum Altitude:
300 ft (91.44 m)
Recommended Rocket Motors:
C6-3 only
Length: 13.5 in (34.3 cm)
Body Diameter: 4.0 in (10.1 cm)
Weight: 4.0 oz (113 g)

Dual 12" Recovery Parachutes

The highly detailed AeroShroud™, realistic optional motor nozzles and 3D maneuvering flaps make the Space Clipper an impressive display model.



Artwork courtesy of McDonnell Douglas Corporation

The McDonnell Douglas DC-Y Delta Clipper system will make commerical space travel a reality, transporting people and cargo with the safety and efficiency of modern airliners.

A computer-designed aerospace framework provides a sturdy base and accurate positioning for the AeroShroud™.

This model kit requires assembly.
White glue, launch control system and rocket motors for launching are not included.

Kevlar is a trademark of DuPont.

SKILL LEVEL

1	2	**3**	4
BEGINNER	INTERMEDIATE	ADVANCED	EXPERT

Recommended for the Advanced Modeler

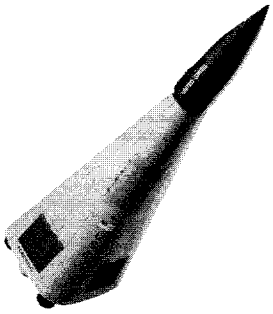
PROOF OF PURCHASE
Quest DC-Y Space Clipper #3004

0 45856 93004 0

QUEST
#3004

SPACE CLIPPER™ ASSEMBLY INSTRUCTIONS

QUEST™

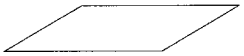


Prod. No. 3004/3504
Skill Level Three

Things You'll Need To Assemble this Kit:

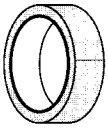
Hobby Knife and Pencil

Sandpaper (220 or 320 Grit)



White Glue

Tape
Scotch Magic Tape or Paper Masking Tape

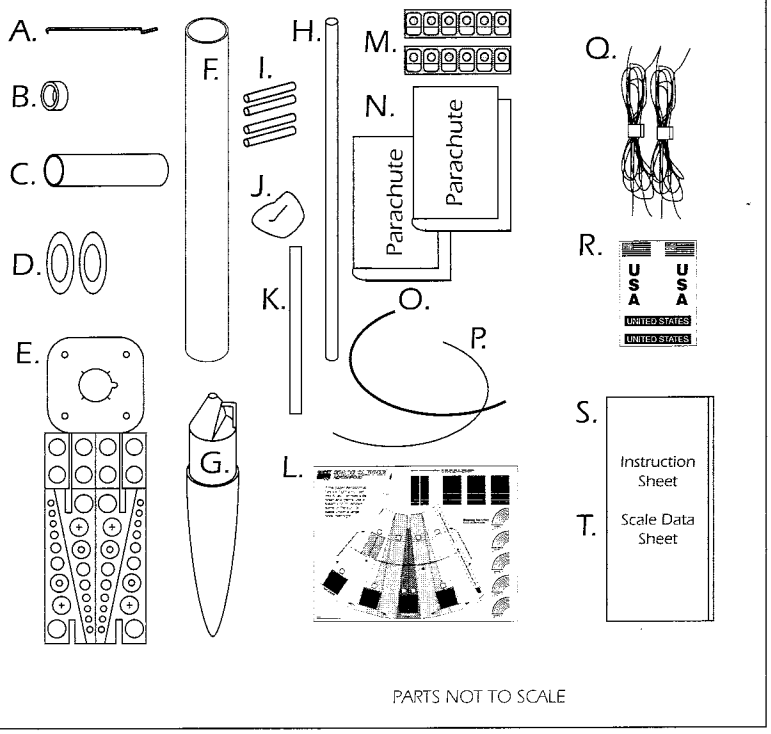


BEFORE STARTING ASSEMBLY READ THROUGH THESE INSTRUCTIONS. IT IS BEST TO TEST FIT ALL PARTS BEFORE APPLYING ANY GLUE. READ AND FOLLOW THE NAR MODEL ROCKET SAFETY CODE.

PARTS LIST

- **A.** 49000 Motor Clip
- **B.** 14000 Blue Thrust Ring
- **C.** 10303 Yellow Motor Mount Tube
- **D.** 16002 Flat Centering Centering Rings (2)
- **E.** 92210 Black Die-cut Parts Sheet
- **F.** 11505 8.5 Inch Black Body Tube
- **G.** 20208 Black Plastic Nose Cone
- **H.** 10005 8.5 Inch Black Launch Lug
- **I.** 10200 Black Landing Gear Tube (4)
- **J.** 49026 Clay Block
- **K.** 94015 8 Inch Double Face Tape Strip
- **L.** 92300 Printed Aeroshroud Sheet
- **M.** 28001 Strip of 6 Gripper Tabs (2)
- **N.** 28102 12 Inch Parachute (2)
- **O.** 50011 18 Inch White Elastic Shock Cord
- **P.** 50051 18 Inch Yellow Kevlar Shock Cord
- **Q.** 50100 Pack of 3/26 Inch Shroud Lines (2)
- **R.** 91017 Decal Sheet
- **S.** 90067 Instruction Sheet
- **T.** 90985 Scale Data Sheet

* Kevlar is a registered trademark of Dupont



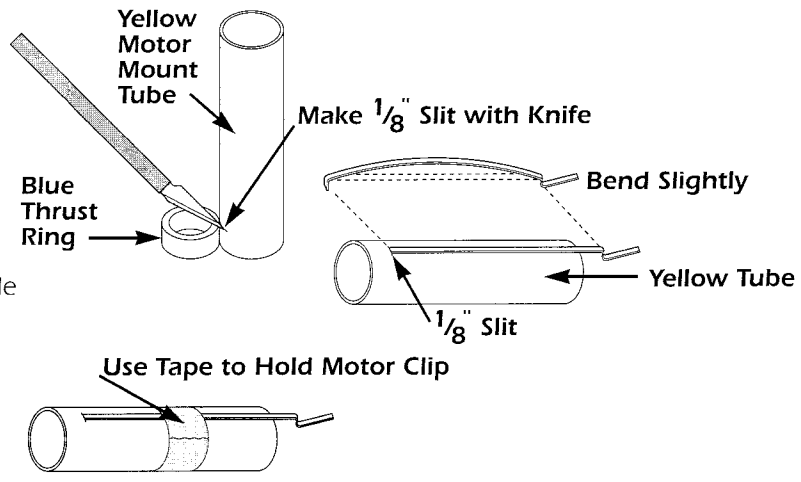
PARTS NOT TO SCALE

STEP 1

A. Place the Blue thrust ring up against the side of the Yellow motor mount tube and use it as a guide for your knife to make a small 1/8 inch long slit in the side of the Yellow Motor Mount Tube as shown.

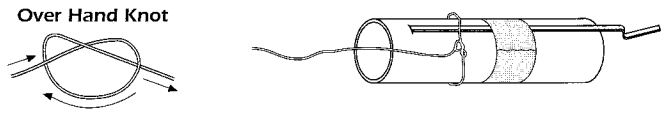
B. Make a slight bend in the motor clip as shown. Insert the clip into the slot you made in the Yellow Motor Mount Tube.

C. Wrap a piece of tape all the way around the Yellow Motor Mount Tube to hold the motor clip in place.



STEP 2

A. Use two overhand knots to tie the Yellow Kevlar shock cord around the Yellow Motor Mount Tube as shown.



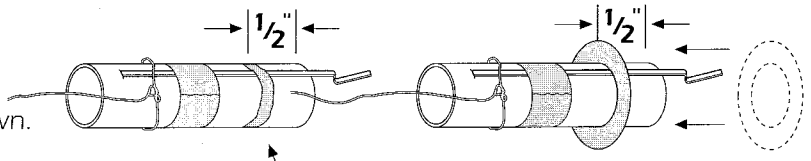
STEP 3

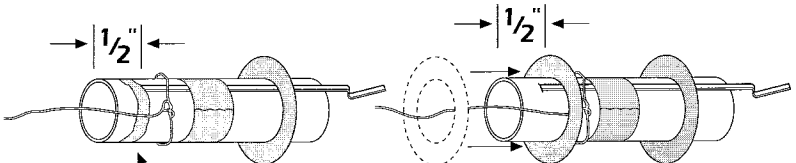
A. Apply a bead of white glue around the Yellow Motor Mount Tube 1/2 inch from rear end as shown.

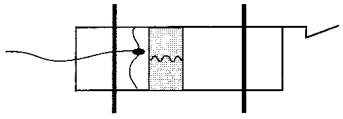
B. Slide one of the paper centering rings onto the Yellow Motor Mount Tube and into the bead of glue. Check to be sure ring is aligned straight on Yellow tube as shown.

C. Apply a bead of white glue around the Yellow Motor Mount Tube 1/2 inch from the forward end as shown.

D. Pass the Yellow Kevlar shock cord through the remaining paper centering ring. Slide the ring onto the Yellow Motor Mount Tube and into the bead of glue. Check to be sure ring is aligned straight on Yellow tube as shown.





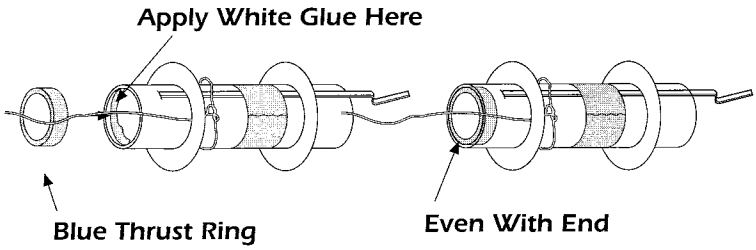


STEP 4

A. Apply white glue around inside edge of Yellow Motor Mount Tube as shown.

B. Insert the Blue thrust ring into the Yellow Motor Mount Tube so it is even with the end of the Yellow Motor Mount Tube.

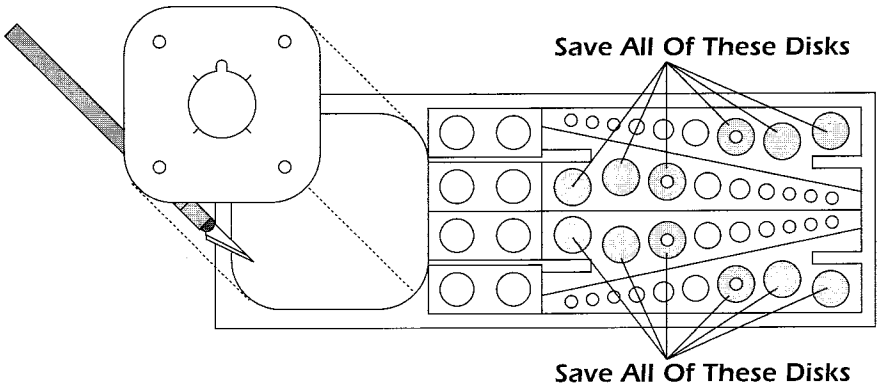
C. After the glue has set completely, apply a small bead of white glue to both sides of each centering ring. Smooth out the glue with your finger. Wipe excess glue off your finger onto a tissue or paper towel.



STEP 5

A. Use a sharp hobby knife to remove all the die-cut parts from the master sheet by carefully cutting through each of the "Tick" marks that hold the parts together.

B. Save the 12 disks as shown

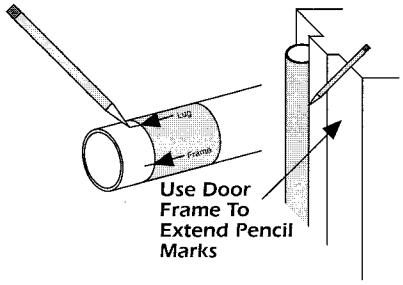


STEP 6

A. Cut out the tube marking guide from the front page of the instruction sheet.

B. Wrap the tube marking guide around the body tube. Mark the body tube at each of the arrows with a pencil. Mark the body tube at the arrow marked "lug".

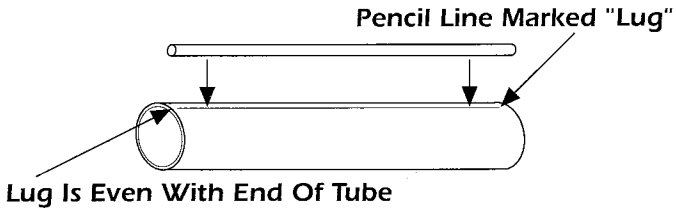
B. Use a door frame as a guide and extend each of the pencil marks up the entire length of the body tube.



STEP 7

A. Apply white glue along the pencil line marked lug running the entire length of the body tube. Place launch lug onto glue and check alignment. Set aside to dry.

Check to be sure the lug is even with both ends of the body tube and perfectly straight along the length of the body tube.



STEP 8

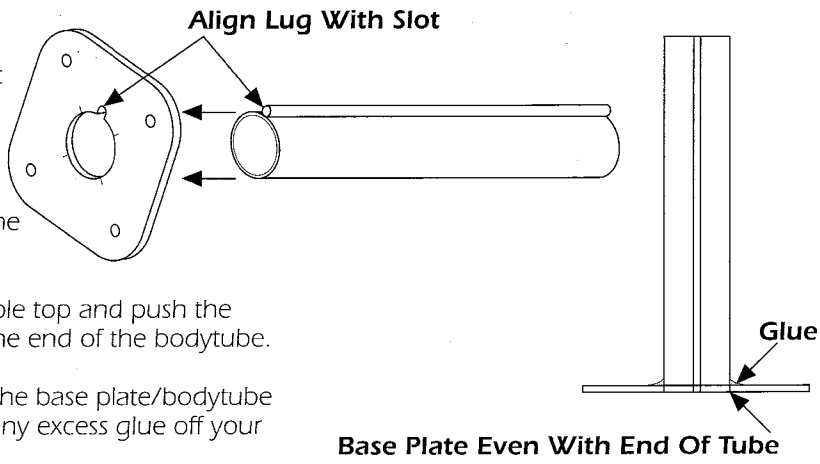
A. Align the launch lug with the corresponding slot in the base plate and slip the base plate onto the body tube.

B. Check to be sure that the four "tick" marks in the base plate line up with the four frame lines along the body tube.

C. Stand the base plate/body tube upright on a table top and push the base plate down so that it is absolutely even with the end of the bodytube.

D. Apply a bead of white glue all the way around the base plate/bodytube joint. Smooth out the glue with your finger. Wipe any excess glue off your finger onto a paper towel or tissue.

Stand the assembly upright on a table top to dry.



STEP 9

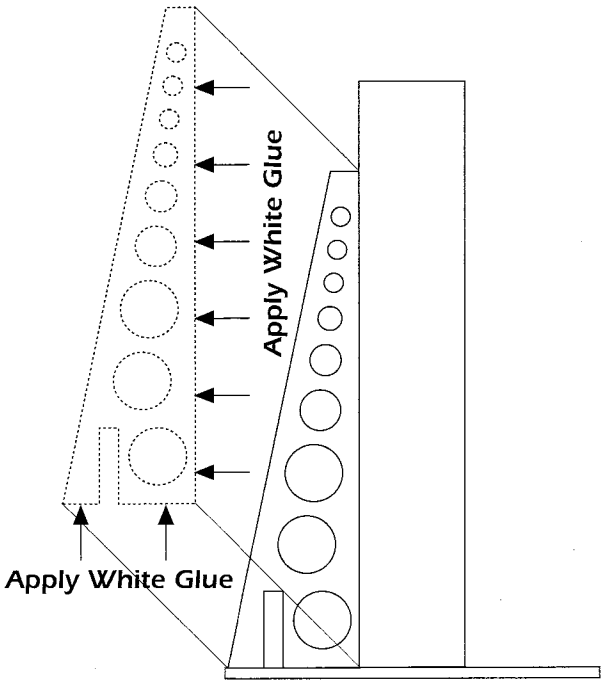
A. Apply white glue to the root edge of one of the four frame pieces.

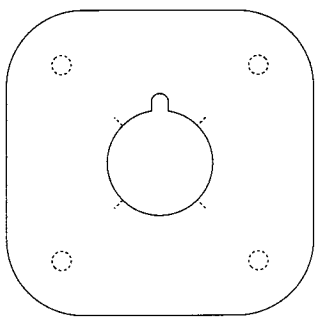
B. Place it straight along one of the pencil marks along the bodytube.

C. Sight along the bodytube from the forward end to be sure the frame is straight as shown.

D. Repeat the procedure above for the remaining three frame pieces.

NOTE: You may need to use a sharp hobby knife to trim the corner of each frame piece to allow it to fit tightly against the tube.





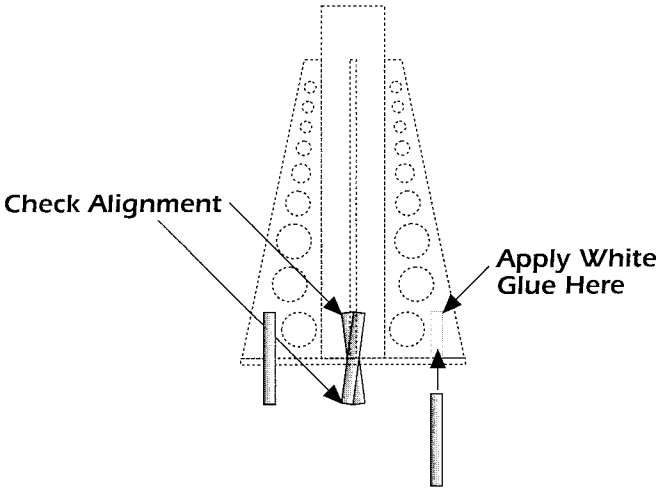
STEP 10

A. Test fit the landing gear tubes into each of the slots in the frame.

B. Apply white glue to the joint between the slot in the frame and the landing gear tube.

C. Check alignment.

D. Repeat procedure for the three remaining landing gear tubes.

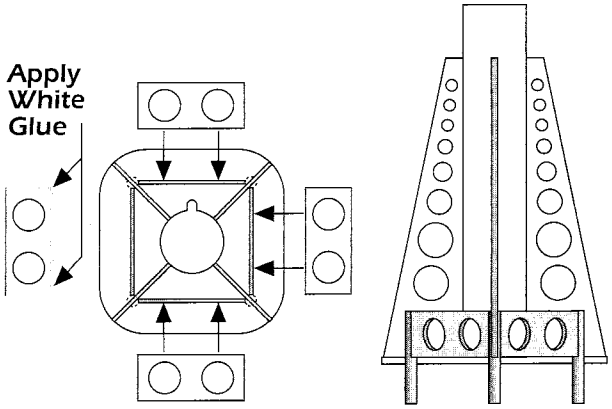


STEP 11

A. Apply white glue to the bottom and side edges of a landing gear gusset as shown.

B. Position the gusset between two landing gear tubes as shown.

C. Repeat for the three remaining gussets.



STEP 12

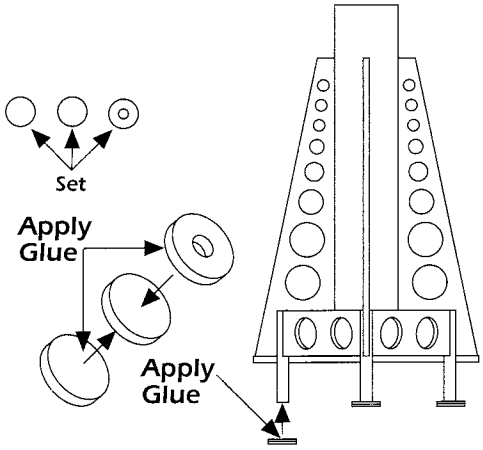
A. Locate the landing gear disks you saved in Step 5. Group them into sets of one disk with a hole paired with two plain disks.

B. Apply white glue to one disk with a hole and press it together with a plain disk. Apply white glue to anther plain disk and press it into three layers. This assembly makes one landing gear pad.

C. Apply white glue to the hole in one of the landing gear pads and press it onto one of the landing gear tubes.

D. Repeat procedure for the remaining three landing gear pads. Once all four pads have been glued on, place the entire assembly on a flat surface to dry.

NOTE: After the glue is completely dry apply a small bead of white glue to both sides of all frame body tube joints.



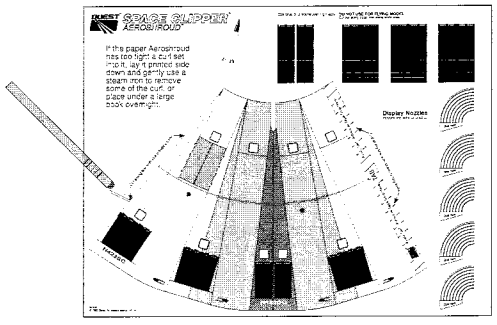
STEP 13

A. Unroll the paper Aeroshroud and lay it printed side up on a flat surface.

B. Using a sharp hobby knife, cut right on the printed outline of the Aeroshroud to remove it from the sheet.

NOTE: Scissors are not recommended for this step. Use a sharp hobby knife for best accuracy.

If the paper Aeroshroud has too tight a curl set into it, lay it printed side down and gently use a steam iron to remove some of the curl.



STEP 14

NOTE: Practice forming the Aeroshroud without the self-adhesive strip a few times before proceeding.

A. Remove the white backing from the 8.5 inch self-adhesive tape strip.

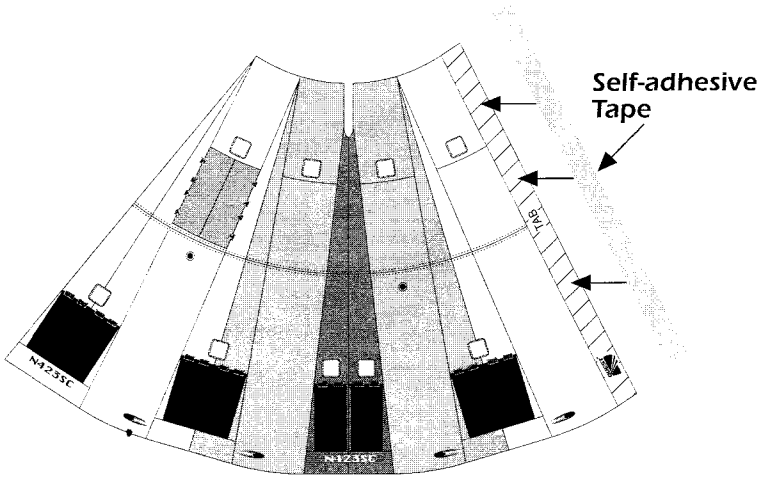
B. Place the tape strip along the edge of the paper Aeroshroud. Burnish the tape onto the Aeroshroud with your finger.

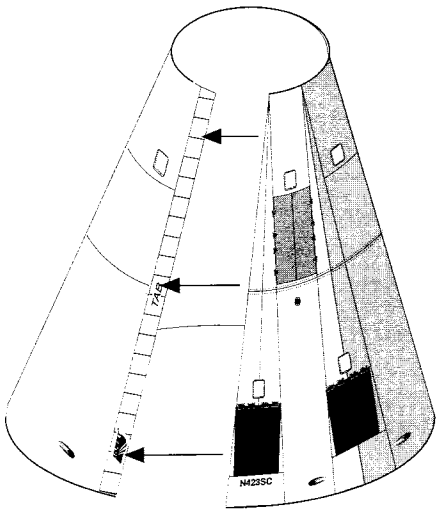
C. Remove the brown paper backing from the tape strip leaving behind the adhesive strip along the edge of the Aeroshroud.

D. Carefully form the Aeroshroud into a cone shape by aligning the two edges of the shroud together.

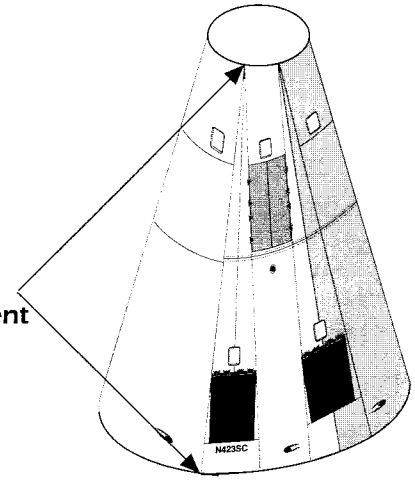
NOTE: If you do not get a perfect alignment on the first try, gently peel the two surfaces apart and try again.

After you have aligned the shroud correctly, lay the cone on a flat surface with the seam facing down and rub your finger back and forth along the seam.





NOTE: Practice forming the Aeroshroud without the self-adhesive strip a few times before proceeding.

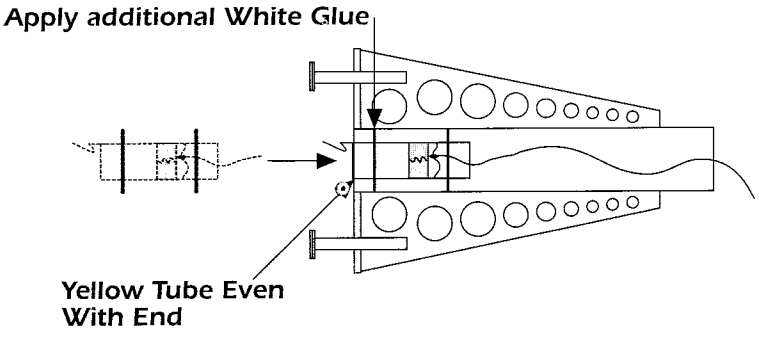


STEP 15

A. "Feed" the yellow Kevlar shock cord attached to the motor mount assembly into the body tube until the cord comes out the other end of the body tube.

B. Apply white glue around the inside edge of the body tube.

C. Immediately insert the motor mount assembly into the body tube and PUSH IT INTO THE BODY TUBE WITH ONE FAST & SMOOTH MOTION until the yellow motor mount tube is even with the end of the body tube and base plate and the motor clip is aligned opposite the launch lug.



STEP 16

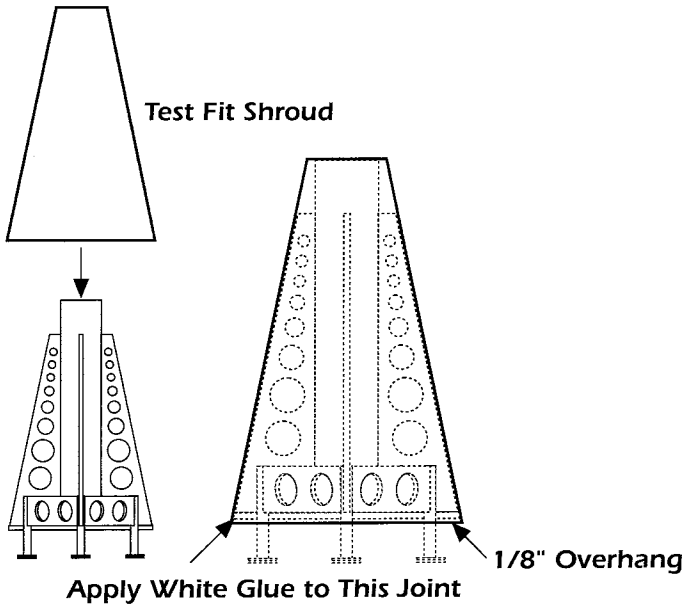
IMPORTANT: Test fit the Aeroshroud first before applying any glue.

A. Align the launch lug with the cut-out in the Aeroshroud.

B. Slide the Aeroshroud onto the frame and over the base plate. The Aeroshroud should overhang the base plate by 1/8 inch.

NOTE: The Aeroshroud fits tight around the base plate. To help slip it over all four sides, use the back edge of an X-acto knife to work the Aeroshroud over the base plate.

C. Apply white glue around the joint of the Aeroshroud and base plate. Stand upright to dry.



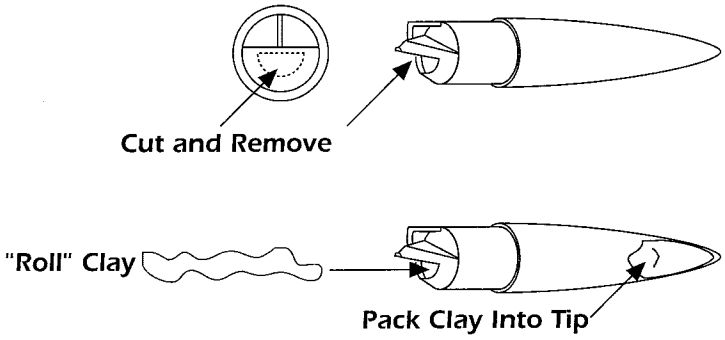
STEP 17

A. Use a hobby razor saw to cut a hole in the base of the plastic nose cone as shown.

B. Place the clay between your hands and "roll" it into a long tubular shape that will fit through the hole you've just cut in the nose cone.

C. Insert the clay into the nose cone and use the eraser end of a pencil to pack it tightly into the tip of the nose cone.

NOTE: You must use all the clay provided for proper stability.

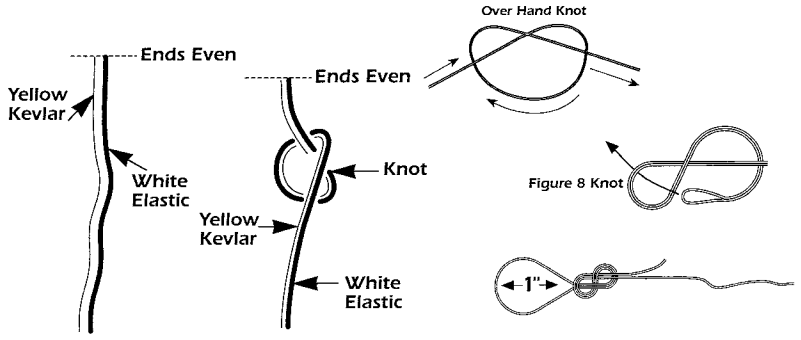


STEP 18

A. Hold the Yellow Kevlar Shock Cord and the White Elastic Shock Cord side by side with the ends even. Hold the two cords together and tie a single overhand knot approximately one inch from the ends as shown.

B. Gently pull on both cords to set the knot and prevent it from slipping.

C. Tie a loop in the loose end of the white shock cord using a figure "8" knot as shown.

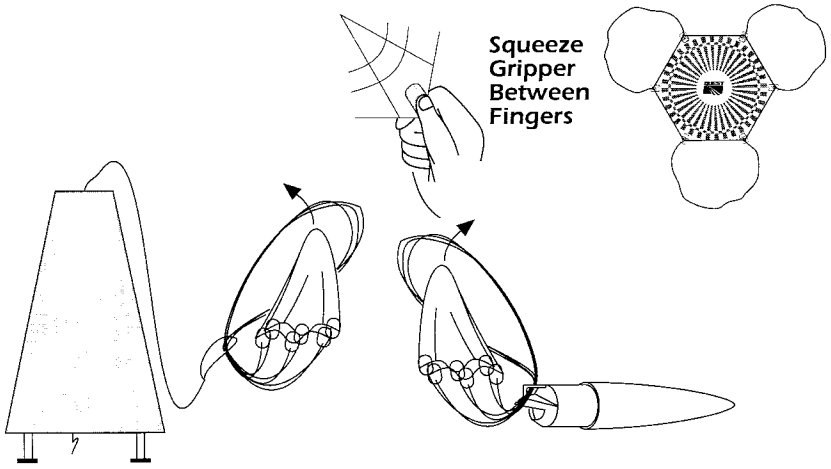


STEP 19

A. Assemble both parachutes according to the instructions printed on them.

B. Pass the shroud line loops of one parachute through the eyelet in the nose cone. Pass the parachute through the loop and pull the lines tight against the eyelet.

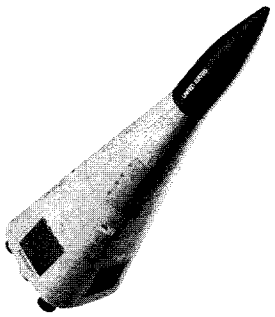
C. Pass the shroud line loops of the second parachute through the loop you made in the White Elastic Shock Cord attached to the rocket body. Pass the parachute through the loop ends and pull the lines tightly against the White Elastic.



STEP 20

A. Use a sharp hobby knife or scissors to cut out the self-adhesive decals.

B. Use the kit panel or photo as your guide for placement.



OPTIONAL DISPLAY NOZZLES AND MANEUVERING FLAPS Do Not Use For Flying Model

STEP 1 NOZZLES

A. Use a sharp hobby knife to cut out the display nozzles from the sheet.

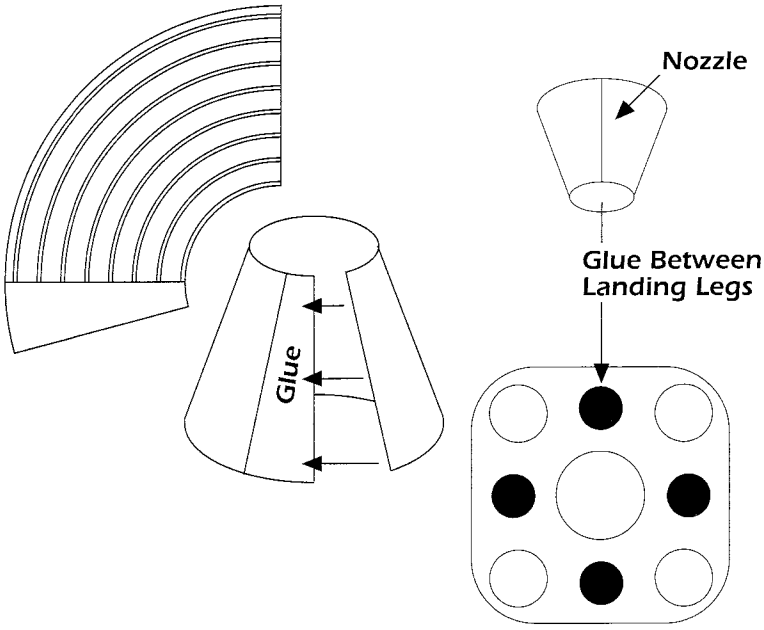
B. Practice forming the nozzles to get a set in the paper before applying any glue.

TIP: Roll the paper over the edge of a pencil to help get the correct curl.

C. Apply white glue to the nozzle and hold nozzle together for about on minute while the glue sets.

D. Place a bead of white glue in the small end of the nozzle and glue in place half way between two landing legs.

NOTE: You must use all the clay provided for proper stability.



STEP 2 FLAPS

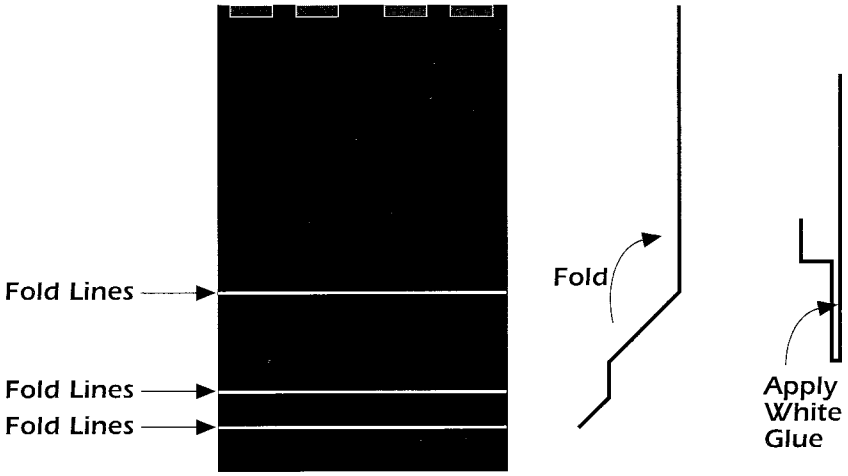
A. Use a sharp hobby knife to cut out the maneuvering flaps from the sheet.

B. Use small ruler or straight edge and fold the flaps along the white lines as shown.

C. Apply a small amount of white glue and glue the flap together as shown.

NOTE: The flaps are the same sizes as the printed flaps on the Aeroshroud. Use the flaps on the Aeroshroud as your guide and glue each flap in place.

Tip: Use a black felt tip marker to make the flap edges black after folding.



FLYING YOUR SPACE CLIPPER ROCKET

WHAT ELSE YOU WILL NEED:

To successfully fly your rocket you will need the following items:

- QUEST Launch Pad (No. 7600)
- QUEST Launch Controller (No. 7500)
- QUEST Parachute Recovery Wadding (No. 7020)
- QUEST Rocket Motors, Type C6-3 only!

ESTIMATED ALTITUDES

The following is a guide to assist you in determining which motor to use based on the wind conditions and size of flying field available.

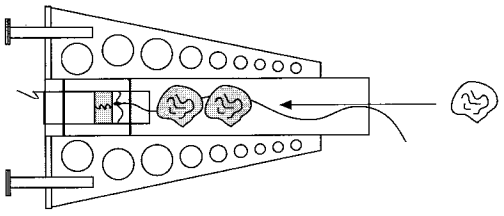
MOTOR	ESTIMATED ALTITUDE
C6-3	220 FEET

Use C6-3 motor type only!

PREPPING YOUR ROCKET FOR FLIGHT

STEP 1

Pull the shock cord all the way out of the body tube. Crumple four sheets of recovery wadding and insert one by one into the body tube making sure that the Knot between the Kevlar and white elastic shock cord is on the nose cone side of the wadding. Wadding should fit loosely in the tube but tight enough to form a good seal against the wall of the body tube.



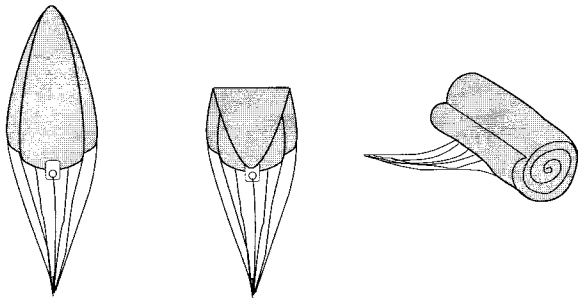
STEP 2

A. Grab the parachute at its center and allow the rocket to hang from it. The weight of the rocket will pull the parachute into several triangular shapes.

B. Gather the triangles together into one flat triangle.

C. Fold the top of the parachute down over itself once.

D. Continue to loosely roll the parachute over its self. Stop when you reach the shroud lines. The size of the rolled parachute should be just slightly smaller than the inside of the bodytube.



STEP 3

A. Pack the parachute into the body tube and then stuff in the shroud lines and shock cord.
THE PARACHUTE MUST SLIDE EASILY INTO THE TUBE.
If it is a tight fit, remove and re-fold the parachute.

TIP: LIGHTLY DUST YOUR PARACHUTE WITH TALCUM OR BABY POWDER TO KEEP IT FROM DEVELOPING A SET SHAPE. THIS TECHNIQUE IS ESPECIALLY EFFECTIVE IF THE WEATHER IS HOT AND HUMID OR VERY COLD.

B. Fold the second parachute the same way as described above and pack it into the bodytube on top of the first parachute.

C. Re-fit the nose cone onto the rocket. BE CAREFUL NOT TO CATCH ANY OF THE SHOCK CORD OR SHROUD LINES BETWEEN THE SHOULDER OF THE NOSE CONE AND THE BODY TUBE.

READ AND FOLLOW THE N.A.R. SAFETY CODE DURING ALL YOUR MODEL ROCKETRY ACTIVITIES.

IRONCLAD GUARANTEE
If for any reason, you are not totally satisfied with our product, QUEST will provide whatever you think is fair, from refund to replacement.

QUEST™

Manufactured by:
QUEST AEROSPACE EDUCATION, INC.
P.O. Box 42390
Phoenix, AZ 85080-2390

QUEST AEROSPACE EDUCATION, INC.
Phoenix, AZ 85027-2921 U.S.A.

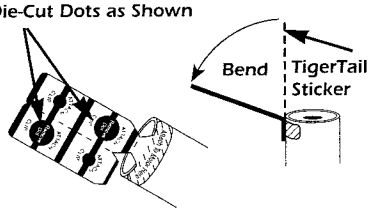
LAUNCHING PROCEDURES

This sheet covers basic Launching Procedures for single stage model rockets with parachute or streamer recovery systems. Review your kit instructions for additional information about your model rocket. Specific details for launching multi-stage models, glider recovery vehicles or other different types of model rockets are featured in the instructions of specific kits.

TIGERTAIL IGNITER INSTALLATION

Launch your model rockets by electrical means only. Use a Quest Launch Controller and TigerTail Igniters. Install TigerTail Igniter carefully, following these instructions.

STEP 1

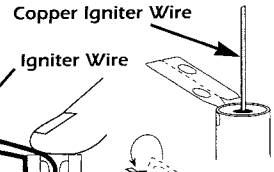


A) Carefully remove self-adhesive TigerTail sticker from its backing sheet.

B) Remove the two die-cut black dots from the TigerTail sticker.

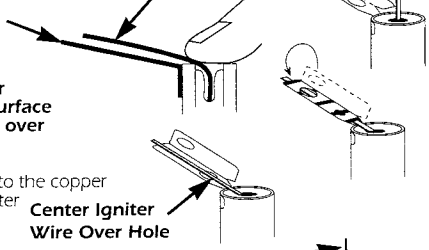
C) Wrap the "T" shaped end of the TigerTail sticker around the nozzle end of the rocket motor.

D) Bend sticker to the side away from the rocket motor.



E) Place the coated end of the copper igniter wire into the rocket motor nozzle, as far as it will go.

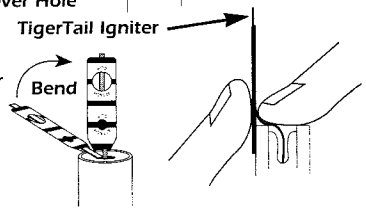
STEP 2



A) Using your finger to hold the igniter in place, bend the copper igniter wire onto the adhesive surface of the TigerTail sticker, centered over the hole as shown.

B) Fold TigerTail sticker over and onto the copper igniter wire. Be sure the copper igniter wire is centered and visible through both holes in the TigerTail sticker.

STEP 3

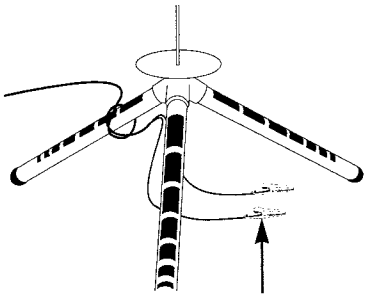


A) Using your finger to hold copper igniter wire against motor nozzle, straighten the TigerTail Igniter as shown.

B) Place rocket motor with TigerTail Igniter into the motor mount of the rocket.

C) For best results DO NOT place motor mount clip over TigerTail Igniter.

STEP 4

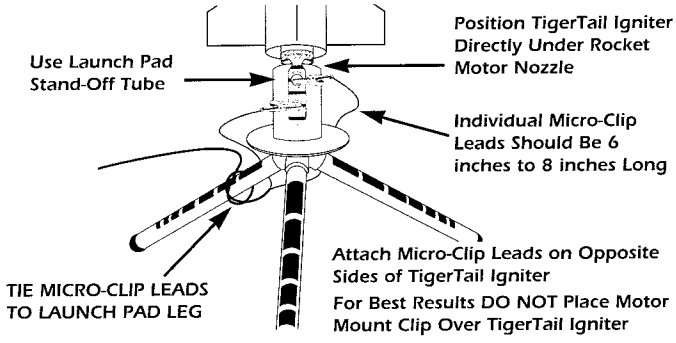


A) ANCHOR THE LAUNCH CONTROLLER'S MICRO-CLIP LEADS TO THE LAUNCH PAD BY ATTACHING THEM TO A LAUNCH PAD LEG USING A SINGLE OVERHAND KNOT. This prevents micro-clip leads from easily pulling away from the launch pad.

B) Micro-clip lead wire should also be pulled apart so each individual micro-clip lead is 6" to 8" long.

C) Attach one micro-clip lead from the launch controller to each hole, where the copper igniter wire is exposed, on the TigerTail Igniter. For best results bring one micro-clip lead around each side of the Launch Rod Stand-Off tube before hooking up to TigerTail Igniter.

D) Be sure TigerTail Igniter points straight down under rocket motor nozzle when micro-clip leads are attached. Micro-clips should be positioned on opposite sides of the TigerTail Igniter.



LAUNCH SITE SELECTION: Select a large area away from tall trees, power lines and low flying aircraft. Parks, playgrounds, soccer and football fields make great launch sites. DO NOT LAUNCH ROCKETS IN AREAS WITH BROWN GRASS, DRY WEEDS, OBSTRUCTIONS OR ANY HIGHLY FLAMMABLE MATERIALS. The larger the launch site the easier it will be to recover your rocket. See the N.A.R. Safety Code for additional information.

Motor Type	Minimum Site Dimensions (feet)
A	100
B	200
C	400

LAUNCH PREPARATIONS: **(1)** Parachute Recovery Wadding should be positioned between the rocket motor and the recovery system to prevent scorching of the parachute or streamer. The wadding should loosely fill the body tube for a depth of approximately two body tube diameters. Crumble the wadding loosely to get maximum bulk and a good seal against the wall of the body tube. See Recovery Wadding instructions for more information.

(2) Recheck the recovery system of your model to be sure it has been prepped and packed per its instructions. Your parachute or streamer should fit loosely inside the rocket's body tube so it can deploy easily. Lightly dust your parachute with baby or talcum powder to keep it from developing a set shape inside your rocket body tube. This technique is especially effective if the weather is hot and humid or is very cold.

(3) Check the nose cone fit to be sure it's snug, but not too tight. If it's too loose add a small piece of tape to the shoulder of the nose cone. If it's too tight lightly sand the shoulder of the nose cone and/or stretch the end of the body tube slightly by inserting the pointed end of the nose cone into the body tube and gently twist it back and forth a few times.

(4) To select the correct rocket motor consult the current Quest Catalog, product packaging or instruction sheet for recommended rocket motors to use in your model. Follow all igniter and rocket motor installation procedures.

(5) Install the TigerTail Igniter into the rocket motor per the TigerTail Igniter instructions.

(6) When placing the rocket motor into the easy-lock motor mount be sure the motor mount clip is securely positioned over the end of the rocket motor. **For best results DO NOT place the motor mount clip over the tigertail igniter.**

(7) Unwind the wire leads from your Launch Controller and place the controller the full length of the wire leads away from the launch pad (at least 15 feet).Be sure the launch controller is disarmed and is in good working condition. Micro-clips must be clean. **ATTACH THE CONTROLLER'S MICRO-CLIP LEADS TO THE LAUNCH PAD BY TYING THEM TO ONE OF THE LAUNCH PAD LEGS WITH A SINGLE OVER HAND KNOT.** Micro-clip lead wire should be pulled apart so each individual micro-clip lead is 6 inches to 8 inches long.

(8) ALWAYS USE CAUTION WHEN BENDING OVER YOUR LAUNCH PAD TO AVOID EYE INJURY. Remove the launch rod safety cap and lower the rocket onto the launch pad positioning it on the Launch Rod Stand-Off several inches above the blast deflector. The launch lug on the rocket's body tube should glide easily over the launch rod. Check to be sure their are no rough surfaces or obstructions on the launch rod which could hinder the lift-off of the model. For eye safety keep the tip of the launch rod covered with the Launch Rod Safety Cap until you are just ready to begin the countdown.

(9) Be sure the Safety Key is with you before hooking up the micro-clips to the TigerTail Igniter. Attach one micro-clip lead to each hole in the TigerTail Igniter where the copper wire is exposed. The micro-clips MUST NOT touch each or the blast deflector. Use the Launch Rod Stand-Off, an empty motor casing or piece of tape wrapped around the launch rod to position the rocket several inches above the blast deflector to keep the micro-clips from touching it and shorting out. For best results bring one micro-clip lead around each side of the Launch Rod Stand-Off and the hook up to TigerTail Igniter.

COUNT DOWN PROCEDURE: **(1)** When your rocket is ready to launch be sure you and all spectators are standing at least 15 feet away from the launch pad. **(2)** Make sure the sky is clear of low flying aircraft. Wind conditions should be gentle. Be sure you have the attention of all individuals in the launching and recovery areas. **(3)** Arm your Launch Controller with the Safety Key. The arming light should go on. If arming light does not go on check battery power, electrical connections and igniter installation. Clean micro-clips with sand paper if necessary **(4)** With rocket armed announce to the spectators in a loud vice, "the rocket is armed, and counting...5...4...3...2...1...Lift-Off!" **(5)** Push the launch button down momentarily until the rocket motor begins thrusting, then release it. The rocket should lift-off from the launch pad almost instantly. **(6) BE SURE AND REMOVE THE SAFETY KEY FROM THE LAUNCH CONTROLLER AS SOON AS THE ROCKET LIFTS-OFF. KEEP THE SAFETY KEY WITH YOU AT ALL TIMES. (7) REPLACE THE LAUNCH ROD SAFETY CAP IN BETWEEN LAUNCHINGS.**

RECOVERY PROCEDURE: **(1)** Track the flight of your rocket until the recovery system is deployed and the rocket is returning gently back to Earth. **(2)** If the rocket appears to be drifting away from the launch area keep your eyes on it until it touches down. **(3)** If the recovery system malfunctions be prepared to alert the spectators that the rocket is returning to Earth faster than normal and to be "heads-up" and aware of the area where the rocket is falling to.

MISFIRE PROCEDURE: **(1)** Occasionally, at the end of the countdown the rocket will fail to lift-off because the rocket motor did not ignite. This usually occurs because the igniter was not making the proper contact with the surface of the rocket motor's propellant. **(2)** Disarm the launch controller, wait one minute, then remove the model from the launch pad. **(3)** Remove the TigerTail sticker from the end of the motor casing, clean the micro-clips and install a new TigerTail Igniter. **(4)** Repeat the countdown procedure again. **(5)IF TIGERTAIL IGNITER TEARS APART, DO NOT ATTEMPT TO REPAIR. REPLACE WITH A NEW TIGERTAIL IGNITER.**

BATTERY TEST: If batteries are weak replace them. Battery strength can be tested by attaching both micro-clips together and inserting the Safety Key. The arming light should glow brightly. Batteries are week if light is deem. **Be sure to use alkaline type batteries for best results.**

QUEST™ SPACE CLIPPER™ SCALE DATA

With Tech Report On Stability Of Cone-Stabilized Rockets

The first real spaceship is coming.

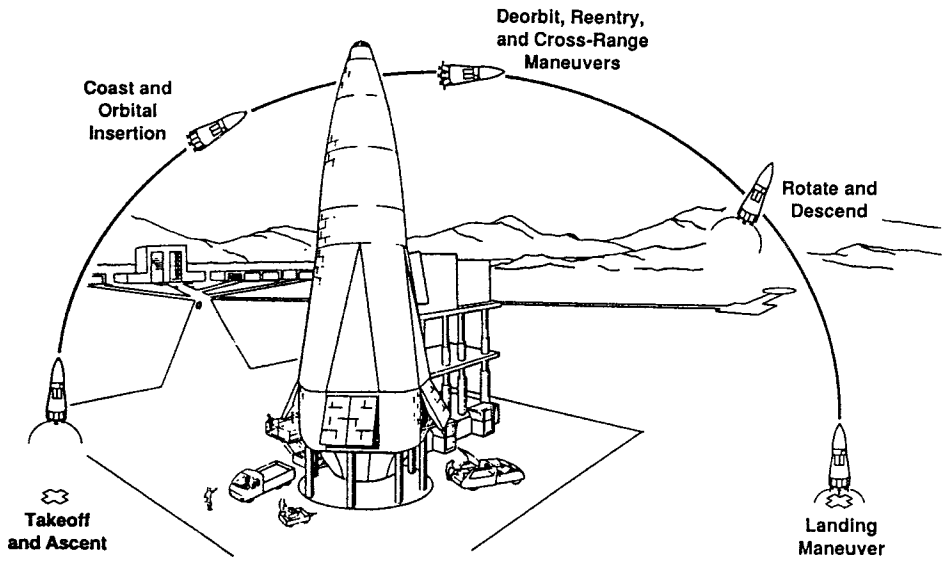
For 35 years, people and cargos have been shot into space with modified ballistic missiles that are really long-range artillery shells. However, none of our transportation systems work by shooting little old ladies or fresh eggs from one place to another inside artillery shells. People and cargo fare better when they ride in boats, trains, cars, and airplanes.

To date, space launch vehicles have been multi-staged rockets that consume themselves in flight. They can't be reused. Getting into space with these disintegrating totem poles has been like building the Cunard ocean liner, H.M.S. *Queen Elizabeth II*, sailing it once across the ocean, and sinking it upon arrival in New York harbor. It's too expensive and difficult to continue doing that forever.

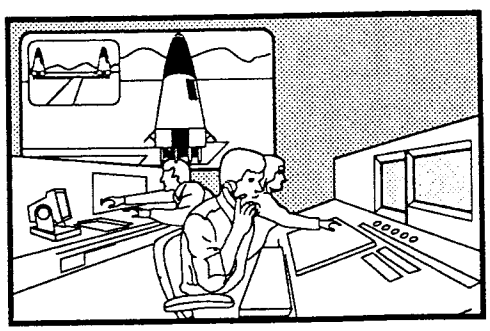
As a result, space transportation is undergoing a revolution. We're going to stop shooting people and cargos into space in artillery shells. We're going to build and fly real spaceships. The first one, the McDonnell Douglas "Delta Clipper," is now in development. A one-third scale prototype is scheduled for flight testing at White Sands in 1993.

Why is it "the first real spaceship?"

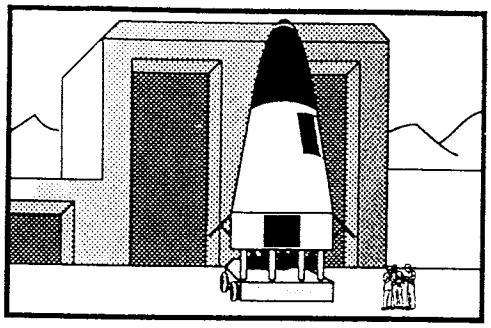
The Delta Clipper is completely reusable like a jet airliner. It doesn't drop any boosters or lower stages when it comes and goes to orbit. It's a "single-stage-to-orbit" (SSTO) spaceship. It takes off vertically, flies into orbit, deposits or retrieves its payload, flies back to its spaceport, and lands on its tail under rocket thrust like the Apollo Lunar Module landed on the Moon back in 1969.



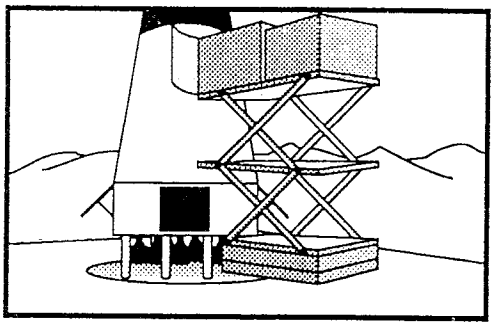
The flight crew consists of two people either on the ground in an all-electronic computer-based "virtual cockpit" or actually riding aboard. The flight crew will monitor the spaceship's systems using off-the-shelf PC computers and software. They'll do just what airline pilots do today in the latest jet airliners: monitor and manage automatic systems. Former astronaut Charles "Pete" Conrad, the third person to walk on the Moon, will be "flying" the Delta Clipper DC-X during its 1993 tests at White Sands.



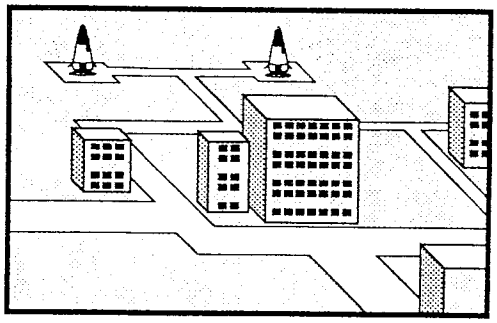
The Delta Clipper spaceship is being designed to be serviced and reflown within 24 hours. Airlines don't make money if their airliners aren't flying, and space transportation must adopt this procedure if costs are to be drastically reduced so everyone has access to space. An airliner or spaceship sitting idle isn't working to pay for itself. So once the Delta Clipper returns from orbit, its passengers or cargo are unloaded. Only 50 people are on the ground crew. Their job is to get the Delta Clipper flying again as quickly as possible just like an airliner's ground crew gets the airplane ready to fly again in an hour or so. They perform a "walk-around" inspection and check the on-board diagnostic computers that report if anything needs fixing. These computers are already in use with modern military aircraft, the new jet airliners, and some new cars. If they report that major maintenance needs to be done, the



spaceship will be towed to the maintenance hangar. Otherwise, the ground crew pumps propellants – liquid hydrogen and liquid oxygen – into the spaceship. Passengers go aboard or palletized cargo is loaded. And the Delta Clipper is on its way again in less than a day.



Delta Clipper and the spaceships to follow will use new spaceports built and operated like commercial airports. Tons of concrete, mobile skyscrapers for servicing, 6 months of time, and tens of thousands of people will no longer be required to get a spaceship back into space. The new spaceports can be – and will be – located anywhere because the new spaceships don't drop anything in



flight and have flight safety built into their designs. An SSTO spaceship takes off vertically from a very austere "flight simplex." Only a five- to ten-mile clear zone around the spaceport is needed to keep noise below that of jet airliners. An SSTO spaceship has "engine-out safe abort" capability that allows it to return to the spaceport, go to another spaceport, or fly around the world and land where it took off. Airliners have this today. The loss of an engine doesn't result in an airliner – or a spaceship – falling on people.

Because the new spaceships will be operated like airliners instead of artillery shells, the MDC Delta Clipper won't be flown using a "count down" that came from the testing of expendable, long-range ballistic missiles. Airline pilots don't launch or fire airliners into the air, and space pilots won't do it either. The "count down" will become history. Spaceship pilots will use new commercial spaceship takeoff procedures. The radio exchange will be like that heard when a Boeing 747 leaves New York's Kennedy International Airport or Los Angeles International Airport for a flight halfway around the world. Here's what it will sound like:

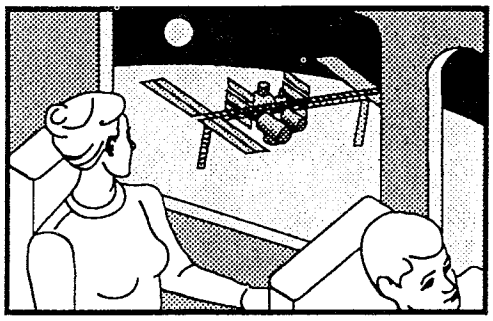
"Regional Tower, this is Delta Clipper four-two-three Sierra Charlie, ready for takeoff."

"Delta Clipper four-two-three Sierra Charlie, Regional Tower. Cleared for takeoff. Climb out and depart according to flight plan. Contact North American Space Control Center passing Flight Level six-zero-zero."

"Roger, Tower, Delta Clipper four-two-three Sierra Charlie is initiating takeoff sequence . . . Engines start . . . Throttles at idle . . . All engines go . . . Throttle up . . . Takeoff thrust . . . *Up ship!*"

Returning from orbit, the Delta Clipper enters the atmosphere nose first 50 miles up. Because its unusual shape is a high-speed lifting body, it's flown to its desired landing point. Ten thousand feet above the landing pad, it swaps ends and its rocket motors are turned on. It lands tail-first, descending vertically under rocket thrust in the same manner as the 1969 Apollo Lunar Module and today's McDonnell Douglas AV-8B Harrier jump jets. The spaceship will touch down gently on its landing gear within 50 feet of the desired landing point because Global Positioning System (GPS) satellites tell it exactly where it is.

McDonnell Douglas, builder of the famous DC-3 that ushered in safe and affordable airline transportation 60 years ago, plans to have the Delta Clipper Type Three (The "DC-3," of course!) ready for commercial use by 1999. Even at a vehicle cost of $500 million, the Delta Clipper can be flown for about $1.6 million per flight, carrying up to 10 tons to orbit and back. Studies conducted by the Enterprise Institute, Inc. revealed that a round-trip to orbit would cost $15,000 dollars, about the price of a round-trip airline fare from North America to Australia. Or a new car.



Furthermore, because the Delta Clipper uses rocket-powered vertical takeoff and vertical landing, it can be refueled in orbit by another Delta Clipper (whose payload is rocket propellant) and then flown to the Moon, landed there, and flown back to Earth orbit. It doesn't need an atmosphere for operation. It can fly anywhere in the solar system if rocket propellant is provided. Thus, Delta Clipper can open up the solar system, too!

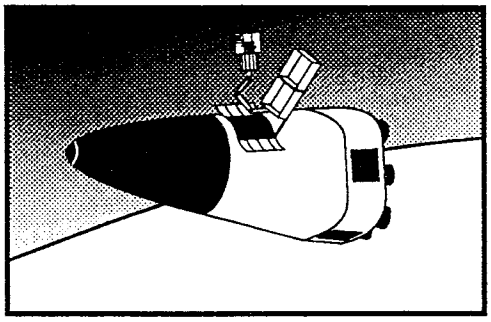
An SSTO spaceship that flies to orbit can also take its payload to any spot on the face of the Earth in less than an hour. This "fractional orbital transportation system" reduces a 15-hour transpacific subsonic airliner flight to a one-hour journey. Several package delivery companies are involved in the design process already. One of them wants to positively, absolutely guarantee delivery of a package anywhere in the world *today*. When flying eastbound out of Japan, however, the cargo can be delivered *the previous day* because the spaceship crosses the international date line en route!

Delta Clipper and other SSTO spaceships to follow – Boeing, General Dynamics, Lockheed, and Rockwell International have their own designs on the drawing board – will change space transportation beyond belief. SSTO will make access to space available on regular flight schedules, with airline-level margins of safety, and at reasonable costs to everyone.

The consequences of the SSTO spaceship are as profound and far-reaching to space transportation as the introduction of the Douglas DC-3 in 1933 or the Boeing 707 jet airliner in 1958 were to air travel.

Want to put a satellite into orbit? Build it, call the spaceline, and reserve space on next Tuesday's flight. The satellite can be made more cheaply and with a different design philosophy than one that is committed to a space-going artillery shell that must work without fail on the first try.

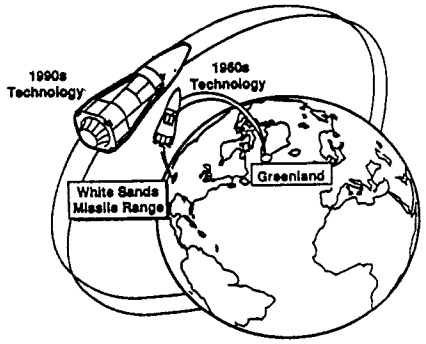
Want to do research in orbit? Many universities and corporations can afford less than $2 million for a flight. And a space station isn't any more difficult to build than an offshore oil platform. Call any engineering company that does this, tell them to build a space station that will keep three people in orbit for a week, and they can do it with what we already know. Take delivery, schedule a launch, and have it lifted to orbit. Once there, the flight crew opens the cargo hatches, pushes the station out of the payload bay, and waves to the three-person space station crew. "See you next week!"



What are other changes that regular, inexpensive, reliable access to space is going to make? When Americans opened the western frontier with the railroad and pioneered worldwide air travel, these things benefitted everyone in ways we couldn't predict. Can we move industry into space where it can't pollute the environment? What can we make in space that we can't make here on Earth? Asteroids may contain enough raw material to supply us for thousands of years to come. Energy abounds in space because we will be able to harness the fusion energy of a the Sun. Will people living in space form their own governments and, if so, what kind? The consequences of real spaceships are more than scientific and technical; these consequences will affect the lives of everyone on Earth in the 21st century.

Why haven't we had SSTO spaceships before? First of all, an engineer always uses available equipment. A rocket engineer is no different. Thirty years ago, ballistic missiles were the only vehicles available as space launchers. Therefore, they were used.

With technology available in 1970, an SSTO would have been too heavy. It could have flown only from White Sands to Greenland, for example. Using off-the-shelf technologies



available in the 1990s, however, an SSTO can fly to orbit with the same amount of rocket propellant. New, strong, lightweight materials such as titanium aluminide, high temperature thermoplastics, and titanium matrix composites have been developed. Miniature high-speed computers are available. Existing rocket engines can be modified to propel the SSTO.

Where did all this new technology come from? While the initial conquest of space with ballistic missile boosters was going on, a lot of technology was developed and often put on the shelf because it wasn't useful at the time. Engineers and scientists have developed a *lot* of technology since we went to the Moon in 1969. So the technology necessary to build and fly single-stage-to-orbit spaceships exists and was paid for during the last 35 years of the national space program.

Suddenly – as has often happened in the history of science and technology – all the elements necessary for a revolutionary breakthrough have fallen into place. Thus, a job that has been impossible or horribly expensive suddenly becomes one that can be done safely and economically.

Quietly, without fanfare, and quite abruptly, we have reached that point in space transportation.

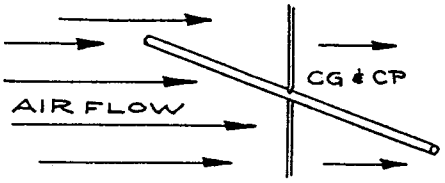
On the 40th anniversary of the first lunar landing (or before), anyone may be able to stand in Neil Armstrong's lunar footprints and be part of the next giant step for mankind: access to the final frontier for everyone.

FLIGHT STABILITY OF A CONE-STABILIZED ROCKET

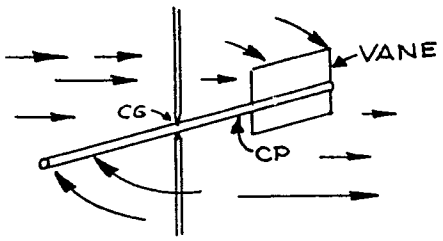
The MDC Delta Clipper's shape is a modified cone with flat sides. This shape came from NASA research on maneuverable lifting bodies – space vehicles without wings whose shapes actually produce lift when passing through the air. The NASA Space Shuttle is a winged lifting body whose design is more than 25 years old. Wingless lifting body research findings allow the Delta Clipper to fly through the earth's atmosphere when it comes back from orbit.

The Delta Clipper has three flaps and one split-flap around its base. These are extended during the atmospheric entry phase of the flight to provide control like the elevators, ailerons, and rudders of an ordinary airplane. The Delta Clipper's landing gear remains retracted during liftoff and flight, extending from the base of the spaceship only for landing. But Delta Clipper and the Quest™ Space Clipper™ have no fins.

How can a spaceship without fins be stable in flight? Like a finned rocket vehicle, the Delta Clipper and the Quest™ Space Clipper™ use the forces of the flowing air flowing to keep them flying straight and nose-first.



The drawing above shows a stick placed in an air flow and held in low-friction pivots at its balance point, the center of gravity (CG) so it can turn easily. It will not point into the air flow because the CG and the center of air pressure (CP) are at the same place. No aerodynamic force exists to make this happen.

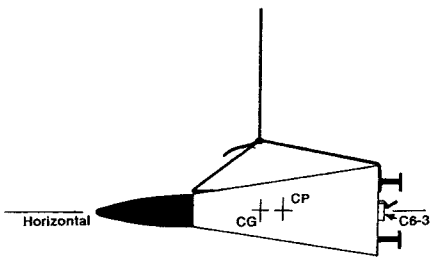


This drawing shows a vane added to one end. This moves the CP away from the CG. The force of the flowing air on the vane causes the object to point into the flow with the CP behind the CG. Ordinary finned rockets use this form of stabilization. Fins are like feathers on an arrow. They put the CP behind the CG.

The vane or fins can be replaced with a cone whose area positions the CP behind the CG. The cone-stabilized body then points into the moving air flow. A badminton shuttlecock or a conical paper drinking cup have cone stability and will fall in a point-first attitude when dropped. Using conical stability increases air drag but permits a more robust structure with more internal volume, factors that offset the complex structural and weight problems created by attaching fins. The Delta Clipper and the Quest™ Space Clipper™ model use a conical shape to position the CP behind the CG.

Mathematical tools exist to permit the calculation of the CP of an object. These were used in the design of the Quest™ Space Clipper™. But a simple experiment known as the "swing test" can be conducted to check for stability.

Attach a 6-foot length of string parallel to a launch rod with a single wrap of tape. Thread it through the launch lug of the Space Clipper™. Remove the thread from the rod. Tie it as shown. Install a Quest™ Type C6-3 model rocket motor.

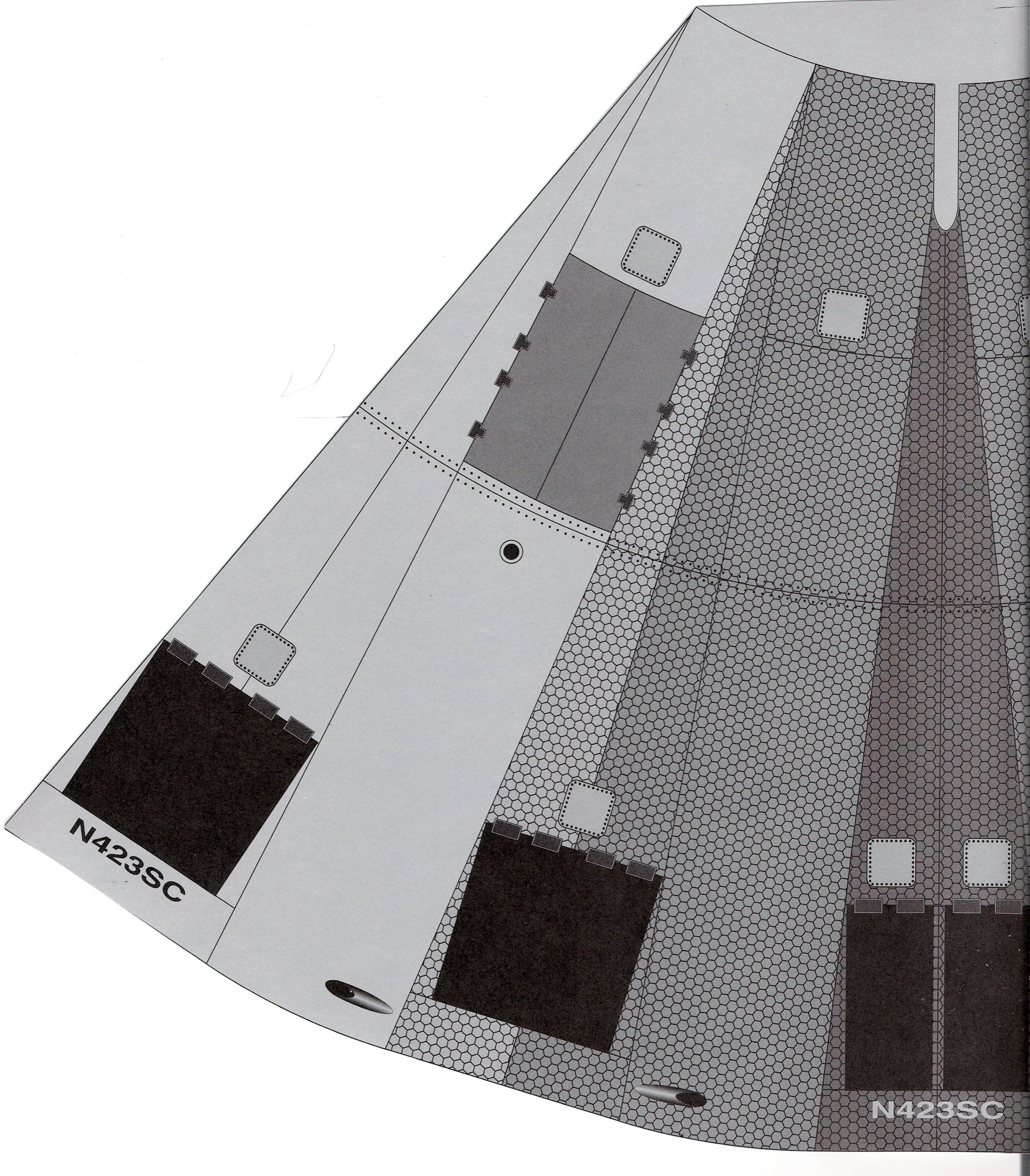


Adjust the position of the knot so the Space Clipper™ hangs horizontally. This balances the model at its CG. The CG should be at the second payload bay hinge mark on the AeroShroud™. Use a bit of tape on the base to secure the string in position.

Choose a clear area **outside**. Make sure no one is standing where they could be struck by the model or string when you swing it around your head in a circle at the end of the 6-foot string. Swing the model fast enough to keep it off the ground and give it some air speed. The Space Clipper™ will slowly turn so its nose points in the direction you're swinging it. Six to ten turns may be required for the model to stabilize with its nose pointed in the direction of the swing. This is because the shape of a cone-stabilized object doesn't have the strong stabilizing forces of a fin-stabilized model. It takes longer to recover its stability when it isn't pointed nose-first into the air stream, especially at low air speeds. This is an important reason to use a full 36-inch launch rod for flying the model.

This test will confirm that the model will point its nose into the air flow and is stable in flight. You have also demonstrated the principle of equivalency – the results are the same whether the object moves through the air or the air moves past the object.

QUEST™
Manufactured by:
QUEST AEROSPACE EDUCATION, INC.
P.O. Box 42390
Phoenix, AZ 85080-2390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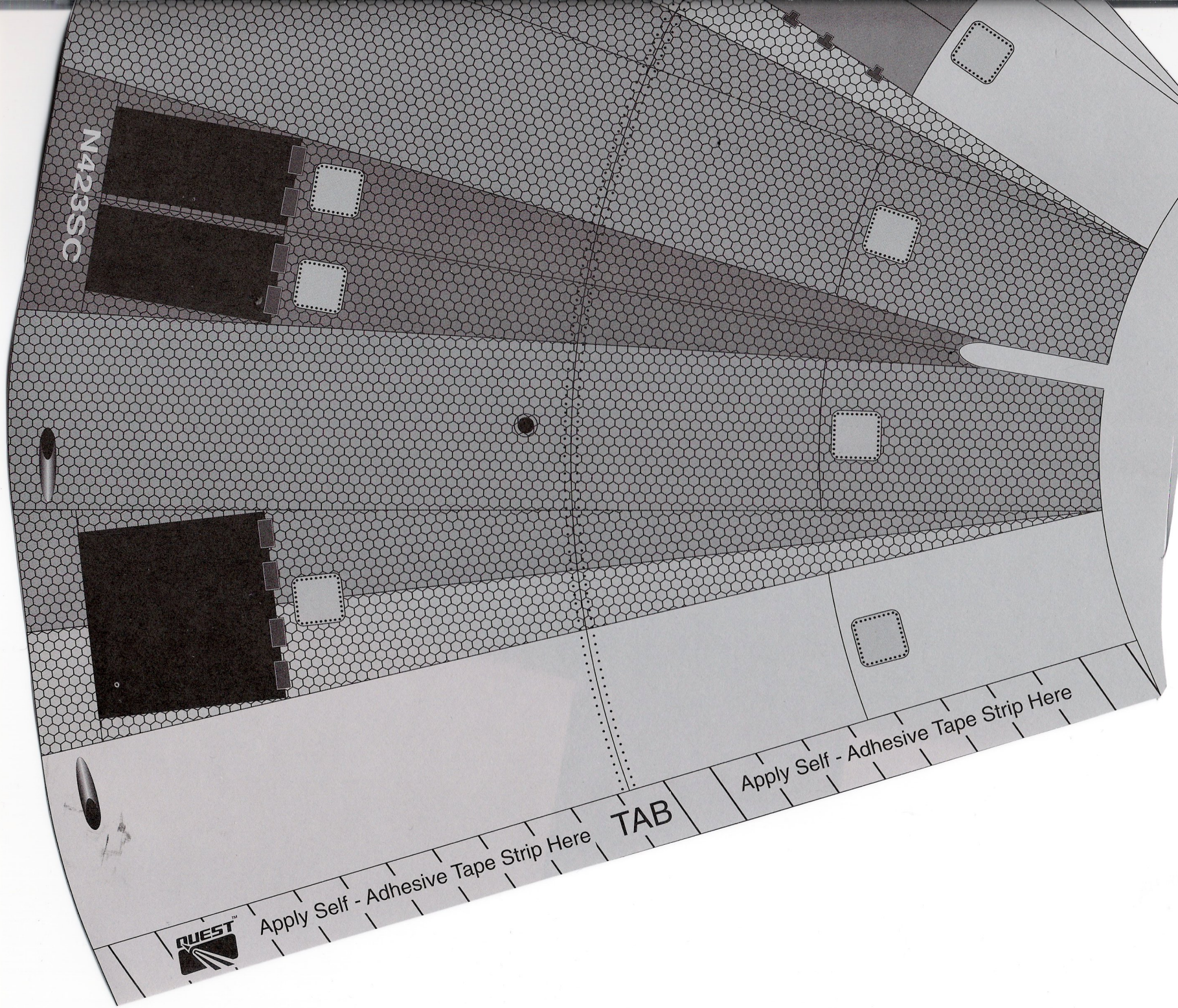
N42SC
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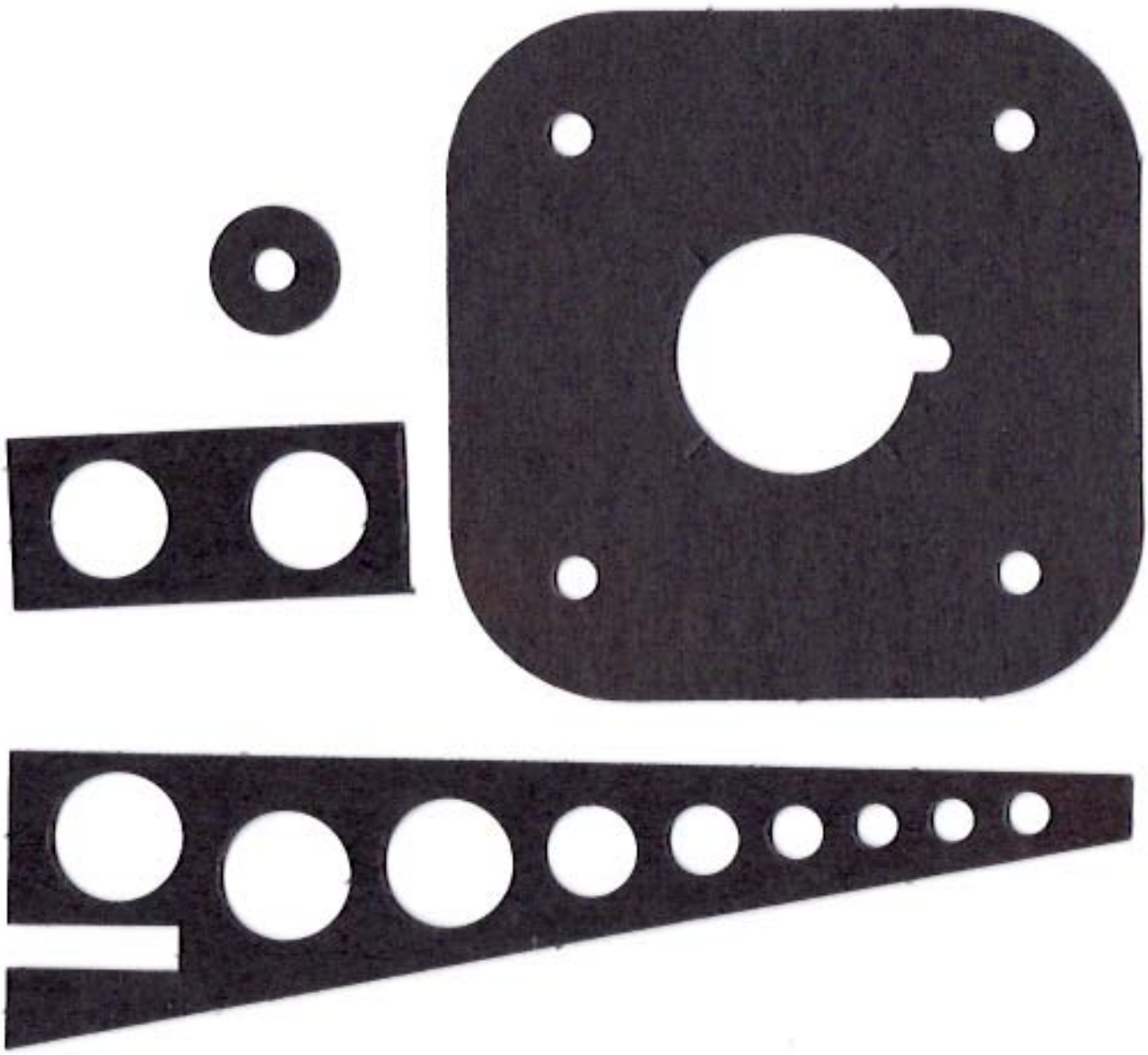
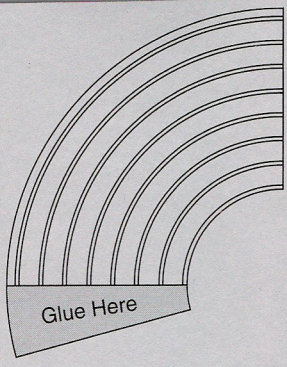
QUEST™

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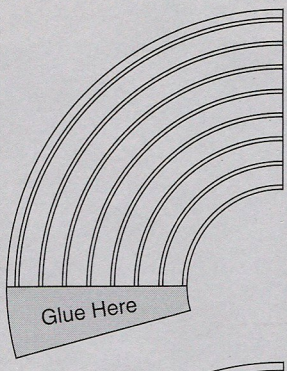
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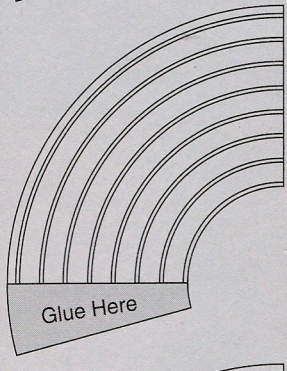
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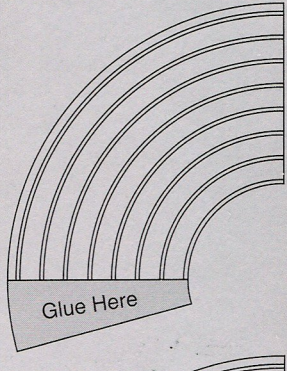
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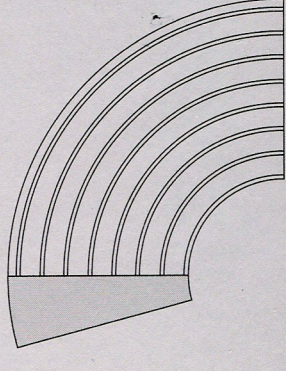
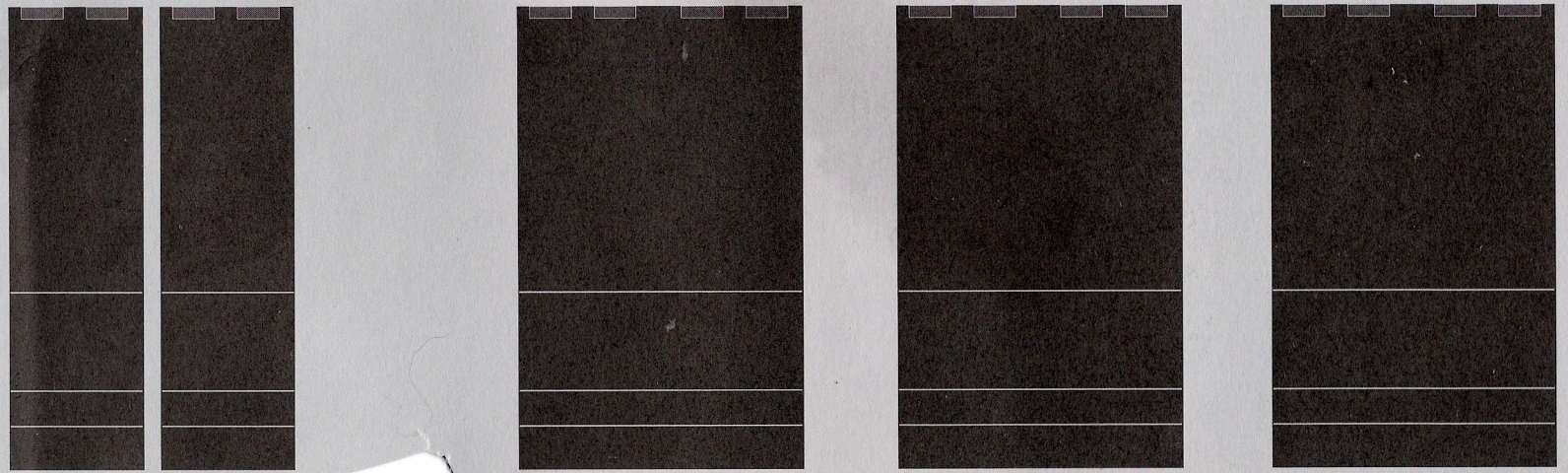


Optional 3-D Maneuvering Flaps - **DO NOT USE FOR FLYING MODEL**

Cut out along edge, fold along white lines



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