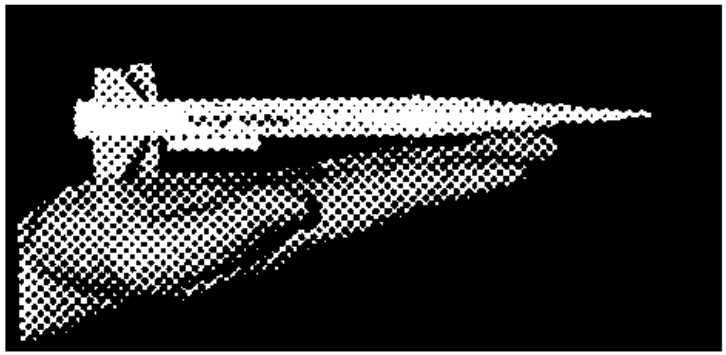


NIKE SMOKE

flying model rocket kit in teensy-weensy 1/30 scale

It's so cute!

- 7.64" long, 0.55" diameter
- balsa nose cone and fins
- 13mm engine mount
- scale data sheet included
- water-transfer decals
- streamer recovery
- Kevlar shock cord
- recommended for the experienced modeler
- building, finishing, and flying supplies not included

Seattle
ROCKET WORKS

NIKE SMOKE 1/30 Scale

Seattle ROCKET WORKS

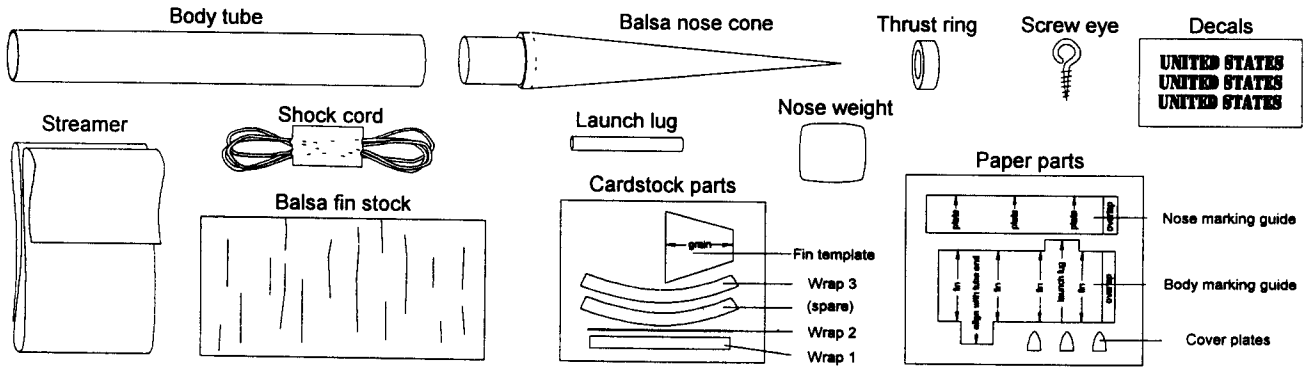
Introduction

The Nike Smoke was a NASA research rocket used to study winds at high altitudes. Its nose cone was filled with a chemical that left a highly visible trail of "smoke"* as the rocket streaked upward. Photographic analysis of the smoke trails revealed information about wind patterns. Hundreds of Nike Smokes were flown from the early 1960s through the '70s.

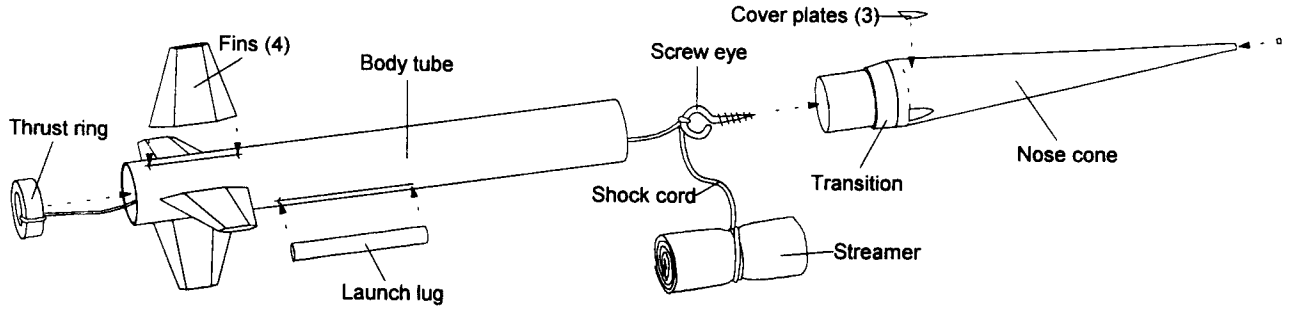
The Seattle Rocket Works Nike Smoke is a 1/30 scale model of the real thing. With some patience and work, you will produce a nearly-exact replica (however, its nose cannot be filled with a smoke-producing chemical!) The following instructions assume you have enough rocket-building experience to know what glue to use and how to paint a model; however, construction of a scale model generally requires extra work and advanced techniques compared to non-scale models, so read the instructions through carefully at least once before starting to build.

* Hence the second half of its name; the first half came from the fact that it was powered by the same rocket motor used in the US Army's Nike missiles. (*Nike*—which rhymes with *Mikey*—was also the name of the Greek goddess of victory.)

Parts list

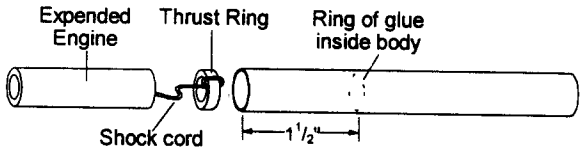


Exploded view

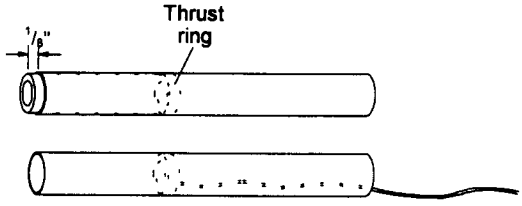


Body

The first step is to install the thrust ring, which serves double-duty as the shock cord anchor. Tie one end of the shock cord to the thrust ring. Apply glue around the inside of the body tube about 1½" from the aft end.

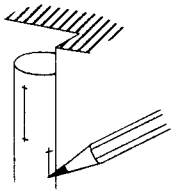


Use an expended mini-engine to push the thrust ring 1⅝" up the tube (⅛" of the engine will protrude out the back.) The shock cord can be put into the engine casing while the thrust ring is being positioned, then threaded through to the



forward end after the engine is removed.

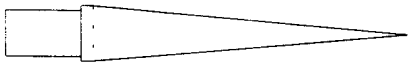
Cut out the body tube marking guide. Wrap it around the body tube, aligning the tab with the rear edge of the tube, and tape it into position. The tab offsets the fins from the end of the body (refer to the scale diagram.) Mark the body tube as indicated on the guide: two marks each for the four fins, and one for the launch lug. Remove the marking guide. Place the tube in a door frame to draw straight lines connecting the pairs of fin marks, and draw a $1^1/_4$" long line extending forward from the launch lug mark.



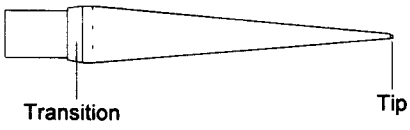
The body tube has a spiral groove which you may want to fill.

Nose

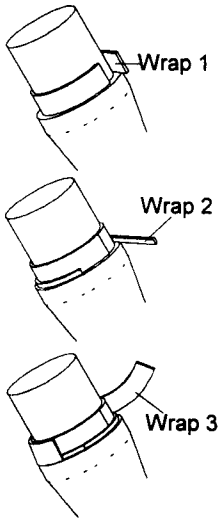
This is the raw balsa nose cone provided in the kit (note the cylindrical region at the base of the cone):



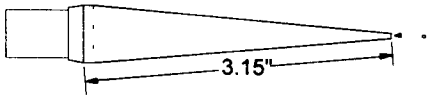
Test-fit the nose in the body tube; some sanding may be necessary for the nose to slide in and out smoothly. You are going to add a transition at the base of the nose and modify the tip to produce this:



The transition is constructed from several pieces of cardstock. Cut out cardstock nose wraps 1 through 3. Spread a thin film of glue on the back of wrap 1 and glue it around the base of the nose as shown. In similar fashion, glue wrap 2 over wrap 1, and then glue wrap 3 over the other two wraps. Although every effort has been made to ensure accurate fit, there will be some unavoidable discrepancies due to the nature of paper and balsa wood. Some pieces may need trimming; others may leave gaps that will need to be filled. Only wrap 3's appearance is really important, so a spare is provided "just in case."



The next step is to form the "inlet pipe" at the tip. From the top of the transition, measure 3.15" (just about $3^5/_{32}$") along the side of the nose cone and cut the tip off at that point, being careful not to lose it. Take the tip piece and roll it between your fingers to make



it more cylindrical. Cut a section approximately $^1/_{32}$" long, $^1/_{32}$" in diameter, and glue it to the flat front of the nose cone.

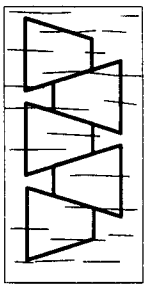
Apply your favorite balsa filler or sanding sealer to seal the surface of the nose cone.

Screw the screw eye into the base of the nose cone, remove it, add a drop of glue, and replace the screw eye.

The cover plate details are attached just above the cylindrical portion of the nose, 120° apart (see scale diagram and exploded view.) Use the nose marking guide to mark the positions. Glue the cover plates on after you have filled and sealed the nose cone. If you are really ambitious, you might try using tiny drops of glue to form the fastener heads marked on the plates.

Fins

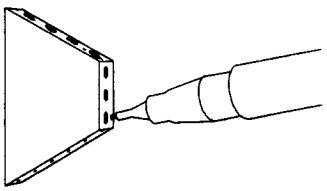
Cut out the fin template from the cardstock sheet. Trace around the template onto the balsa sheet to draw the outlines of five fins, then cut them out. (You only need four, but a spare fin is always a good idea.) Remember to align the arrow on the template with the grain of the balsa wood. (You could instead align the leading edge or trailing edge of the fin with the grain; in any case, the grain must run between the root edge and every point on the fin or else the fin will be too fragile.) Once you have all the fins cut out, stack them together and sand the edges flat to make sure all the fins are the same shape.



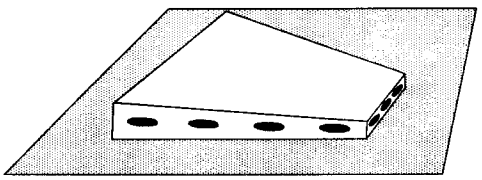
The next step, beveling the fins, requires a lot of work, but adds a lot to the accuracy of the model. First, study the scale data sheet to get a feel for the shape of the real Nike Smoke's fins. Note in particular that the fin cross-section is a "double-wedge" airfoil, and each fin is thinner at the tip than at the root. The following instructions show how to sand each fin to the correct shape, starting with the taper in thickness, then forming the airfoil.


"Double-wedge" airfoil

With a pen, go around the leading edge, tip, and trailing edge of each fin marking the mid-plane of the fin (use a pen that doesn't need a lot of pressure to leave a mark); even three or four dots on each edge will be sufficient to give you a reference when you are sanding.

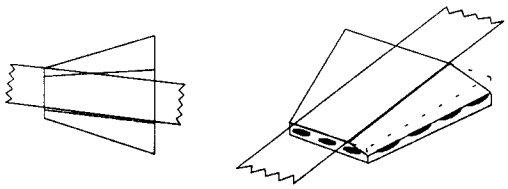


Lay some sandpaper face-up on a flat surface and place a fin on the sandpaper; hold the sandpaper still and move the fin. Apply slightly more pressure near the tip than at the root. Work on both sides, checking your progress against your reference marks, until the tip is $^1/_{32}$" thick (half the thickness of the root.)



Using the scale diagram as a guide, mark the facet edges on the fin. Put a piece of tape along the facet edge to protect the area that shouldn't be sanded; this will yield better-defined facets. Sand down the leading and trailing edges

between the tape and the mid-plane reference marks. Also, you might want to apply balsa filler or sealer at this stage of construction, since you're sanding the fins anyway.



Forming the fins takes a bit of practice—if you had the foresight to make an extra fin, congratulate yourself now.

Glue the fins to the body, making sure that each fin is straight and perpendicular to the body tube.

Launch lug

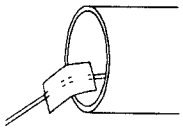
Glue the launch lug to the body along the line previously marked for this purpose. Even though the nose cone is wider than the main body, the launch lug does not need a stand-off because it is loose enough on a standard 1/8" launch rod.

By the way, the launch lug is definitely not scale; it is only needed to guide the rocket along the launch rod. If you have a launch system that doesn't use a launch rod (such as a launch tower or piston launcher) then by all means leave the launch lug off.

Recovery system

Tie the shock cord to the screw eye, leaving about 2" free beyond the knot. Form the free end into a loop and secure it to one end of the streamer with a square of sticky tape. Press the tape and streamer together firmly so that they mold around the loop.

Take a piece of masking tape or duct tape about 1/2" square and fold it over the shock cord, then slide it halfway into the body as shown. This should help prevent the shock cord from cutting or "zippering" the body tube at ejection.



Finishing

The rocket should be painted flat white overall, with a black nose tip, three fluorescent red fins, and one fluorescent yellow fin. Refer to the scale diagram.

The "UNITED STATES" markings are provided on the decal sheet. Only two are needed; the third is provided "just in case." The clear decal material covers the entire sheet, so you must cut out each marking separately. Place one decal at a time into a shallow dish and cover it with a few drops of water. Don't use too much water or the decal will float off of the backing paper and become unusable. After about 30 seconds, you should be able to slide the decal off the paper and onto the rocket. Refer to the scale diagram for placement, and pay close attention to the orientation of the lettering. Carefully blot away excess water and allow to dry.

Balancing the model

The proper relationship between a rocket's center of gravity (CG) and its center of pressure (CP) is absolutely essential for stable flight: the CG must be ahead of the CP by a sufficient margin. The CP is a function of the rocket's shape and is something we can't change; we can, however, alter the CG by adding nose weight. Determining the location of the CP is an involved process; fortunately, NASA has already done most of the work. According to NASA's calculations, the real Nike Smoke's center of pressure is 40.08" from its aft end. According to Seattle Rocket Works' calculations, that translates to 1.33" from the aft of the model. (This assumes that the model replicates all the details of the real thing.) The center of gravity should be located at least one caliber, or body diameter, in front of the CP—about 1 7/8" from the end of the body tube.

Prepare the rocket for flight as described below. An unspent engine must be in before checking the CG. Wrap some of the supplied nose weight around the screw eye before fitting the nose cone into the body. Find the rocket's balance point. Adjust the amount of nose weight until the rocket balances 1 7/8" from the end of its body (not the end of the motor.) Note that the choice of rocket engine will influence the CG slightly, so it's a good idea to check the CG before each flight.

Launch preparation

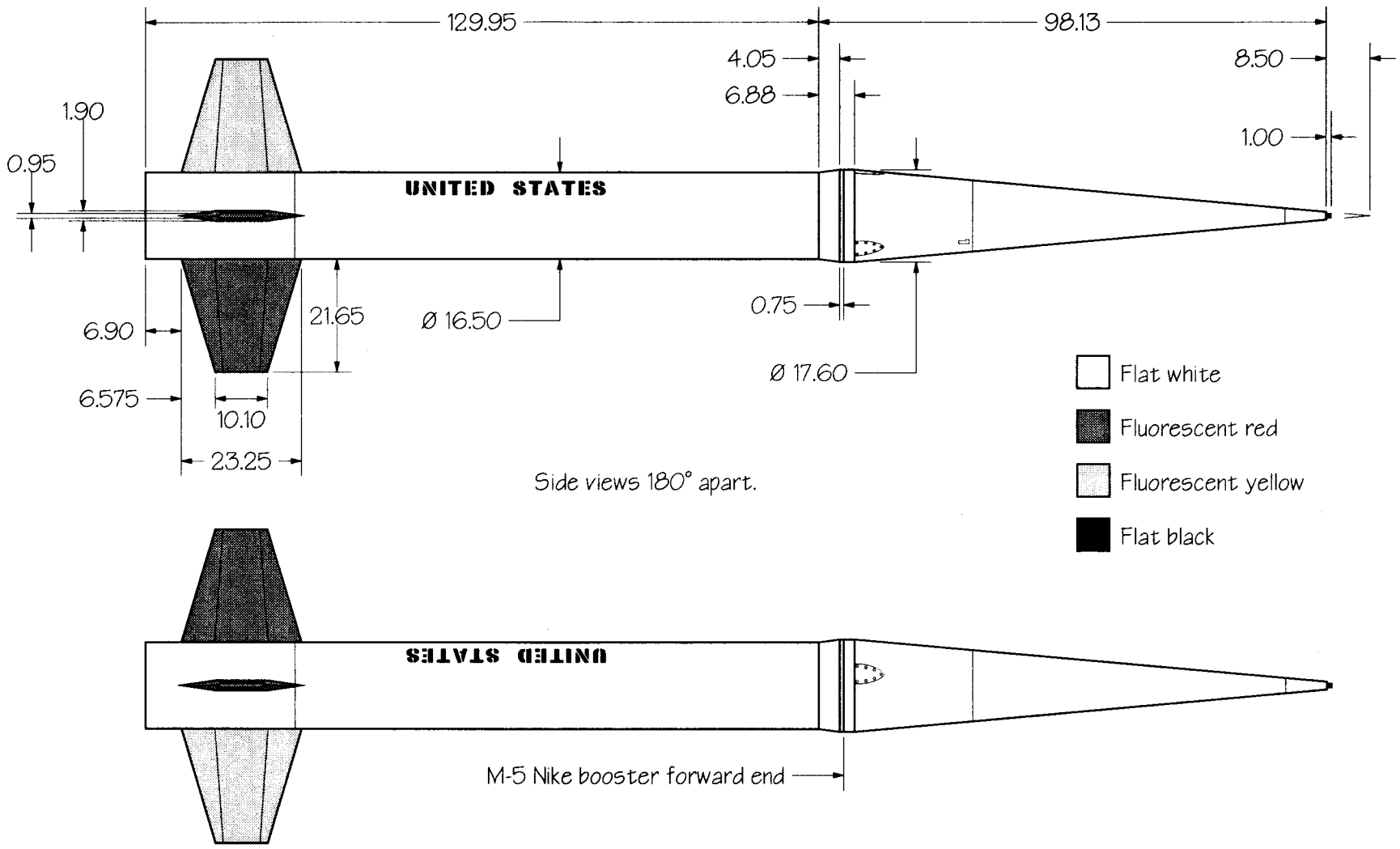
The Seattle Rocket Works Nike Smoke uses readily-available "mini engines" (13mm diameter.) Recommended engines are ½A3-2T, ½A3-4T, A3-4T, and A10-3T. Wrap some masking tape around the engine and insert it into the rocket. Adjust the amount of tape until the engine fits tightly, but not too tightly.

Fold the streamer in half a few times, then roll it up. Wrap a few turns of shock cord around it, then pack some recovery wadding, the shock cord, and streamer into the rocket. Since both the Kevlar™ shock cord and the streamer are fireproof, no wadding is really necessary; however, a bit of wadding will help the streamer last longer. Some tracking powder, such as powdered tempera paint or carpenter's chalk, placed above the streamer will aid in tracking by making a colored cloud at ejection.

At this point, check that the rocket's CG is 1 7/8" from the aft end of the body, adding nose weight if necessary (see above.) Your Nike Smoke is now ready for launch! Always conduct your launches in accordance with the National Association of Rocketry Safety Code (see next page.)

Seattle Rocket Works shall not be held responsible for injury or damage caused by improper storage, handling, or use of this product.

Seattle Rocket Works • 410 E. Denny Way, Suite 115 • Seattle, WA 98122 • (206)720-2901 • srw@mccs.seaslug.org



0 10 20 30

All dimensions in inches.

NIKE SMOKE

1/30 scale

Sources:

- Rockets of the World, Peter Alway, 1993
- QUEST Inc., scale data included with model

NAR Safety Code

1. Materials

My model rocket will be made of lightweight materials such as paper, wood, rubber, and plastic suitable for the power used and the performance of my model rocket. I will not use any metal for the nose cone, body, or fins of a model rocket.

2. Motors/Engines

I will use only commercially-made, NAR-certified model rocket motors in the manner recommended by the manufacturer. I will not alter the model rocket motor, its parts, or its ingredients in any way.

3. Recovery

I will always use a recovery system in my model rocket that will return it safely to the ground so it may be flown again. I will use only flame-resistant recovery wadding if wadding is required by the design of my model rocket.

4. Weight and Power Limits

My model rocket will weigh no more than 1,500 grams (53 ounces) at lift-off and its rocket motors will produce no more than 320 newton-seconds (71.9 pound-seconds) of total impulse. My model rocket will weigh no more than the motor manufacturer's recommended maximum lift-off weight for the motors used, or I will use motors recommended by the manufacturer for my model rocket.

5. Stability

I will check the stability of my model rocket before its first flight, except when launching a model rocket of already proven stability.

6. Payloads

My model rocket will never carry live animals (except insects) or a payload that is intended to be flammable, explosive, or harmful.

7. Launch Site

I will launch my model rocket outdoors in a cleared area, free of tall trees, power lines, buildings, and dry brush and grass. My launch area will be at least as large as that recommended in the accompanying table:

LAUNCH SITE DIMENSIONS			
Installed Total Impulse (newton-seconds)	Equivalent Engine Type	Minimum Site Dimension (feet)	(meters)
0.00–1.25	¼A & ½A	50	15
1.26–2.50	A	100	30
2.51–5.00	B	200	60
5.01–10.00	C	400	120
10.01–20.00	D	500	150
20.01–40.00	E	1000	300
40.01–80.00	F	1000	300
80.01–160.00	G	1000	300
160.01–320.00	2Gs	1500	450

8. Launcher

I will launch my model rocket from a stable launch device that provides rigid guidance until the model rocket has reached a speed adequate to ensure a safe flight path. To prevent accidental eye injury, I will always place the launcher so the end of the rod is above eye level or I will cap the end of the rod when approaching it. I will cap or disassemble my launch rod when not in use and I will never store it in an upright position. My launcher will have a jet deflector device to prevent the motor exhaust from hitting the ground directly. I will always clear the area around my launch device of brown grass, dry weeds, or other easy-to-burn materials.

9. Ignition System

The system I use to launch my model rocket will be remotely controlled and electrically operated. It will contain a launching switch that will return to "off" when released. The system will contain a removable safety interlock in series with the launch switch. All persons will remain at least 15 feet from the model rocket when I am igniting model rocket motors totaling 30 newton-seconds or less of total impulse and at least 20 feet from the model rocket when I am igniting model rocket motors totaling more than 30 newton-seconds of total impulse. I will use only electrical igniters recommended by the motor manufacturer that will ignite model rocket motors within one second of actuation of the launching switch.

10. Launch Safety

I will ensure that people in the launch area are aware of the pending model rocket launch and can see the model rocket's lift-off before I begin my audible five-second countdown. I will not launch my model rocket so its flight path will carry it against a target. If my model rocket suffers a misfire, I will not allow anyone to approach it or the launcher until I have made certain that the safety interlock has been removed or that the battery has been disconnected from the ignition system. I will wait one minute after a misfire before allowing anyone to approach the launcher.

11. Flying Conditions

I will launch my model rocket only when the wind is less than 20 miles per hour. I will not launch my model rocket so it flies into clouds, near aircraft in flight, or in a manner that is hazardous to people or property.

12. Pre-Launch Test

When conducting research activities with unproven model rocket designs or methods I will, when possible, determine the reliability of my model rocket by pre-launch tests. I will conduct the launching of an unproven design in complete isolation from persons not participating in the actual launching.

13. Launch Angle

My launch device will be pointed within 30 degrees of vertical. I will never use model rocket motors to propel any device horizontally.

14. Recovery Hazards

If a model rocket becomes entangled in a power line or other dangerous place, I will not attempt to retrieve it.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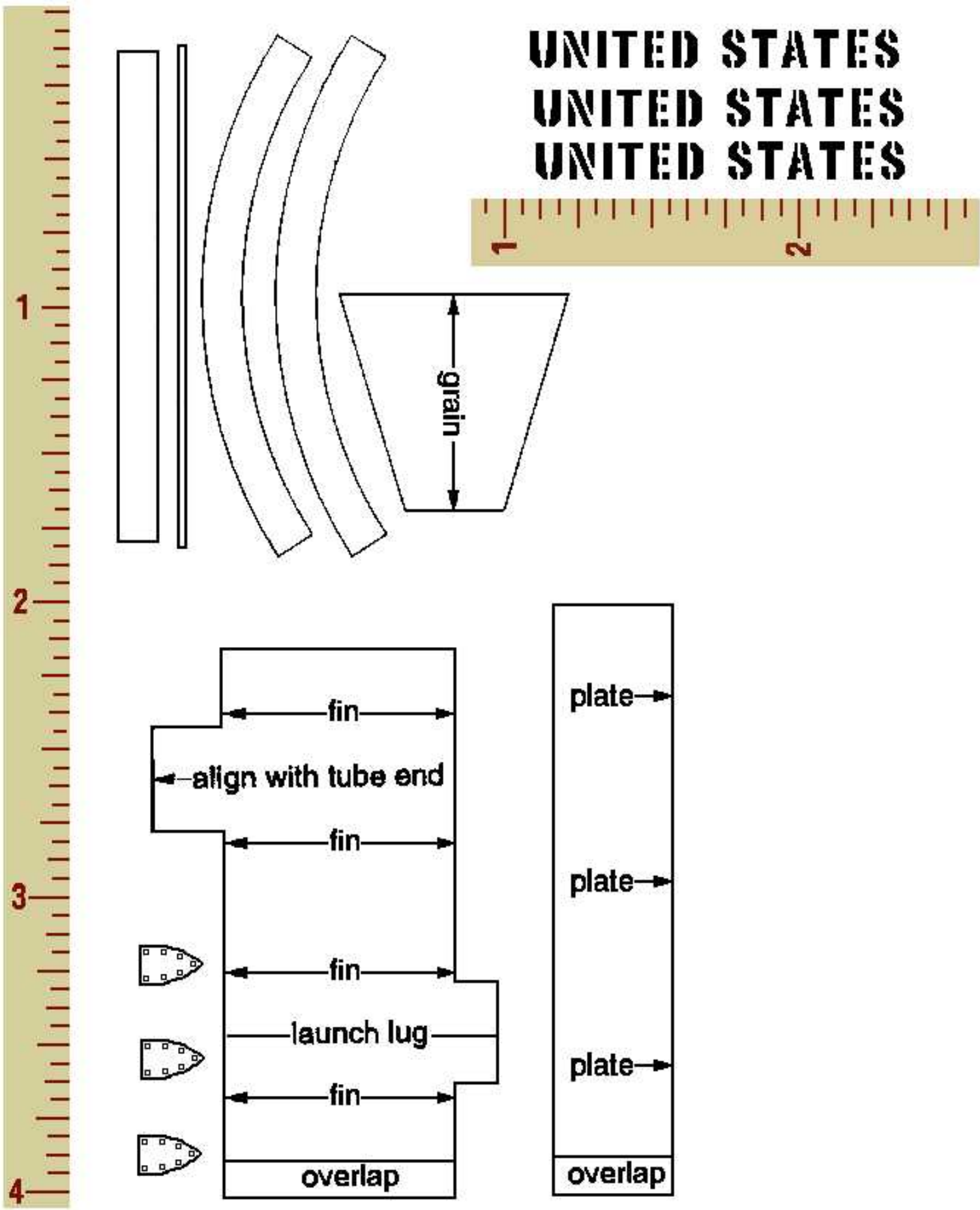
3
2
1



Seattle Rocket Works Nike Smoke