

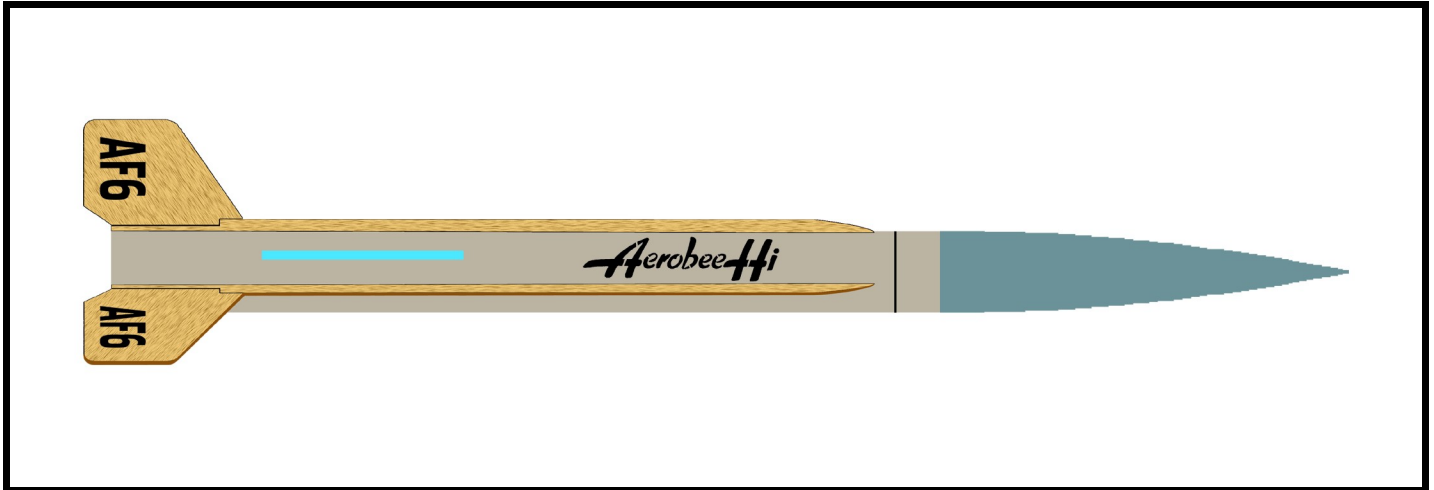


Skill Level 1

Aerobee+fi

Created By C. P. McGraw

Revised Date: 07/09/05



Length	15.12"
Diameter	0.908"
Fin Span	3.414"
Weight	1.31 oz

Parts List

Nose Cone.....	BC-848
Sustainer Body Tube.....	ST-8100
Engine Mount.....	EM-78
Fin Stock.....	3/32" x 3"
Conduit Stock.....	1/8" x 3/16"
Launch Lug.....	LL-18
Parachute.....	CPK-12
Elastic Shock Chord.....	SC-24
Kevlar Shock Chord Mount.....	SCK-24
Screw Eye.....	.1"
Snap Links.....	(2) #10
Ballast.....	(3) 1/8 oz round fishing sinkers

Additional Items Required

Small bottle of yellow carpenter's glue; sharp hobby knife; 0.05mm pencil; steel ruler; sheets of 220-, 400-, and 600-grit sanding papers; lightweight filler compound; tack rag; sprayable primers, paints, and Acrylic gloss clear coat; small, soft-bristle hobby brushes; various clamps and weights; one expended 18mm motor casing; clear decal paper.

It is also recommended that you have a personal copy of **The Model Rocketry Handbook, Seventh Edition**, by G. Harry Stine and Bill Stine. Read and understand the sections on Construction, Recovery, and Safety.

History of this design

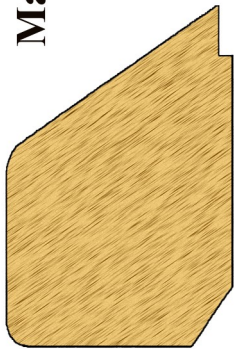
Appearing in magazine advertisements during the late 1950's, the Model Missiles' version of the Aerobee-Hi was one of the first true model rocket kits available in the United States. Every model rocket kit produced by the many model rocket companies which came and went thereafter, right down to this day, shares virtually the same construction and arrangement of components found in this pioneer model. The old adage of "If it ain't broke, don't fix it!" truly applied here, and for 50 years the same formula for model rocket design has continued to prove successful.

In 1965, a copy of this design appeared in "Model Rocket News" as "Estes Industries Rocket Plan #32", using the same nose cone and other similar components to the original MM version. Some enthusiasts today dub this EIRP version as "The first model rocket clone". According to the history of the two companies, Estes bought up the remaining stock and toolings for this nose cone from MM after that company closed. Estes, however, never produced its own kit of this rocket, and subsequently discontinued producing these parts within a few years.

To the delight of many rocketry enthusiasts and collectors, some of these original MM kits have survived these 50 years in good condition. Some of these are appearing on the online auction sites, sometimes available for a reasonable price.

The BARCLONE version of this classic design is not a true-scale replica of either the original Aerobee-Hi, or of the Model Missiles' kit, but is instead a modernized, "upscale replica" based around the EIRP plan. Where the EIRP version used Estes' BT-40 parallel-wound paper tubing (0.822" diameter), we are using SEMROC/CENTURI ST-8 spiral-wound paper tubing (0.908" diameter). This produces a 10% upscale in diameter. Additionally, where the earliest MM version used a turned hardwood nose cone, and where the later MM and EIRP versions used the vinyl PNC-40G nose cone, our version uses the SEMROC turned balsa ogive BC-848. There is a difference in the length of this nose cone compared to the calculated upscale length, but this difference is quite minimal and does not detract from the finished appearance of the model.

Make 3 -- 3/32" balsa sheet



Make 3 -- 1/8" balsa sheet



Aerobee-Fi

AF6

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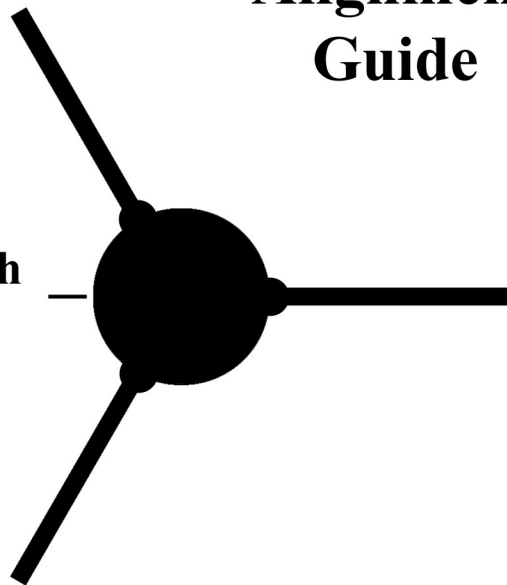
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Decal Image

**Alignment
Guide**

**Launch
Lug**



Fin and Conduit Shroud Templates

- **Step 1** Carefully reduce the length of the ST-8100 body tube to 9.25" using a sharp hobby knife. Use the cut end of the tube as the **bottom** of the tube in the remaining steps.
- **Step 2** Give the body tube and the nose cone a surface sanding with 220-grit paper to reduce fuzziness from the balsa (caused by humidity and temperature), and to reduce the shine from the tube. Do not sand through the outer layer of the tube, and do not gouge the surface of the nose cone, or change its shape.



Figure 1

- **Step 3** Modify **both** of the CR-78 centering rings in the EM-78 engine mount kit as shown in the **left-side image** of Figure 1. Next, modify **one** of the two rings as shown in the **right-side image** of Figure 1. Now, dry-assemble the EM-78 engine mount according to the SEMROC instructions, using the ring with the "V" notch as the **forward** ring. The flat notches must be aligned over the engine hook. Do not apply glue to the subassembly yet.

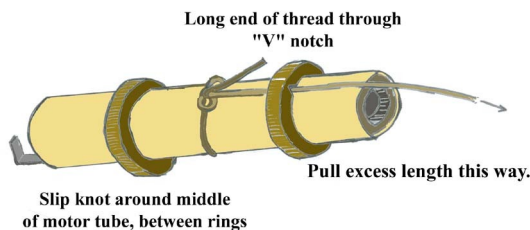


Figure 2

- **Step 4** Tie a slip knot around the middle of the engine mount subassembly using the Kevlar thread, as shown in Figure 2. Push the free end of the Kevlar thread through the "V" notch, and pull the excess toward the front as you slide the slip-knot loop up against the back of the forward ring. Now, apply a bead of glue around all of the mating surfaces, securing the Kevlar thread at the same time. Set this aside and let dry.

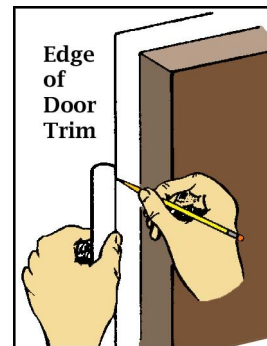


Figure 3

- **Step 5** Print several copies of the alignment guide onto cardstock and cut them out, leaving as much around the silhouette as possible. Take note that the conduit shrouds are wider than the fins. Trim out the silhouettes, and slip one over the bottom of the body tube, about 1" up. Use the alignment guide to locate the marks for **both sides** of the three conduit shrouds and the launch lug on the body tube. Draw all of these lines the full length of the tube, using the trim around a door as shown in Figure 3, or use a 9" length of 1/4" brass angle stock (see the Handbook for a full explanation), to keep the lines parallel to the body.

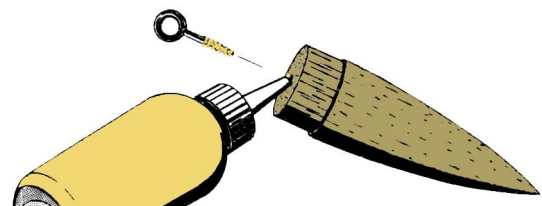


Figure 4

- **Step 6** Use the threads of the screw eye to cut a hole in the base of the nose cone, then carefully reverse-thread the screw eye back out. As shown in Figure 4, force glue down into the hole, and coat the threads on the screw eye with glue. Now, re-thread the screw eye into the hole, and set aside in a nose-down vertical position until the glue has dried.
- **Step 7** Make three round depressions in the base of the shoulder, close to the screw eye, just large enough for the round sinkers to fit into. A motor tool with a spherical grinding bit or stone will help here. Mix up a small amount of epoxy and put a thin smear into each hole. Apply a similar smear to each of the three sinkers and insert these into the holes. Allow the epoxy at least a day to fully cure.

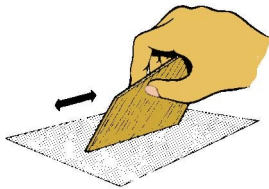


Figure 5

- **Step 8** Cut out the fins and the conduit shrouds from their respective balsa stocks, using the patterns on page 3 of these instructions. Trim down the pieces carefully until they are the correct sizes (or find someone capable of laser-cutting the pieces). Round over all of the **outer** edges of the fin pieces with 400-grit paper, but **square up** the root edge with 220-grit paper where it will attach to the conduit, as seen in the illustration in Figure 5. Give the faces of the fins a careful sanding with 220-grit paper to remove the fuzziness. Round over the **outer** edges of the conduit shroud with 220-grit paper the full length **forward** of the notch for the fin, but **square up** the bottom of the conduit with 220-grit paper where it attaches to the body tube.

- **Step 9** Using a soft-bristle hobby brush, apply a layer of **thinned** yellow glue to the body tube **between** the conduit lines for a distance of 8.5" from the **bottom** of the tube. Mark the launch lug line 1.75" and 4" from the bottom of the tube, and apply a layer of thinned yellow glue to the line between these marks. Allow this glue to dry.
- **Step 10** Apply a layer of thinned yellow glue to the **bottom** of all three conduit shrouds, for their full length, and to the **top edge** of the conduit shrouds in the area where the fins will attach. Apply a similar layer of glue to the **root edges** of the three main fins. Allow this to dry.
- **Step 11** Assemble the parachute according to the SEMROC instructions, and attach the shroud lines to the barrel end of one of the snap links.

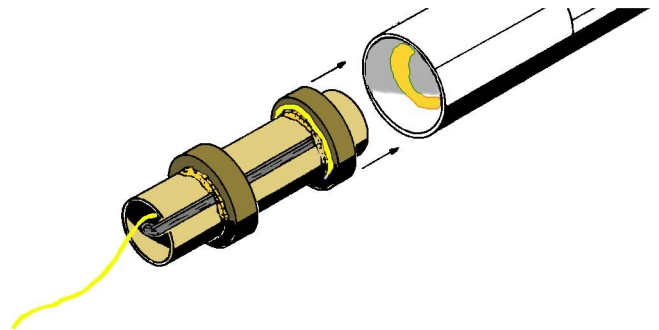


Figure 6

- **Step 12** Push the Kevlar thread down through the center of the engine mount and pull the excess out of the way. Apply a generous bead of full-strength glue up inside the bottom of the body tube, about 1" up from the edge. As shown in Figure 6, insert the forward end of the mount into the body tube and through the glue, until the bottom of the motor tube is even with the bottom of the body tube. Do not stop at any time during this action, or the glue will "freeze" the mount in the wrong place. Set this aside to dry.

- **Step 13** Apply a narrow bead of glue to the bottom of one of the conduit shrouds along its length, and to the body tube between the alignment lines for one of the shrouds, directly on top of the glue layer you applied in Step 8. Place the rear edge of the shroud (the end with the fin notch) even with the rear edge of the tube, and push the shroud down until the full length is in contact with the tube. Use a moist hobby brush to smooth out the glue which squeezes out from the joint. Make certain the shroud does **not** slide out from between the alignment lines. Let the glue dry for about 20 minutes, then repeat this series for each of the remaining shrouds.

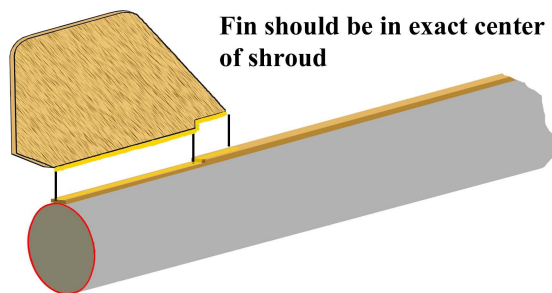


Figure 7

- **Step 14** Apply a narrow bead of glue to the **root edges** of a main fin, and to the matching area on top of one of the conduit shrouds. Attach the main fin to the shroud as shown in Figure 7. The fin should be aligned exactly half-way between the sides of the shroud, and the trailing edge of the root edge should be even with the rear edge of the shroud. Smooth down the glue that squeezes out with a moist hobby brush. Slide at least two of the alignment guides onto the body tube from the top, and locate them at 1" and 1.5" from the rear of the tube. Adjust the angle of the fin carefully to set the proper alignment. Give this fin about 20 minutes to dry, then remove the guides. Repeat this sequence for each of the remaining fins.
- **Step 15** Attach the launch lug to the body tube along the launch lug alignment guide

between the marks. Smooth out any glue from the joint with a moist brush. Allow this to dry.

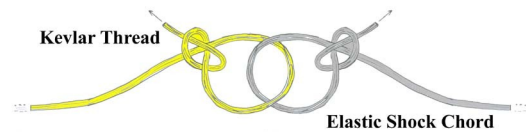


Figure 8

- **Step 16** Push the Kevlar thread back through the engine mount and out the top end of the body tube. As shown in Figure 8, tie a slip knot loop in the free end of the thread. Insert one end of the elastic chord through this loop and tie a slip knot loop in it. Pull these loop knots tightly together and secure the knot with a layer of thinned glue. Allow to dry. Tie the free end of the elastic chord to the barrel end of the remaining snap link and secure this knot with a layer of thinned glue. Let dry.
- **Step 17** Apply a lightweight filler compound to all exposed balsa surfaces at this time. We currently recommend **Elmer's "Fill-N-Finish"**, thinned with water to a consistency of thin pea soup, or a cream soup, and brushed rigorously into the grain. Allow this compound a full day to dry before attempting to sand smooth with 220-grit paper. Thoroughly examine the balsa surfaces for gouges or other imperfections received during construction. Repeat this compound application and sanding sequence as many times as needed to achieve as smooth a surface as possible.
- **Step 18** The illustration in Figure 9 shows the correct method to spray your model, regardless of the equipment used. Always spray from the top down. Never try to spray from the bottom up, or from side-to-side. This applies to primer, paints, and the clear coat final layer.

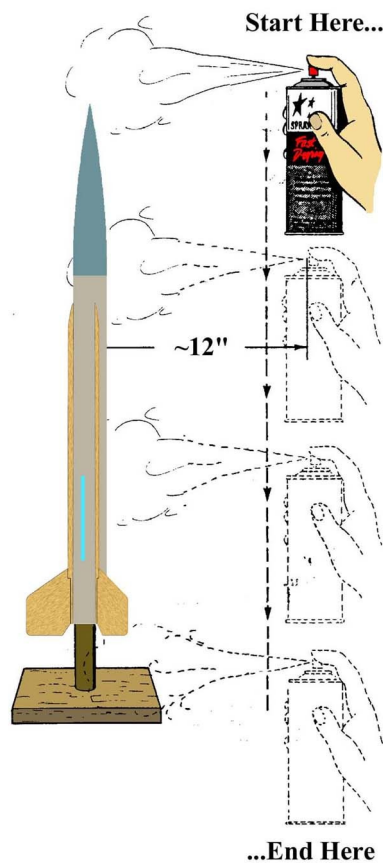


Figure 9

- **Step 19** Tack-rag the entire model, and spray at least **two** coats of primer, allowing each coat a full day to dry. Our primer of choice at this time is **Rust-O-Leum White Bare Metal Primer**. Sand carefully with 220-grit paper and examine for blemishes. Repeat this sequence **as many times as needed** to achieve a near-glass-smooth surface for the paint. The effort you spend here will pay off in the very next step! When you are satisfied with the surface, **apply another layer** of primer, then sand with 400-grit paper. This will help to polish out the surface roughness from the 220-grit paper. You may even **gently sand** with 600-grit paper after this, but do not sand too hard or you will damage the prime.
- **Step 20** Tack-rag the model thoroughly to remove all traces of sanding dust. Try not to handle the model with bare fingers now. The skin oils will harm the finish! Use a

holder tool inserted into the engine mount to hold the model until you have finished these next few steps. A simple tool can be made from a length of 1/2" dowel and a spent 18mm casing rammed down onto one end.

The paint scheme suggested by the EIRP plan sheet is as follows:

White main body, conduit shrouds, and two fins.

Silver nose cone with a black tip (upper 3/8").

One black fin (both sides). An image has been provided to create a pair of decals that completely cover the faces of this fin. You only need to go around the edges of this fin with black paint to finish the job. The prototype was done this way, with excellent results.

A thin black line to mark the payload section separation joint (about 1/16" wide), 1/2" down from the top of the body tube. An image has been provided with the patterns so that you can create a decal for this stripe.

It is highly suggested that you paint the nose cone as a separate item, to achieve a clean color separation with the body. Use a scrap piece of ST-8 as a holding tool, with the shoulder of the nose cone fully inserted into the tube.

Paint the nose cone, the entire body, conduit shrouds, and all three fins, with a base coat of white.

Our current paint of choice is an artist's tube acrylic, **Liquitex Basics**, mixed with airbrush medium and water to an airbrush consistency. You will **not** achieve a complete coat with one application; it usually takes several sprays to build up enough coverage. Take your time.

Allow at least three days drying time after the white base coat has been applied, so that the paint is fully cured and has adhered to

the primer. Do not attempt to mask off for the fin before this. Use a low-tack masking tape and follow the root outline of the one black fin, then fully cover the remainder of the model with a clean, **ink-free** masking paper, sealing the gaps with regular masking tape.

You can speed up the drying process with the trim color by using a hair dryer, set on medium-high heat. Don't hold the airflow on a single spot for more than a second or two, as the heat will damage the finish. When the paint appears to have "flattened out", examine the coverage and spray a second (or third) coat as needed. Set this aside and allow to finish curing for a day.

For the nose cone, you will need to use a true spirit-based enamel to get the silver color. We used **Krylon's Metallic Silver**. Allow this type of paint at least three days to fully cure before masking off for the tip. Use a matching enamel from the same company that made the silver. As before, use a low-tack masking tape.

- **Step 21** When all of the paint has fully cured, remove the masks and carefully wipe off any remaining residue with a soft cloth. Do not rub too hard, or the finish will become marred.
- **Step 22** Attach the snap link of the shock chord to the screw eye in the nose cone, and push all of the chord into the body tube. Do not attach the parachute at this time! Insert the nose cone into the top of the body tube.
- **Step 23** Apply a clear gloss Acrylic to the entire model and allow to dry. We have tried and have had good success with several brands of this product, including **Krylon** and **Valspar**. After spraying, let this clear coat cure fully, until there is no longer a smell of the solvent. This will usually take a full day to two days. Do not spray this when the weather is humid or raining, as it

will introduce a cloudiness into the finish.

An image is provided, in three sizes, for the "Aerobee-Hi" name decal. The smaller one should be correctly sized, but the others are provided in the event you need to resize it. Use the largest one if you need to scale down. Also included are images for the fin decals. The two reverse images need to be printed on **white** decal paper, while the other images need to be printed on **clear** decal paper. Seal the decals with **at least two or three coats** of the clear Acrylic before using. You need the additional thickness to keep the decals from breaking up. Apply this image as shown in the cover profile. The black stripe wraps completely around the body tube 1/2" from the top edge.

When all of the decals have been applied and allowed at least a day to dry, wipe away any decal adhesive residue away with a soft cloth. Spray the entire model again with the clear acrylic, and allow to dry for several days before handling with your bare hands.

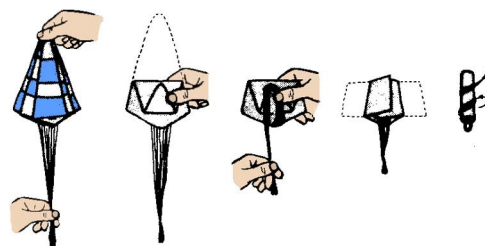


Figure 10

- **Step 24** Study the illustration in Figure 10 to see the correct way to fold the parachute. Do not wrap the lines tightly, but just enough that the parachute retains its shape. This step should **only** be done just before flight – **NEVER** pack the parachute in the rocket when you are storing it between flight sessions. In cold climates, or during winter months, you will find it helpful to dust the parachute with talcum powder. This will keep the plastic from sticking in a closed condition after deployment.

by C. P. McGraw

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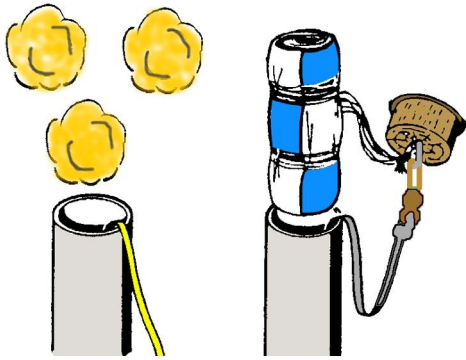


Figure 11

- **Step 25** When preparing to fly, insert three or four sheets of flameproof recovery wadding, or about 2” of shredded cellulose attic insulation, down into the body tube just in front of the engine mount. Do not pack this material tightly, as it **must come out** at deployment to function properly. You only need a gas seal to protect the parachute and the lines from the hot gases and particles which emerge from the engine.

Attach the snap link on the parachute to the nose cone screw eye. Push the shroud lines into the body tube completely, followed by the parachute. This should not be tight, but rather loose. If it is tight, re-fold the parachute and insert it again. Finally, push the nose cone down into the top of the body tube.

- **Step 26** We recommend the A8-3 and A8-5 engines for your first flights with this rocket. The -3 engine should deploy the parachute just **before** apogee, and the -5 should deploy just **after** apogee. This is a lightweight model. With this engine, you should easily achieve 250-350 feet in altitude. Remember, you want to **get the model back for more flights!**

Model Rocket Safety Code

Materials: I will use only lightweight, non-metal parts for the nose cone, body, and fins of my rockets.

Motors: I will use only certified, commercially-made model rocket motors, and will not tamper with these motors or use them for any purposes except those recommended by the manufacturer.

Ignition System: I will launch my rockets with an electrical launch system and electrical motor ignitors. My launch system will have a safety interlock in series with the launch switch, and will use a launch switch that returns to the "off" position when released.

Misfires: If my rocket does not launch when I press the button of my electrical launch system, I will remove the launcher's safety interlock, or disconnect it's battery, and will wait 60 seconds after the last launch attempt before allowing anyone to approach the rocket.

Launch Safety: I will use a countdown before launch, and will ensure that everyone is paying attention and is a safe distance of at least 15 feet away when I launch rockets with "D" motors or smaller, and 30 feet when I launch larger rockets. If I am uncertain about the safety or stability of an untested rocket, I will check the stability before flight and will fly it only after warning spectators and clearing them to a safe distance.

Launcher: I will launch my rockets from a launch rod, tower, or rail that is pointed to within 30 degrees of the vertical to ensure that the rocket flies nearly straight up, and I will use a blast deflector to prevent the motor's exhaust from hitting the ground. To prevent accidental eye injury, I will place launchers so that the end of the launch rod is above eye level or I will cap the end of the rod when it is not in use.

Size: My model rocket will not weigh more than 1,500 grams (53 oz) at liftoff, and will not contain more than 125 grams (4.4 oz) of propellant or 320 N-sec (71.9 lb-sec) of total impulse. If my model weighs more than one pound (453 grams) at liftoff, or has more than four ounces (113 grams) of propellant, I will check and comply with Federal Aviation Administration (FAA) regulations before flying.

Flight Safety: I will not launch my rockets at targets, into clouds, or near airplanes, and will not put any flammable or explosive payload into my rockets.

Launch Site: I will launch my rockets outdoors, in an open area at least as large as shown below, and in safe weather conditions with winds speeds no greater than 20 MPH. I will ensure that there is no dry grass close to the launch pad, and that the launch site does not present risk of grass fires.

LAUNCH SITE DIMENSIONS		
Total Impulse (nSec)	Motor Size	Minimum Size
0.00 – 1.25	1/4A – 1/2A	50'
1.26 – 2.50	A	100'
2.51 – 5.00	B	200'
5.01 – 10.00	C	400'
10.01 – 20.00	D	500'
20.01 – 160.00	E, F, G	1000'
160.01 – 320.00	2G	1500'

Recovery System: I will use a recovery system, such as a streamer or parachute, in my rockets so that they return safely and undamaged and can be flown again, and I will use only flame-resistant or fireproof recovery system wadding in my rockets.

Recovery Safety: I will not attempt to recover my rocket from power lines, tall trees, or other dangerous places.

Model Rocket Safety Code
developed by the
National Association of Rocketry
Revised Code November, 2004