



*Skill Level 1*

# TROPOSPHERIC EXPLORER

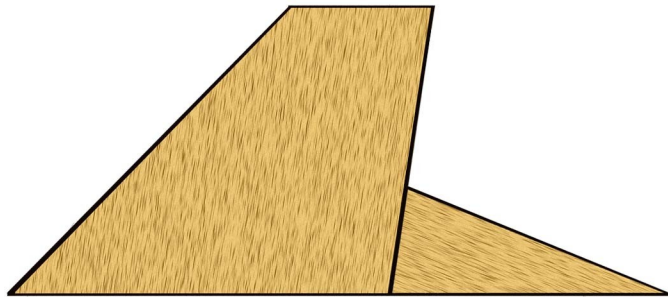
*Created By C. P. McGraw*



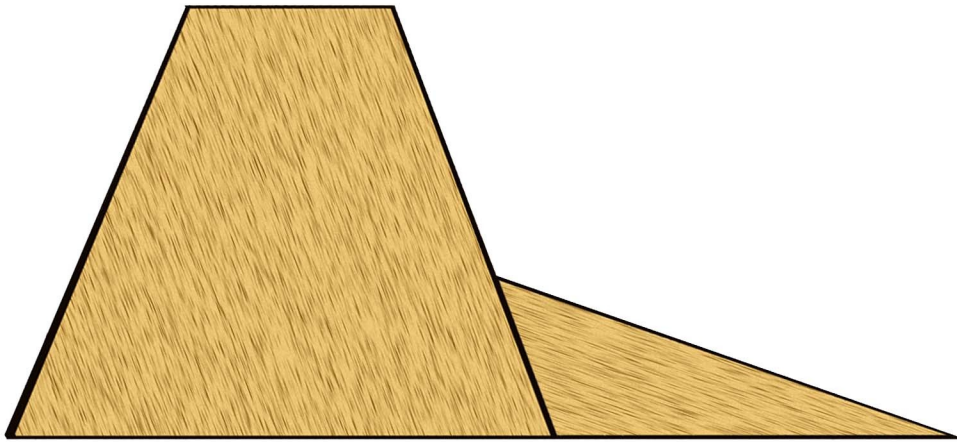
Length	14.80"
Diameter	0.908"
Fin Span	6.75"
Weight	1.0 oz

### *Parts List*

Nose Cone.....	BC-848
Body Tube.....	ST-8100
Engine Mount.....	EM-78
Fin Stock.....	1/16" Balsa Sheet
Fin Stock.....	3/32" Balsa Sheet
Launch Lug.....	LL-18
Parachute.....	CPK-12
Snap Links.....	(2) #10
Screw Eye.....	1"
Shock Chord.....	SC-24
Shock Chord Mount.....	SCK-24
Dowel Stock.....	3/32" x 12"



*Vertical Fin Patterns*  
*-- Make from 3/32" balsa sheet --*

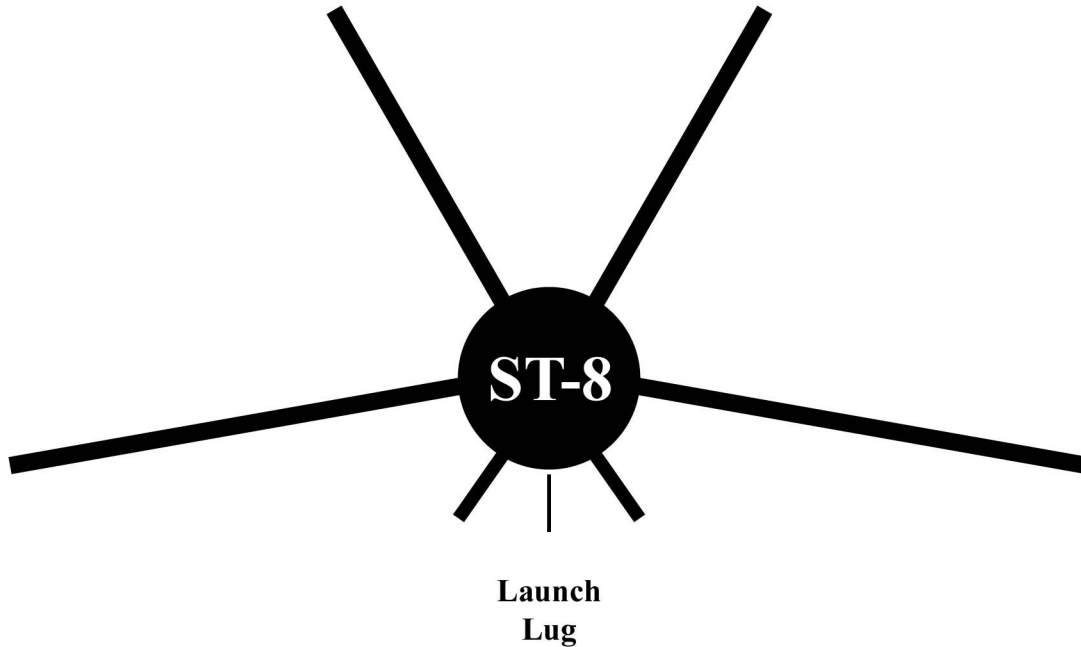


*Main Fin Patterns*  
*-- Make from 3/32" balsa sheet --*



*Subfin Pattern*  
*-- Make from 1/16" balsa sheet --*

# Alignment Guide

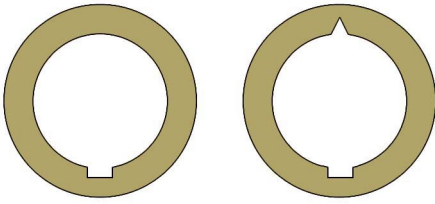


## Additional Items Required

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 motor casing; sheets of printable cardstock for guides and templates.

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.

"V" notch for Kevlar thread



Flat notches to fit motor hook

Figure 1

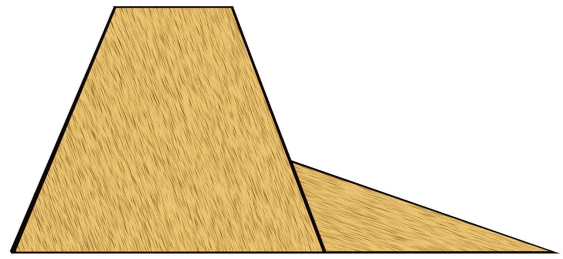


Figure 3

- **Step 1** Modify both of the CR-78 centering rings as shown in the left-side image of Fig. 1. Modify one of these rings with a "V" notch, as shown in the right-side image. Assemble the EM-78 engine mount subassembly according to the SEMROC instructions, with the flat notches aligned over the engine hook, and the "V"-notched ring placed at the front of the mount. Use a moist, soft-bristled hobby brush to remove any glue that fills the "V" notch before the glue sets up. Allow this subassembly at least 20 minutes to dry.

- **Step 2** Give the nose cone and the body tube a gentle sanding with 220-grit paper. This is to remove the fuzziness and swelling of the nose cone caused by humidity and temperature, and to remove the shine from the surface of the tube. Test-fit the nose cone into the tube, but do not force it. If the shoulder is too tight, *carefully* reduce the diameter of the shoulder by rolling it between the workbench and a flat, solid block, *gently* compressing the diameter until it fits the tube. Do not over-compress the shape of the shoulder, or allow the visible portion of the cone to be crushed. Take your time, and roll the cone *slowly*.

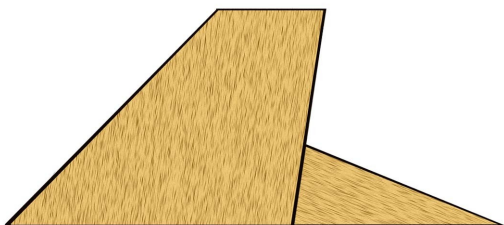


Figure 2

- **Step 3** Cut out the subfins from 1/16" sheet stock and set aside. Cut out the pieces for the vertical fins and assemble them as shown in Fig. 2 on a piece of wax paper, aligning the root edges of the strakes to their respective main fins. Do the same for the main fins as shown in Fig. 3. Weight or clamp them down flat to the building surface, and leave these alone for an hour to dry.

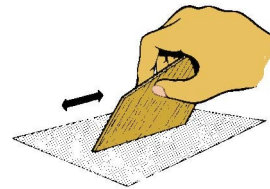


Figure 4

- **Step 4** Round over the outer edges of all six fins with 400-grit paper, except for the root edges. As shown in Fig. 4, square up the root edges of all six fins to allow them to fit properly against the body tube.

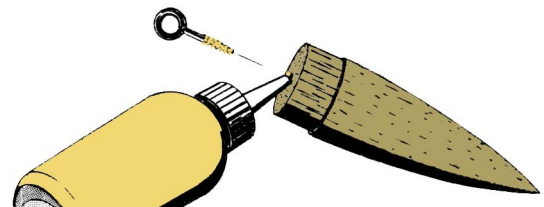


Figure 5

- **Step 5** Using the threads on the screw eye, cut a hole into the base of the nose cone, then carefully reverse the screw eye out. As shown in Fig. 5, force glue deep into

the hole, and coat the threads on the screw eye. Reinsert the screw eye into the hole, and rotate until the screw eye is fully seated. Do not wipe away any glue. Set aside in a vertical attitude, pointed down, until dry.

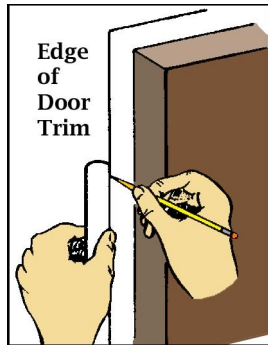


Figure 6

- **Step 6** Mark the body tube for six fins and the launch lug, using one of the cardstock alignment guides as a locator. As shown in Fig. 6, use the trim around a door, or a length of brass angle stock, to extend the alignment lines along the tube. The main fins extend 5” from the rear edge of the tube, the vertical fins and the subfins extend 3.5” from the edge, and the top of the launch lug should be 5” from the edge of the tube. The bottom edge of the launch lug is 2.25” to the rear of the 5” location. Mark the alignment lines at these locations.
  
- **Step 7** Apply a layer of thinned glue to the root edges of all six fins, the launch lug, and to the alignment lines on the body tube between the respective marks. Allow the glue to dry about 20 minutes.
  
- **Step 8** Assemble the parachute according to the SEMROC instructions, then attach the shroud lines to the barrel end of one of the snap links. Do not attach the parachute to the nose cone at this time.

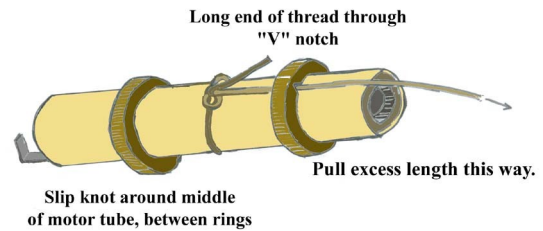


Figure 7

- **Step 8** As shown in Fig. 7, tie a slip knot loop around the middle of the engine mount using the Kevlar thread, and pull this loop tight. Push the free end of the Kevlar through the “V” notch in the upper ring, and pull the excess toward the front, sliding the loop up against the rear of the ring as you go. Secure this loop with a layer of thinned glue, and let dry another 20 minutes.
  
- **Step 9** Sand the fins with 220-grit paper to remove any excess glue from the joints, but be careful not gouge the surfaces. Round over the outer edges of all six fins **except** the root edges, and the tips of the four large fin sets where the dowel probes are to be attached.

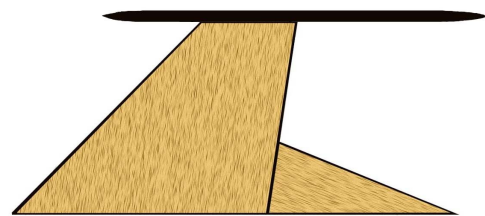


Figure 8

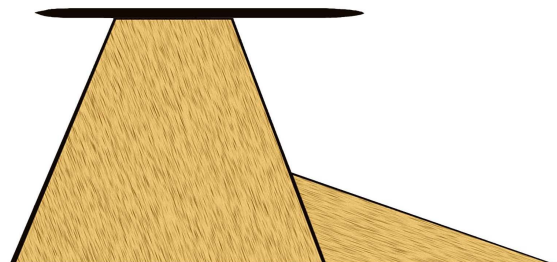
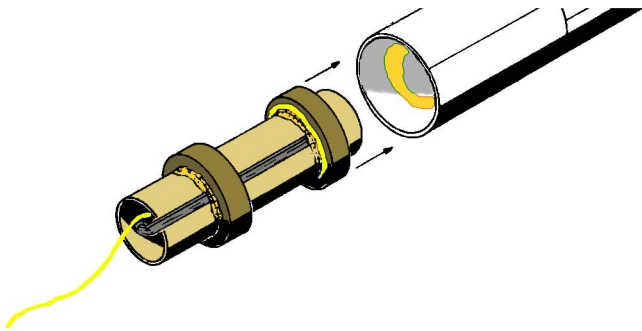


Figure 9

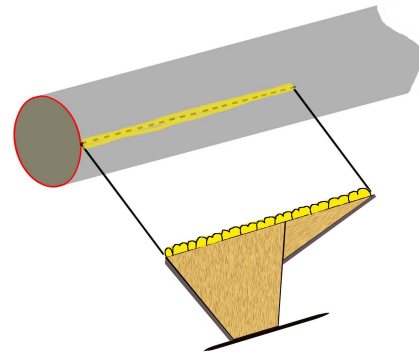
- Step 10** Cut the 12" dowel into 4 equal-length pieces (3" each). Taper one end of each dowel about 3/8", and the other end about 1/4", then smooth out the tapers with 220-grit paper. As shown in Figs. 8 & 9, attach the probes to the top of the main and vertical fins as shown. The probes should have the long taper pointing forward, and the rear 3/4" of the probe should fall behind the trailing edge of the fins. Set these aside to dry.



*Figure 9*

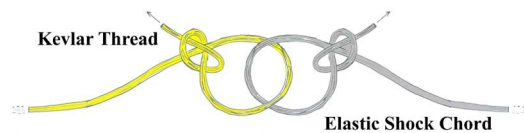
- Step 11** Push the Kevlar thread down through the engine mount from the top, and pull the excess line out the rear of the mount, as shown in Fig. 9. Apply a generous bead of glue up inside the body tube, about 1" from the rear edge, completely around the inside diameter. Push the engine mount into the body tube and up through the glue until the rear edge of the motor tube is even with the rear edge of the body tube. Do not stop during this push, or the glue will "freeze" the mount in the wrong place. Set the body tube in an upright position until the glue has dried at least an hour.
- Step 12** Apply a bead of full-strength glue to one of the fin alignment lines on the body tube, and to the root edge of the matching fin. Press the fin into place with the trailing edge touching the rear edge of the tube, as shown in Fig. 10, and hold in place for about 12 seconds before releasing it. Use the moist brush to smooth out the glue that squeezes out from the joint. This

creates the first fillet layer. Slide two of the cardstock guides down over the tube and over the fin, gently nudging the fin into the guide slot. Allow this to dry for at least 20 minutes. Remove the guides and repeat this sequence for each of the remaining five fins. For the subfins, the long taper is toward the front of the model.



*Figure 10*

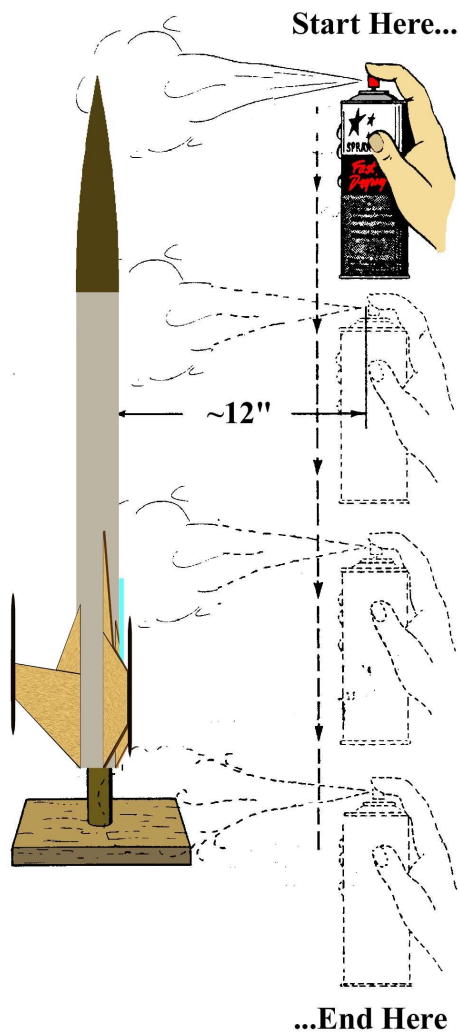
- Step 13** Attach the launch lug to the body tube on the lug alignment line, between the two marks. Smooth out the glue with a moist brush. Allow about 20 minutes to dry.



*Figure 11*

- Step 14** Push the Kevlar thread back through the engine mount, up through the body tube, and out the top end. As shown in Fig. 11, tie a slip knot loop in the free end of the Kevlar, then run one end of the elastic shock chord through the loop and tie a slip knot **around** the Kevlar. Pull these knots tightly against each other, then secure the knots with a layer of thinned glue. Allow to dry. Attach the free end of the elastic chord to the barrel end of the remaining snap link, then attach the snap link to the screw eye in the base of the nose cone. Push all of this recovery line into the body tube, and insert the nose cone.

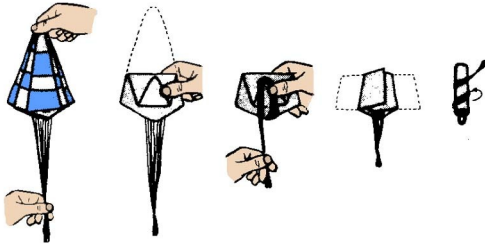
- Step 15** Fill any exposed balsa grain, and the spiral groove of the body tube, with a lightweight filler compound. Our current preference is for **Elmer's Fill-N-Finish**. Thin this compound with water until it has a cream soup consistence, and brush this into both sides of the fins (balances out the warping due to swelling), the nose cone, and the body tube spiral. Allow a full day to dry, then sand with 220-grit paper. Inspect for blemishes and other surface imperfections that need to be filled again. Repeat this sequence until all of these blemishes are dealt with. Tack-rag the model to remove sanding dust.



*Figure 12*

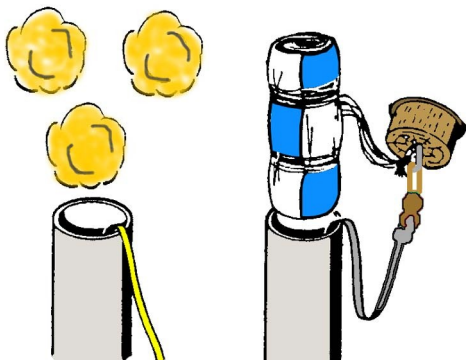
- Step 16** The illustration in Fig. 12 shows the correct method of spraying your model, regardless of the equipment used, or whether you are spraying primer, paint, or the final gloss coats. Always spray from the top down – never from side-to-side, or from the bottom up. This reduces the chances of the paint running. Keep the tip of the sprayer about 12” from the model. Start the spray pattern ahead of the model, and stop the spray past the end of the model.
- Step 17** Give the model at least two full coats of primer, with time to dry between coats, before sanding with 220-grit paper. Our primer of choice is **Rust-O-Leum White Clean Metal Primer**. Tack-rag and inspect the surface of the model after sanding for scratches or other imperfections that might show up in the color coats (like the spiral groove in the body tube, or exposed balsa grain). Repeat this sequence of primer and sanding until the surface is free of these noticeable blemishes. Give the model one final prime and a complete sanding with 400-grit paper, then tack-rag the model to remove any remaining sanding dust.
- Step 18** The suggested paint scheme is an all-white body with your choice of trim for the nose. Give the entire model a complete coat of white and allow at least two full days for this to cure. Inspect for any coverage problems, respraying the areas that need touching up, and allow another two days to cure. You want the paint fully cured before masking. Remove the nose cone and spray it with your color coat as a separate item, using a scrap piece of ST-8 tubing as a holder. Allow each color two full days to dry before applying the next color.
- Step 19** After the final color has cured, spray the nose cone and main body with the first coat of gloss clear Acrylic. We have used several brands of this product, including **Krylon** and **Valspar**, with equal

success. Allow at least a full day to cure, or until the solvent smell has fully dissipated. Apply any decals you may wish to use (we prefer waterslide decals), and when these have fully dried, wipe the model down with the soft cloth. Finally, give the model a second complete spray of Acrylic to seal the decals, and allow to cure completely.



*Figure 13*

- **Step 20** Study the illustrations in Fig. 13 to see how to correctly fold the parachute for flight. In cold climates, or in winter, dust the parachute with talcum powder to prevent the plastic from sticking to itself. Only fold the parachute just prior to flight – never pack the parachute for storage in the body tube, or even in a folded condition.



*Figure 14*

- **Step 21** Attach the parachute's snap link to the screw eye in the nose cone. As shown in Fig. 14, insert at least three crumpled sheets of recovery wadding (in practice, more like 5 sheets), or at least 2" of shredded cellulose house insulation, into the body tube and push this down to just above the motor tube. Do not pack this

material tightly! It must be able to come out for recovery to be successful. It is used to provide a gas seal between the engine and the recovery devices. Now insert the recovery lines on top of this, and insert the parachute on top of the lines. Finally, insert the nose cone into the body tube.

- **Step 22** Select the motor for flight. We recommend the A8-3 and A8-5 for your first flights with this model. The -3 should deploy just ahead of apogee, while the -5 will deploy after apogee. Use these motors until you have become accustomed to the flight profile of the model.

**Developed for BARCLONE Rocketry  
by C. P. McGraw**

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by C. P. McGraw**

**Instruction text copyright © 2005**

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# 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 its 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 wind 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 Field Size
<i>0.00 – 1.25</i>	<i>1/4A – 1/2A</i>	<i>50'</i>
<i>1.26 – 2.50</i>	<i>A</i>	<i>100'</i>
<i>2.51 – 5.00</i>	<i>B</i>	<i>200'</i>
<i>5.01 – 10.00</i>	<i>C</i>	<i>400'</i>
<i>10.01 – 20.00</i>	<i>D</i>	<i>500'</i>
<i>20.01 – 160.00</i>	<i>E, F, G</i>	<i>1000'</i>
<i>160.01 – 320.00</i>	<i>2G</i>	<i>1500'</i>

**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