

## **Building and Launching Rockets With Groups of Kids**

**By Ted Cochran**

Kids that are middle school aged can build different rockets, but for younger kids, it is easier if they are all building the same rocket as a group exercise. For planning purposes, you should take into account the age of the kids, the number of kids, and the number of rockets being built. For example, in 45 minutes to an hour, you and a couple of helpers can easily help 25-50 kids at a time build the same rocket in teams of 3 or 4 kids per rocket. But if each kid has their own rocket to build, you may need to cut the number of kids in half or double the number of helpers.

If the rockets are being built by teams of kids, divide the teams into roles such as Propulsion, Guidance, Recovery, Airframe (or Marketing). For E2-X style rockets, Propulsion builds the motor mount (Marks the MT, installs the hook and the retainer ring, and installs the mount in the tail). Guidance glues the green retaining ring on and does the launch lug. Recovery builds the SC mount and installs it, builds the chute and installs it. Airframe glues the BT to the tail, and applies the decals. Although the building session will look and sound like chaos, you can have many of these steps proceeding in parallel. Just make sure the appropriate team member is listening to your instructions while the others are doing their assignments.

Another thing to remember is that what seems trivially easy to us may boggle the minds of the kids! The vast majority of kids in classroom sessions have not built rockets before. Some of them may not have built anything remotely similar. Most kids have not used a hobby knife, plastic cement, or sandpaper before. Some kids may not be able to cut a parachute out with scissors, or tie a decent knot in string. The kits are pretty robust (see below) but patience is required of you and the helpers.

### **Hints on the E2X**

Kids can and do assemble the E2X in an amazing variety of configurations. Due to the robust design of the kit, however, nearly all of them end up having successful flights. In my experience with kids (and their teachers) of different ages, there are some steps that don't matter much, and some that do. In my opinion the steps should be done in a different order than the instructions suggest, especially if you need to build fast and launch the same day.

1. First, do the MM [motor mount] as instructed
  - o Unless you have lots of helpers during the build session, cut the slits for the engine hook ahead of time. If you don't want the kids using hobby knives, and haven't cut the slits, you can have them push the hook through the tube by wiggling it, instead of cutting the slit first.
  - o The black ring not only holds the engine hook in place, it serves as the stop for the tube in the fin can. If it is too far forward, the tube sticks out of the back of the rocket, but that isn't a big deal. If the ring is too far back, though, the hook doesn't clear the base of the BT, and motors are difficult (but not impossible) to insert and remove. So the ring location is important, but not rocket-threatening.

2. While the MM dries, do the SC [shock cord] attachment, and the parachute construction. [Note that newer kits have parachutes pre-assembled--a big time saver--but the kids should still check the knots.]
  - o Estes SC mount. Make sure they get the mount far enough down the tube. "Use your longest finger."
  - o Parachute. Most kids under 12 years old can't divide a long string into three pieces using the looping technique described in the instructions. Instead, tell them to use a ruler and cut the string into three pieces all 12" long .
3. Once that's done, it is time to finish the Motor mount. Inserting the assembled MT [motor tube] into the fin can is tricky for first timers. More than half of the kids (and teachers!) get this wrong on the first try. Here's what you have to do
  - a. Show them the fin can, tell them the flat end is the bottom/back and the angled end is the top/front.
  - b. Demonstrate how to put the MT in, but tell them to only put it in partway. "Hold the front of the fins in one hand, and the metal hook in the other hand, and push the blue tube partway in.."
  - c. THEN tell them to look at the front (top) of the fin can to find the little slot for the engine hook. Have them rotate the MT until the hook enters the slot, and slide it the rest of the way in.
4. Gluing the MT into the fin can (actually, clamping it there using the green tube) is about the only step in which you can make an error that ruins the kit (or at least causes much in the way of field hacking.). The green ring has to end up tight against the fin can, which is itself tight against the black ring on the MT. The directions show one way to do it, but IMO there is an easier way
  - . Have them slide the green ring on the front of the blue tube, but only partway.
  - a. Have them push the MT all the way in (or confirm that it is already there). Show them how to hold it in one hand with the thumb on the aft end of the tube and the fingers on the fins.
  - b. Have them apply glue TO THE BLUE TUBE as close to the fins as they can.
  - c. Have them push the green tube down quickly and without stopping. In my experience, putting glue in the green tube, instead of on the blue tube, ensures that some of them will get stuck partway down, making for a loose engine mount.
5. Glue the BT onto the green tube the same way. Put the BT on partway, apply glue to the bottom of the Green tube, and then slide the BT on the rest of the way without stopping until it is hard against the fin can.
6. THEN glue the LL [Launch Lug] on. Place the rocket on a flat surface, so that it rests on two fins at one end and the forward end of the BT on the other. Now glue the launch lug on top, so that the aft end is even with the fin leading edge. In my experience, drawing a line isn't really necessary--kids that can't eyeball the LL straight when they glue it on top are going to need help drawing and using the line anyway.
7. Tie the SC [shock cord] to the NC [nose cone] and the Parachute to the SC. The rocket is ready to take to the field--but the kids aren't.
8. Use a \*large\* xeroxed copy of the safety code, and review it with the kids. You can tell them that many of the items (such as assuring stability, and using electrical ignition) are taken care of by the kit and the launch pad they are using. Other items, such as retrieval

from trees, need more explanation. When you are done reviewing the safety code, get them to all sign it, showing that they understand it and intend to follow it.

## **Group flying sessions with younger kids (6 through about 10).**

You can count on being able to launch 30 rockets or more in an hour, but planning is necessary!

The trick is to figure out what kind of throughput you'll need, and prepare for it. For a launch with younger kids, when most are doing this for the first time, figure you can do one launch cycle in 10 to 12 minutes on average. This results in about 5 cycles per hour. If you have ten rockets, you'll need two pads and controllers to match. If you have 24 rockets, you'll need five or six pads. A decent multi-pad controller with continuity checking, a big battery to reduce misfires, and some large pads (build them cheaply with PVC) make for excellent reliability and good capacity. I like to put 100' between the pads and the firing console, for several reasons

- First, it absolutely assures that you have a good view of the pads and the cleared area around them. With big crowds of kids, it is easy for someone to get excited and wander too close.
- Second, it helps provide an additional safety margin for those first rockets. Although I've never seen one go unstable, separations are not uncommon.
- Third, it enables the kids to follow the rockets much more easily. It is hard for kids to track E2Xs when standing almost underneath them, especially if you are able to allow launches on B or C motors.

I have attended launches in which more than 100 kids were involved, and the pads were 15' away, and it was a bit too crazy for my tastes.

In preparation for the launch, set up a wadding station, a motor station, and an ignitor station. Try to have an adult per station, but worst case, an adult can supervise all three simultaneously.

Before rockets are prepped, discuss safety again. Make sure everyone understands that they are a deputy safety officer, with the authority and responsibility to shout "HOLD!" if they see airplanes, people on the field, or other unsafe conditions.

Assign the rockets to racks based on the number of pads you have. Figure on about five or six racks per hour. Call the kids associated with rack one up to the wadding station.

If the rockets have not been RSO'd, do that first.

Demonstrate how to insert wadding. From then on, every kid should be expected to do their own.

Demonstrate how to fold and insert the parachute. Remind the kids that while it is hard to wind the shrouds around the chute too tightly, it is easy to have the chute be too tight in the BT. Once everyone has done that, demonstrate motor installation.

Demonstrate ignitor installation.

When everyone in Rack 1 is ready to go, bring them out to the pads and load and hook up their rockets. Meanwhile, get the Rack 2 fliers started on their preparation.

When the first rack is ready to go, stop the preparation, and make sure that everyone gets to watch every launch.

As the rockets are launched, give nothing but praise, while explaining the reasons for any anomalous behaviors. E.g., "The chute looks like it tangled, but that sure was a high flight."

## **Contests**

**Spot landing.** You can launch an E2X of your own first, and mark that spot with a flag. Closest rocket to it gets its team a prize.

**E2X parachute duration.** If everyone is flying the same size motor, you can run a duration contest. Be sure to explain the rationale behind a duration contest like this--in order to win, the rocket has to be built strong, light, and straight, the chute made and folded well, and ejection has to occur near apogee. Let everyone join in timing the rocket, starting at lift off. YOU might get tired of "ONE one thousand, TWO one thousand, THREE one thousand..." but the kids won't. You will have to lead the count, though, perhaps by waving your arm like a metronome. Otherwise the kids tend to accelerate the count. 30 seconds is a good number to get on a standard Generic E2X with a 12" chute and a 1/2A6-2 motor (if you can get those).

## **Demonstrations**

You may be asked to give a demonstration launch for a school class. As always, preparation is important--the trick is to be able to launch a lot of rockets in a very short time. Once again, a multiple pad controller will be a big help.

No matter what the age group, the launch should be educational. One technique is to ask a question, and demonstrate the answer with a launch.

## **Sample questions**

- What would make one rocket go higher than another? (then launch rockets that differ in weight, drag, or motor size)
- Does a rocket need fins to fly? (then launch a tube fin rocket, or a saucer)
- What makes a rocket veer into the wind? (then launch rockets of different stability)

## **Other options for demonstrations include**

Something big, low, and slow, such as a Saturn 5, a Venus Probe, or even a 3D cluster that is heavy or draggy enough to stay low. The cluster option provides lots of special effects-- noise and smoke and is big enough for kids to see the whole flight easily, even if you have them far away from the pads.

Camera rocket. Have the kids look up and say, "Cheese!". You might even get a picture of them, but whatever picture you do get, send it to the school after the launch.

Varied recovery systems. A rack consisting of rockets of about the same size and weight but with streamer, parachute, helicopter, and glider recovery will allow you to demonstrate a lot of aerodynamic principles in a short time.

Same rocket, different motors. This is especially effective when you can use widely different motor sizes Launch a Broadsword on a B6-2, and another one on an E18 RMS.

Same motor, different rockets. Alternatively, you can launch a Broadsword on a C6-3 and a Ninja on a C6-3.