# Little Joe

A free 1:31 scale model of the Little Joe and you can print everything out on your desktop inkjet printer from PDF files

It's pre-Little Joe II, but they didn't call it Little Joe One. In fact, this particular model is Little Joe 6, which was actually the second launch on October 4,1959 from Wallops Island. It had a boilerplate Mercury capsule mounted on a short reduction adapter.

After building a free paper rocket (M104-Patriot), a couple of limitations/peculiarities were revealed in paper models. One of the primary goals in creating a new model was to start with a design that has no compound nose cone curves. The Little Joe also has fins that are dimensional, which means they can be built out of paper and still retain rigidity. The original Little Joe fins are longer than the Little Joe II. It looked more stable, and so it turned out to be. No weight was needed in the nose.

Reference Numbers
Center: LARC
Center Number: L-1960-00104
GRIN DataBase Number: GPN-2000-001270

Source Information
Creator/Photographer: NASA
Original Source: DIGITAL

Materials include 5 sheets of Canson Vellum Bristol 2 ply 8.5x11 (14x17 cut in half to go through a letter size printer), 1 sheet of Grafix silver metallic film (grafixarts.com), Minwax Polycrylic Clear Gloss Protective Finish (although a satin or matte finish would be closer to scale), white glue, a shock cord, some 1/8" dowel, a little red and white paint, a red marker, and some toothpicks. The Bristol and silver film are available at artist supply stores. Skill level 3.

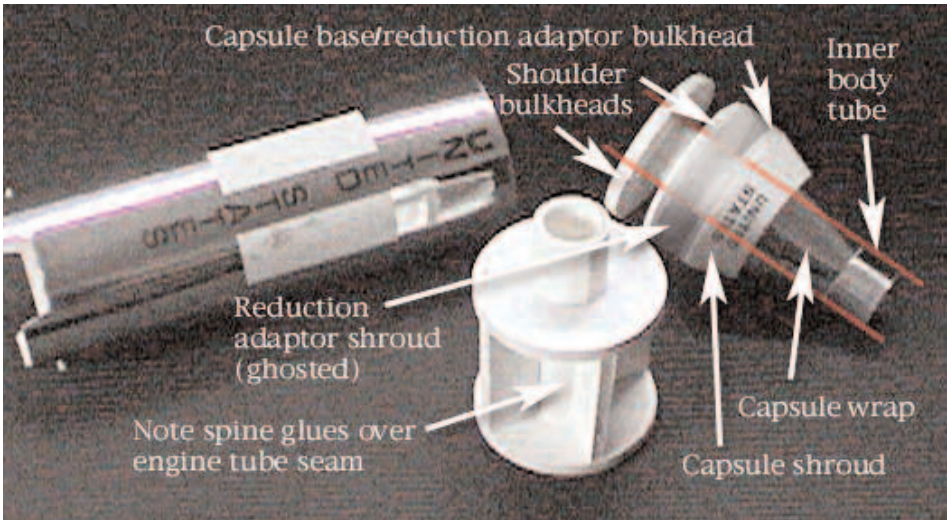
If you're a paper purist, you could build this model without the metallic film or paint (using just a red marker). A PDF of the body with simulated metallic shine is included for this purpose (non-foil option.pdf).

The decision was made to use separate glue tabs (from scrap) on all of the body tubes and shrouds rather than attached tabs because they look better. The only exception is the fins because integrated tabs work great there. Scrap paper (in between the thickness of the Bristol and copy paper) was used for the glue strips. The Bristol 2 ply paper is .015" thick. The metallized silver material is .004" thick.

One option considered in the design process is a Strathmore Metallized gold paper #59802 (for the body wraps) that has an emulsion applied at the factory to allow inkjet printing. It doesn't have adhesive, so it would have to be glued on. It would

look great and be easier, but finishing in silver is closer to scale.

The wrap material is a silver-colored metallized film from Grafix. It's manufactured with adhesive on one side and a mirror finish on the other side. In order to print from an inkjet printer, it must have an emulsion added which adheres to the metal, but also allows water-based ink to dry. To accomplish this, a water-based acrylic polymer from Minwax was brushed on with a soft brush. A few small bubbles were carefully stroked out immediately while it was still wet. It has a milky look when wet but dries clear and glossy. After letting it dry for two hours, it was printed. The printer is a year old, and because the rubber rollers had some "gotcha" gunk buildup, the slightly-still-tacky polyacrylic cleaned off the rollers. You may want to run a sheet of paper with polyacrylic or clear acetate with polyacrylic through your printer to clean off the rollers before doing the wrap. Of course, you put anything that's slightly tacky through your printer at your own risk. The gunky printout was used for the prototype, not only to save money, but because the final product has that "used-and-abused" Star Wars look rather than a pristine new look. The inkjet print then dried overnight (petroleum-based clear coats like enamel and urethane won't work because the water in the ink has to be absorbed into the emulsion). The final product is pretty good. A slight "gotcha" is that, while the ink doesn't smear and isn't tacky, it is extremely sensitive to re-wetting with moisture on the hands and is untouchable with any kind of snow, rain, or water-based cleaning solution. The gray printed areas in the attached pdf were darkened because the prototype wrap turned out somewhat light, which is a problem primarily because of the high reflectivity of the material.




The motor mount is first to build and is straightforward. The engine tube is a 78x85mm piece of scrap Brystol. One of the spines glues over the motor tube seam, so you don't even have to add a paper glue strip to the engine tube. The engine block is simply a 3/16" strip of scrap Bristol wrapped around an approximately 1/2" cylinder a few times until the outer diameter fits snugly into the engine tube (allow white glue to dry a few minutes before installing). The engine tube is long enough to accept an E9, but the prototype probably won't ever fly on an E because of the excessive spin (see fin tips). Besides, it goes pretty high on a D. A 25mm piece of empty D engine casing is added as a spacer to fly on D engines and in addition, an adapter is added to fly on 18mm motors.

The body tube is then printed and glued together with a glue strip, then the completed motor mount glued in. Test fit and sand the motor mount to accommodate the main body tube glue strip. In the photo to the left it's shown having an out of body experience after wrapping, but it can be glued at this point as it provides added rigidity for wrapping and fin gluing.

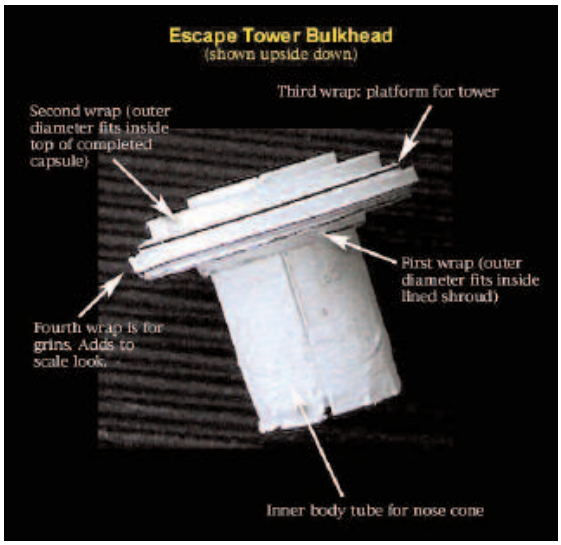
The metallized wrap is then added. It's slightly longer than the paper inner body tube to compensate for materials thickness. On the prototype, the seam is within a hair's breadth, with no overlap. There's an alignment line printed on the inner paper body tube to enhance wrap alignment. The metallized material starts to loosen and sag around the motor mount area after 3 launches; adding some spray glue like Super 77 to the body tube before wrapping may eliminate or reduce this problem.

Next is the Mercury capsule. General description: It's composed of 2 identical bulkheads around which the nose cone shoulder is glued, and which the larger diameter of the reduction adapter abuts. A slightly smaller bulkhead is provided for the capsule base/reduction adapter joint. Sand the bulkheads smooth and round. Before beginning glue assembly, add the shoulder wrap to test fit into the main body tube and sand the shoulder bulkheads if necessary to loosen fit and to accommodate the glue strip on the inside of the main body tube.

The inner body tube of the Mercury capsule is built first (glue tab). The capsule shroud follows (glue tab). Slide the capsule shroud onto the inner tube from the front with glue around the inner tube at

the contact joint (printed on tube). The reduction adapter is assembled next by first making the reduction shroud (glue tab), gluing it onto the slightly smaller forward bulkhead (allow 1/32"of the bulkhead to protrude forward to seat the base of the capsule shroud), then the rearward bulkhead (allow most of the bulkhead to protrude to mount the nose cone shoulder). Slide the assembled reduction adapter onto the inner tube (from the rear) to test fit, then glue around the inner tube and with a small amount of glue seat it inside the capsule shroud base. The rearmost bulkhead is then added and the shoulder. The silver wraps must be added to the capsule last (see notes in the PDF file). The heat shield is simply a series of progressively smaller strips of Brystol carefully glued to the outside of the capsule/adapter joint.


Conceptually, the most complex aspect of this model is the bulkhead the escape tower sits on. The inner nose cone body tube is made first (glue tab) and then the smallest diameter wrap starts around it. It's got 4 different widths (and hence 4 progressively larger diameters) of wrapped Brystol in order to (1) fit outside the bottom end of the small nosecone inner body tube and inside the base of the lined shroud surrounding that tube, (2) fit inside the lower body tube (the upper end of the completed capsule), (3) extend out to provide the mounting platform for the escape tower and (4) provide a smaller step to give a visual reduction for a scale look. Carefully examine photo before starting. Test-fit each diameter into the respective tubes and shrouds and tear off the wrap when you've achieved a good fit.




After the bulkhead is colored with marker, the lined shroud is made (glue tab) and glued on and the nose cone is made (glue tab) and glued on. The finished bulkhead and nosecone assembly can then be glued into the top of the capsule. The nosecone body tube circumference (which protrudes 1/32" from the front of the shroud so the nose cone can be glued) had to be sanded down for a good fit inside the nosecone on the prototype.

The escape tower scaffold was constructed from 1/8" dowel for the 3 main struts and toothpicks for the cross struts. It has 3 main struts that are 3.75" long including the split lower pieces. The prototype is very sturdy, has survived 4 flights, and looks good. It takes a couple of hours to make, but the end product is worth it. However, if you're interested in trying a paper model for the first time using these plans but don't want to invest the time in the tower (or would like to put it off), you are encouraged to do so. It'll look and fly great without the tower.

The fins are easy to build, but here are four tips: Before folding, score with a tool that is small enough to be accurate but doesn't cut. A jeweler's screwdriver with a slightly rounded tip (sandpapered) works great. Insert a small piece of flat aluminum or a small ruler to provide support inside the fins while gluing the tabs. Add a piece of 1/4" foamcore at the root edge (recessed by 1/32" to allow for the curvature of the body tube) for enhanced rigidity. And do not force the corners of the seams together, but allow them to fit according to their natural fold. If you try to force the corners to fit perfectly, you wind up with warp and hence spin. This is the biggest gotcha and in fact it would be best to test-build a couple of fins to get them right before doing the final fins. It's only paper.

The only paint is a little

flat white on the 4 panels on the main body and the red on the escape tower scaffolding. The red on the heat shield and escape tower bulkhead is marker.

One of the pieces of scrap foamcore from the bulkheads is sanded (to account for the thickness of the inner body tube of the capsule) and glued inside 1/16" from the lower end of the inner capsule body tube. Epoxy a screw eye into the center for one end of the 3ft. shock cord and fasten the other end with a folded paper mount. Or Kevlar on the engine mount.


The RockSimulation indicates that a C11-3 will deploy a little early and a C11-5 a little late. I used a C11-5 (5/8/05) on the first two flights, with ejection at 1 second past apogee (~450 ft). They're beautiful flights, perfectly straight, but with a significant amount of spin. We're talking 10 cycles per second or so. No damage on either flight. The first was with a 21" mylar parachute, and it was too much, so I went with an 18" for the second flight, and was able to catch the landing. The heat from the ejection charge has begun to shrink the body wrap toward the top of the seam, so I'll add a little liquid CA to try to reduce or eliminate that. Also, there's a significant amount of ejection charge residue all over the body, but it actually makes it look more scale, so I'm not cleaning it. Third flight was on a D12-5 (C.R.A.S.H. 5/21/05) with ejection just before apogee (~800 ft.). The parachute was a little sticky and stuck together, hence a quick descent with one floppy fin which was easily fixed. The fourth flight was with a C11-3 (COSROCS 5/28/05), and deployment was just before apogee, but no chute damage occurred and it was a beautiful flight.

Recommended engines are B4-2, C6-3, C11-3, C11-5, D12-5, E9-6.

This is a great looking scale rocket that gets attention and flies high. An E9 would be spectacular if you could get the fins straight (~1200 ft.). The shrinking and sagging of the metallic wrap is a problem. If you have some or most of the materials, it's free. Even if you have to purchase some of the materials, it's fun and inexpensive.

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