

# Building an “Egg-Lifter” Payload Rocket

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## **Building a Rocket for Carrying a Delicate Payload**

The rocket will have four sections. Starting from the bottom, they are the (1) Fin Section, (2) the Avionics Bay (AvBay), (3) the Payload Section and (4) the Nose Cone.

These are based on a 34" T80 Body Tube being cut it into three sections – from the bottom, up: 16", 1" and 17". If you have an additional 1" piece of the same T80 body tube, you will only have to cut the 34" main tube once, into two 17" sections (recommended).

**Note:** These directions are not as specific as those from a manufacturer like Estes, PML or LOC-Precision. Take the time to determine the right measurement for your needs. These instructions provide estimates only. Please read each step completely twice before acting.

### ***Assembling a Payload Rocket***

<b>Materials</b>	<ul style="list-style-type: none"><li>(1) 34" x 2.64" Balsa Machining T80 Body Tube</li><li>(1) 1" Piece of T80 Tube (It is preferred to take this from another piece of Body tube, but it can be cut from the above piece.)</li><li>(1) T80 Nose Cone (Ogive or Elipse, as you select)</li><li>(1) 4" long x 2.554" Dia. Balsa Machining -T80 Coupler</li><li>(2) Coupler Bulkhead – Model "T" (Fits Inside Body Tube, on coupler)</li><li>(2) Coupler Bulkhead – Model "C" (Fits Inside Coupler)</li><li>(1) 6-32 (Size 6 – 32 Threads per inch) All-thread rod at least 5" long</li><li>(4) Sets of 6-32 Hex-Nuts &amp; Fender Washers (1 Wing Nut preferred)</li><li>(1) 6" T52 (29mm) Motor Tube</li><li>(2) T52T80 MMT Centering Rings</li><li>(2) Threaded Inserts for 8-32 Screws</li><li>(2) 8-32 x ½" Machine Pan-Head Screws</li><li>(2) Motor Retention Clips for 8-32 Screws (or (1) Motor Retainer)</li><li>(1) 6" x ¼" Launch Lug</li><li>(3 or 4) Fins (Fiberglassing may be necessary, but is optional)</li></ul>
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	<p>(1) Parachute (Size as you choose) with Spill Hole cut to your specs</p> <p>(1) 24" x 1/8" Kevlar Strap</p> <p>(1) 9' (108") Elastic Shock Cord ( 1/8" – 3/8" wide as you choose)</p> <p>(1) 100 lb-test Fishing Swivel with hand-opened-snap</p> <p>(2) Medium Size Stainless Steel Wood-Thread Screw-eyes</p> <p>(2) Self-tapping Sheet Metal Screws</p> <p>(1) T20 Tube about 3.6" Long</p> <p>(1) Package foam padding (Pillow Foam, Air Conditioner Foam, etc.)</p>
<p><b>Step 1:</b> <b>Fiberglass Body Tube &amp; Fins</b></p>	<p><b>(Optional)</b> Apply fiberglass to the body tubes and fins. Sand with 100-grit paper and finishing sander. See <a href="http://www.astralisrocketry.com">www.astralisrocketry.com</a> "InfoBase" for detailed procedures on this technique.</p> <p>For a fin material like Balsa or Basswood, fiberglass may be necessary to make the fins strong enough to handle flight with F+ motors.</p>
<p><b>Step 2:</b> <b>Cut the Body Tubes</b></p>	<p>Cut Body Tube in 3 pieces – (from the bottom up) 16", 1" and 17".</p> <p>Take a 3" automobile hose-clamp and place it on the body tube at the cutting mark so that it is perpendicular to the length of the tube. Tighten the clamp firmly, but do not deform the tube.</p> <p>Lay the body tube on a cutting surface so that the hose-clamp closure hangs over the edge and use a stiff hand saw or Exacto Knife to cut through the body tube. Start opposite the closure and move the blade against the hose-clamp. When your cut reaches the closure, loosen it, turn the clamp around the body, and re-tighten it to get a smooth cut.</p> <p>When using an Exacto Knife, gradually cut the tube by scoring it repeatedly, going deeper each time – take care to keep your non-cutting hand out of the path of the knife when using this technique.</p> <p>Using one of the Body Tube halves, or another piece of similar T80 tube, repeat the process so as to cut a 1" band of body tube from it.</p>
<p><b>Step 3:</b> <b>Build Upper MMT CR</b></p>	<p>Take a MMT Centering Ring and install one of the screw eyes in it, centered in the wood between the Motor Tube Hole and the Edge. Fasten the Screw Eye permanently with epoxy from both sides.</p>
<p><b>Step 4:</b> <b>Build the Lower MMT CR</b></p>	<p>Take the other MMT Centering Ring and rest it on a "scratch" block of wood. Drill two evenly spaced holes on a line. SIZE of holes should match to size of threaded inserts. LOCATION of holes should match to your retention system.</p> <p>Install each threaded insert so that the open end is flush against the</p>

	<p>surface of the ring. Put grease inside the threads and epoxy in place from the back side, making sure to not get epoxy on the threads. Motor retention will be secured here.</p>
<p><b>Step 5:</b> <b>Prep MMT &amp; CR's</b></p>	<p>Sand the outside of the motor tube using 80-grit sandpaper to roughen the surface where the Centering Rings will contact. Sand the inside edges of the Centering Rings. Brush away all dust from all surfaces.</p>
<p><b>Step 6:</b> <b>Assemble MMT and CR's</b></p>	<p>Place Centering Rings on Motor Tube so the Upper Ring is 1/8" from the Motor Tube end and the Lower Ring is 1/4" from the Motor Tube end. The Upper Ring has the Screw Eye facing upward. The Lower Ring has the open ends of the threaded inserts facing downward.</p> <p>Stand the tube so that the Screw Eye is up. Place masking tape on the tube-ring joints <u>below both rings</u> to hold them in place for the next step.</p>
<p><b>Step 7:</b> <b>...cont'd...</b></p>	<p>Epoxy the upper surface of both Centering Rings to the Motor Tube and allow to dry completely. JB-Weld or 15-minute (or longer) epoxy is recommended here. JB-Weld is ideal for high heat applications.</p>
<p><b>Step 8:</b> <b>...cont'd...</b></p>	<p>Remove the masking tape and turn over the assembly so the screw eye rests over the edge of a table. Epoxy both up-facing surfaces of both Centering Rings to the Motor Tube and allow to dry completely. <u>Be careful</u> to not get any epoxy in the threaded inserts.</p>
<p><b>Step 9: Attach Recovery Strap</b></p>	<p>Attach Kevlar Strap to the Screw Eye and tie a permanent knot. Use epoxy on the knot to make it stronger.</p>
<p><b>Step 10:</b> <b>Install the MMT in Body</b></p> <p><b>NOTE:</b> <b><i>You must apply epoxy twice in this step before the epoxy dries.</i></b></p> <p><b><u>So, practice the step completely without epoxy before doing it with epoxy.</u></b></p>	<p>For this step, 30 minute epoxy (or longer) is recommended.</p> <p>Take the Lower Body Tube and roughen its inside surface from one end to about 6" up with 80 grit sandpaper. This will be the bottom end of the section. Brush away dust.</p> <p>Lay the Lower Body Tube on its side and feed the Kevlar Strap through it from the bottom, so it extends out the top, onto the work table. Using a stick, spread epoxy generously inside the body tube, 1" up from the bottom, avoiding getting epoxy on the Kevlar Strap.</p> <p>While pulling the Kevlar Strap from the topside, slide the MMT 1/2 of its length into the Lower Body Tube and tilt it to one side. Now, spread more epoxy inside the Lower Body Tube at the bottom edge, going around, turning the body tube and adjusting the tilt of the MMT to get epoxy all around the Body Tube's inside surface.</p> <p>Now, slide the MMT Assembly fully into place so that the Lower Centering Ring is 1/4" inch inside the Body Tube and the Motor Tube is flush with the end of the Body Tube.</p>

	<p>Wipe away excess epoxy and stand the assembly up to dry. Check back regularly to clean epoxy that drips out the bottom. Let dry.</p> <p>When the epoxy is dry, turn the assembly over, tuck the Kevlar Strap inside, and rest the tube on its top end. Epoxy the bottom CR where the Body and Motor Mount Tubes touch the CR. Dry completely.</p>
<p><b>Step 11:</b> <b>Prepare Body for Fins and 6" Launch Lug</b></p>	<p>Using a 3-Fin or 4-Fin Guide, mark the Body Tube at its bottom edge.</p> <p>Using a Door-Jam or a Fin Marking Jig, extend the Fin Marks up the side of the Body Tube 1-inch above the length of the Fins.</p> <p>Place a mark at a point centered between two Fins and ½" below the TOP of the Lower Body Tube. This is for the Launch Lug guide.</p> <p>Using a door-jam or a Fin Marking Jig, extend the Launch Lug Mark down the side of the Body Tube about 7" (for 6" Launch Lug).</p>
<p><b>Step 12:</b> <b>...cont'd...</b></p>	<p>Using 80-grit sandpaper, roughen the surface of the Body Tube along the length of the Fin Guides and Launch Lug Guide and outward from the Guides ¼" to the sides. This will erase most of the pencil lines.</p> <p>Roughen the Face of each fin going up from the Root Edge ¼", for the length of the Root Edge and roughen the surface of the Launch Lug.</p> <p>After sanding, brush away all dust from all surfaces and re-darken the pencil lines using a Door-Jam or a Fin Marking Jig.</p>
<p><b>Step 13:</b> <b>Attach Fins</b></p>	<p>Attach all Fins one at a time using 5 minute epoxy and let dry completely before adding the next Fin.</p>
<p><b>Step 14:</b> <b>Build Fillets</b></p>	<p>Build fillets around the Fin Root base. Allow each set of fillets to dry completely before starting the next.</p> <p>The size and weight of the fillets should increase directly in relation to the increasing Average Thrust of the Motor Configuration you select.</p>
<p><b>Step 14:</b> <b>Fiberglass Fins to Body Tube</b></p>	<p><b>(Optional)</b> To add strength to your fins, fiberglass the Fins tip-to-tip to the Body Tube. For Basswood and Balsawood, this could be a requirement. For plywood, it's not required for F and G motors.</p>
<p><b>Step 15:</b> <b>Attach Lug</b></p>	<p>Attach Launch Lug on the Guide Line with 5 minute epoxy. Let Dry.</p> <p>Build fillets around the Launch Lug with 15 minute epoxy. Let Dry.</p>
<p><b>Step 16:</b> <b>AvBay Bulkheads</b></p>	<p>Roughen one surface of each Bulkhead disk with 80 grit paper. Brush away all dust from all surfaces.</p> <p>Take one <u>Body-Tube-Bulkhead</u> (<b>Model "T"</b>) and one <u>Coupler-Tube-Bulkhead</u> (<b>Model "C"</b>). The "T" bulkheads are larger in diameter. Mark each with a "T" and a "C". Each assembly consists of one "T"</p>

	<p>and one “C” bulkhead.</p> <p>Spread a quarter-size circle of epoxy on the center of the roughened surface of the Body-<u>T</u>ube-Bulkhead. Place the roughened surface of the <u>C</u>oupler-Tube-Bulkhead against the epoxy and center the disk.</p> <p>Check it repeatedly as the epoxy cures to center the smaller Bulkhead on the larger one. Repeat the process for the second set.</p> <p>Once both sets are dry, test-fit them in the ends of the Coupler Tube. Ensure that the Coupler Tube fits in the Body Tube with the Bulkheads in place. Sand and/or file to fit.</p> <p>Take both Bulkhead Assemblies and hold them together so they are centered on each other. Tape them in place with masking tape. Mark the center of one outside-facing surface with a pencil.</p> <p>Rest the Disks on scratch wood and use a drill bit which allows the 6-32 rod to slide easily through. Drill the center of the Bulkhead Disks and remove the tape. Sand/smooth surfaces &amp; brush away dust.</p> <p>Finally, choose one bulkhead assembly and mark it on the larger disk at a spot centered between the edge and the center. Epoxy a screw eye at the mark. This will be your Bottom Bulkhead Assembly.</p>
<p><b>Step 17:</b> <b>Prep AvBay Center Body Tube Ring</b></p>	<p>Take the Coupler Tube and the 1” Body Tube Ring.</p> <p>Place the Body Tube Ring on the Coupler Tube and center it vertically. Mark the Coupler Tube all the way around at both edges of the Body Ring. Remove the Body Ring.</p> <p>Using 80-grit sandpaper score the outside surface of the Coupler Tube between the marked lines, and the inside of the Body Tube Ring.</p> <p>Use a Dremel Tool or a file to grind small grooves in the outside surface of the Coupler Tube and the inside surface of the BT Ring, running from the top of the BT-Ring to the bottom. (Don’t go so deep that you weaken the tubes.) This will give the epoxy a place to collect in the very tight fit you are about to create. Brush away all dust.</p>
<p><b>Step 18:</b> <b>Epoxy AvBay Center Body Tube Ring</b></p>	<p>Prepare epoxy, paper towel and a garbage bag and 12” x 12” piece of wax paper. Wear gloves.</p> <p>Spread epoxy on the outside surface of the Coupler Tube between the marked lines (<u>Do not put epoxy</u> inside the Body Tube Ring). Slide the Ring onto the Coupler Tube. As you work it over the epoxy, twist it around repeatedly to work the epoxy under the body ring.</p> <p>Once it is centered, wipe away the excess epoxy with a paper towel and let dry on wax paper. When it is dry, test-fit it in the body tube. If</p>

	<p>epoxy is on the coupler, sand it off with 100-grit sandpaper.</p>
<p><b>Step 19:</b> <b>Altimeter Air Holes in AvBay Center Ring</b></p>	<p>The tape in this step aligns the drilled holes along a straight line and spaces them evenly. Perfect alignment and spacing is for looks only.</p> <p>For a 2.6" Diameter tube (T80), lay out an 8.3" piece of ½" masking tape on a cutting board. (Circumference = Pi (3.14) * Diameter)</p> <p>Mark 5 horizontally evenly spaced lines going from the tape's top edge to its bottom edge (about 1.6" apart – precision is not critical).</p> <p>Lift and wrap the tape around the Body Tube Ring so that its top edge is at the vertical center of the Ring, going all the way around.</p> <p>Using a pencil, mark the Body Tube Ring at each of the 5 spots where the line on the tape comes to the top of the tape's edge.</p> <p>Drill a 1/16" hole on the tape's top edge at each mark and remove the tape. These holes will allow air pressure to enter the Avionics Bay during flight so that the altimeter inside can record altitude.</p> <p>Take a file and/or a rolled piece of 150-grit paper and smooth the surfaces of the coupler tube and the holes.</p>
<p><b>Step 20:</b> <b>Altimeter Mounting Rod</b></p>	<p>Cut the 6-32 all-thread rod to a 5" length (1" longer than Coupler). This will be the Altimeter Mounting Rod.</p> <p>On the Rod, the top Bulkhead is permanent and the bottom is removable. The bottom Bulkhead <u>must</u> have the screw eye installed.</p> <p>Take one 6-32 Hex Nut and a Fender Washer. Install the Hex Nut about 3/8" down the rod. It must be far enough down so the Bulkhead Assembly and opposing securing hardware can fit on the rod.</p> <p>Install the Fender Washer flush against the Hex Nut on the short end of the rod. Hold it up so the Fender Washer is on top.</p> <p>Take the non-screw-eye bulkhead assembly and face the <u>larger</u> ("T") Bulkhead Disk upward. Slide the rod upward through the hole so the Fender Washer faces the <u>smaller</u> ("C") Bulkhead Disk. Install a Fender Washer and another 6-32 Hex Nut on the short end of the rod and tighten it down. Confirm it fits properly in the coupler tube.</p> <p>This side will be permanent and should be epoxied in place by loosening the assembly, working epoxy into all the surfaces and then tightening it again. The other side will be a similar configuration, but removable, using a wing nut instead of a hex-nut on the outside.</p>
<p><b>Step 21:</b> <b>Altimeter</b></p>	<p>Take the 3.6" long BT-20 tube and mark it with 4 or 5 pencil dots on a straight line, lengthwise, and evenly spaced. The first and last dots</p>

<p><b>Mounting Tube</b></p>	<p>should be about ¼” in from the respective edges of the tube.</p> <p>Drill a ¼” hole at each pencil mark.</p> <p>Cut a ½” piece of Foam to stuff in each end of the tube. In the field, install the altimeter in this tube with the altitude sensor facing the holes and the Foam above and below the device for padding and retention. Use a piece of insulated wire as a “shunt switch” to keep the battery circuit open until you are ready to load the rocket on the pad.</p> <p>Using two pieces of Electric Tape, affix the BT-20 Altimeter Retention Tube to the 6-32 rod so that one end of the tube is resting on the Bottom Bulkhead. Make sure the tape does not cover any of the air holes in the BT-20 Tube and don’t “crush” it, or the altimeter won’t fit.</p> <p>The Mounting Tube should touch the Bulkheads on both sides for secure retention, but should allow the bulkheads to completely seal the AvBay ends. Sand/File the tube to fit.</p>
<p><b>Step 22:</b> <b>Pressure Release Holes</b></p>	<p>The two holes below will allow pressure to vent in &amp; out as parts are installed or separated. This allows easy assembly and disassembly, and easy separation during recovery deployment.</p> <p>Drill one 3/32” hole in the Payload section 4 inches from the top and on the same line as the Launch Lug.</p> <p>Drill one 3/32” hole in the lower body section 4 inches from the top and on the same line as the Launch Lug.</p>
<p><b>Step 23:</b> <b>Securing Nose Cone and Payload</b></p>	<p>The Nose Cone and Payload section have to be secured. Small sheet-metal screws are used here, but other options are available.</p> <p>Use a small sheet-metal screw and a drill bit which is slightly narrower than the screw (The sheet metal screw has a significant role in “tapping” the hole when installed).</p> <p>Insert the Nose into the payload and the payload onto the top of the Coupler Tube / AvBay (Screw Eye <u>must</u> face down into Fin Section).</p> <p>Mark two spots on the Payload 90-degrees from the Pressure Release Holes. The first is centered vertically on the Nose Cone shoulder and the second is centered vertically on the AvBay shoulder.</p> <p>Drill holes at the two marks, through the Payload wall into the Nose Cone shoulder and into the AvBay shoulder. Sand/File holes clean.</p> <p>Tap the sheet-metal screws into the holes and remove them for later assembly. You may want to repeat the step on both sides of the Payload Tube, so that two screws secure the Nose and Payload from</p>

	<p>opposite sides at the top and at the bottom.</p>
<p><b>Step 24:</b> <b>Securing the Recovery System</b></p>	<p>Recovery Options (it is recommended that you try both): <b>(1)</b> Two parachutes allow the upper section to recover separately from the lower section. Each section has its own parachute. <b>(2)</b> As described below, the two sections are connected by a shock cord and recover together on one parachute.</p> <p>Attach the bottom of the 9' elastic Shock Cord with a permanent knot to the Kevlar Strap extending from the Lower Body Tube (Square Knot works well here). Use epoxy on the knot to make it permanent.</p> <p>About 1/3 of the way down from the top of the elastic Shock Cord, mark the cord with a pencil or "Sharpie" marker.</p> <p>Slide the fixed closure of the Swivel on to the Shock Cord from its top and tie it in place at the mark. Epoxy the knot to make it permanent.</p> <p>If you need weight in your craft, attach the shock cord to the AvBay Bulkhead Screw Eye with a quick-link. If you are minimizing weight, tie the Shock Cord directly to the screw eye without a Quick-Link. Epoxy the knot to make it permanent.</p> <p>Finally, attach the parachute to the shock cord swivel snap by opening the clasp, inserting all the shrouds and closing the clasp.</p>
<p><b>Step 25 (Flight Time):</b> <b>Securing the Motor</b></p>	<p>For single use motors, you will need to make upward retention. Most RMS motors have a retention ring.</p> <p><b>Upward Retention:</b> RMS Motors usually have a retention ring. For a Single Use Motor, use a 1/4" wide piece of cloth tape or Duct Tape. Wrap very tightly a 1/8"– 1/4" thick ring around the base of the motor.</p> <p><b>Downward Retention:</b> If weight needs to be minimized, create downward motor retention using masking tape. If you can afford the weight of 2 screws and 2 clips, slide the motor into place and install the two retention clips with (2) 8-32 screws. Another lightweight method is a 10" (or so) piece of insulated wire wrapped around the screw heads and back and forth across the motor nozzle after it is installed.</p>
<p><b>Step 26:</b> <b>Launch Site Things to Remember</b></p>	<ul style="list-style-type: none"> <li>• Have a stopwatch and flight log to record your flight data. Track the Rocket Hght &amp; Wght, Flight Altitude, Motor &amp; Delay, Flight Time, Parachute Size, Spill hole size, Egg Breakage.</li> <li>• Clean the residue from the launch rod with a piece of 150 grit sandpaper or a "scrubie" sponge <u>every time you fly</u>.</li> </ul>