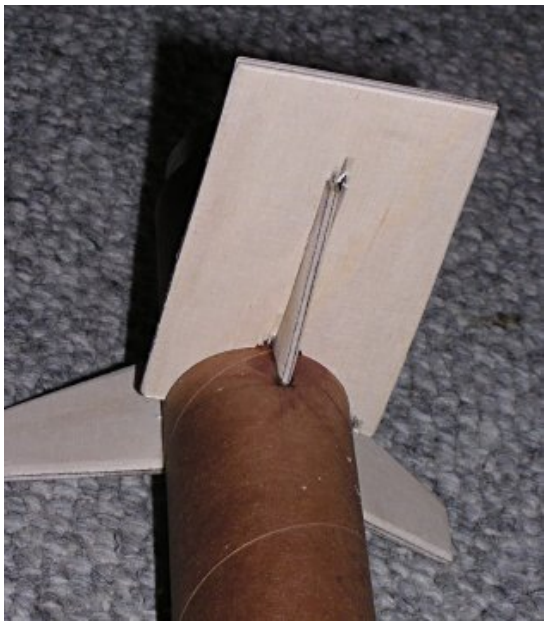
Building the Little Ripper

Builder: Ray Wilkinson

The Little Ripper is our first scratch-built rocket, and also our first rocket dedicated to a hybrid motor. In this case, it's built for our Sky Ripper G63. As the motor is slender (29mm diameter), we designed the rocket to be slim as well. It's built from 38mm bore motor tube. We had a nose turned from balsa, and designed the rest of the airframe to give a nominal length of 52 inches, although the motor retainer adds a little to this. It was designed using Rocksim, which predicts startling performance - over 2000 feet. Because hybrids tend to be long, the aft airframe was left as long as possible. This means that, although the G63 is only 300mm long, larger motors could be used in future.



Fin jig holds fin at correct angle to tube

Once the airframe tubes and motor mount tube were cut to length, the fin slots were marked and cut in the aft tube. Three centering rings were made from ply, and the forward and middle rings were epoxied to the motor tube. A length of stranded steel cable was wrapped round the motor mount, behind the forward centering ring, then passed through a slot in the forward ring - this would later be attached to the shock cord eye bolt, to ensure a firm attachment for the shock cord. The motor mount assembly was then epoxied into the aft airframe, ensuring that there would be enough of the motor tube protruding to take the motor retainer. The aft ring was omitted at this stage, to allow for epoxy fillets on each fin attachment. Next, the 3 ply fins were cut and sanded, then glued into the fin slots, using a home-made jig to make sure they were upright (pictured).

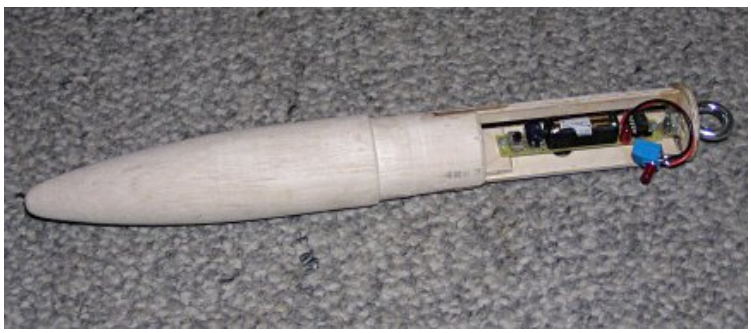
When all 3 fins were fitted, epoxy was run down into the small gap between the airframe tube and the motor tube, on each side of each fin, to provide strong fillets holding the fins in place. Further fillets were added on the outside, on each side of each fin root. This was to ensure the strongest possible attachment for the fins - a large motor on such a slender rocket could easily take it supersonic.

Motor retainer and rail guides fitted

When the fillets were dry, the aft centering ring was attached, again using plenty of epoxy, as this will be the primary load path for motor thrust, and will take the brunt of any shocks due to heavy landings. The motor retainer, made here in the University workshops, was then epoxied in place, and the rail guides fitted. Finally, the Sky Ripper vents out of the side during filling, so a hole was drilled at the correct place, and a small cardboard tube fitted to help with fitting the vent tube. A small vent hole was also drilled at the forward end, as the aft section is otherwise sealed.

So far, the rocket was similar in construction to the others we have built. However, using a hybrid motor meant that we had to make provision for ejection, since hybrids do not have a built-in separation charge. With solid motors, the parachute would be fitted just forward of the motor, but since we had to make separate provision for ejection, it was thought easier to put the altimeter bay behind the nose. The parachute then fits directly behind the altimeter bay, with the charge pushing the aft end of the rocket off the forward end, rather than vice versa.

The attachment of the shock cord to the aft end was then addressed. A ply bulkhead was made, with a snug fit in the airframe tube. This was drilled to take a good-sized eye bolt, which was glued and screwed in place. The stranded cables were passed through the bulkhead and the bulkhead epoxied into the tube, about 50mm down. Once the epoxy was dry, the cable was wrapped and epoxied round the base of the eye bolt. A section of round balsa was made up, then split and cut to fit round the eye bolt. Once epoxied into place, this became the airframe coupler.



Balsa nose, altimeter tray and rear bulkhead

The next stage was the forward tube. An altimeter bay was needed, together with space to hold the chute. A ply platform was fitted to balsa nose and a bulkhead attached to that. The bulkhead would be subjected to the pressure from the ejection

charge, and also would need to carry the shock cord, so an additional reinforcement was added. An eye bolt was glued and crewed in place, and the altimeter, a Transolve P7, was test fitted.

The bulkhead would need to prevent the pressure from the ejection charge reaching the altimeter, so a ply ring was fitted inside the forward airframe tube. An O ring will be placed on top of this before the nose is fitted, compressing the O ring and providing a seal. Two large holes were drilled in the tube, to allow access to the on/off switch and to see the LED for the altitude read-out. These also serve as vent holes. As they're quite large, any slight leakage past the O ring should not pressurise the inside of the altimeter bay significantly.

The final job, apart from wiring up the electronics and fitting the shock cord and parachute, was to spray the rocket. Three coats of UH purple were applied on top of 2 coats of primer. Two coats of clear varnish were then applied. Unfortunately, there was not enough time to fill and sand the spirals, as we were up against a deadline to be ready for April EARS, but perhaps this can be done later.

The finished rocket at 48 inches long (now modified to 52 inches)

Six metres of 500lb Kevlar tape were used for the shock cord, with a Sky Master 28-inch parachute. There wasn't much room for this and the ejection canister, and a trial fit found that everything was just too tight. The forward tube was cut about 50mm aft of the plywood ring, and a coupler made up by splitting a section of airframe tube. This was epoxied into the forward section and another piece of tube added, 4 inches (100mm) longer. This extended tube gives enough room for everything (just), and also makes it easier to check the O ring is properly seated. Just to be safe, it will be ground tested to ensure effective ejection before flying it.