Materials for Model Rockets

By Phil Charlesworth, UKRA

One of the basic problems that all new rocketeers experience knows which materials to use. This article is intended to explain the materials that are used to make model rockets, and where they are used. The list is not exhaustive, but reflects the most common materials and their properties.

The first lesson is that a rocket doesn't need to be heavy to be strong. Materials such as wood, cardboard and plastic are very good for making the bodies and nosecones. Not only are these materials really light, but they contribute to the safety of the design as they crumple on impact. This is very useful if things go wrong during flight.

Metals are only used where extreme strength is required, for example motor hooks and shock cord attachments. This is because metallic parts don't crumple on impact, and add a lot of weight to models.

Nosecones. There are many excellent nosecones on the market. Most of them are made from plastic or balsa wood, and are very strong for their weight. Plastic nosecones tend to be easier to paint and are normally hollow. This can be useful if you need to add any weight to the nose of the rocket for stability. Balsa nosecones are generally lighter than plastic so if weight is your main concern go for balsa. Unless you're planning on going at speeds of over 600 mph the shape of the nosecone will have very little impact on performance, so choose a cone that looks right. Specialist nosecones for carrying payloads such as eggs are available, but these can sometimes be hard to obtain.

Tubes. There are several inexpensive and strong specialist tubes that can be used in model rocketry. Spiral wound tubes from Estes and Apollo are purpose made for model rocketry. If you need a stiffer rocket then tubes with thicker walls are available from LOC. Forget using kitchen roll tubes or other domestic materials. They won't be strong enough to take the forces on a rocket and will crumple in flight.

Fins. There are three main materials that are used for fins: wood, plastic or fibre glass. Balsa wood is a very good material for fins as its strong and light, and perfect for rockets up to around D impulse. Balsa has a tendency to dent or split if it's handled roughly, and some rocket fliers use basswood as a stronger alternative. Some model shops stock thin plywood, which makes excellent fin material for rockets in the E to H impulse range. Sheet plastic can also be useful as a fin material in low power rockets, though it can be quite flexible which precludes its use for large fins. Fibre glass is very common for F motors and above as it is light, stiff and strong. Glueing plastic and fibre glass to cardboard tubes can be quite difficult, so most low and medium power rockets use wooden fins.

Centering rings & Bulkheads. These can be made from many materials. For low power rockets (up to C impulse) cardboard is generally strong enough. It's worth using a good quality card, 1mm thick, to ensure strength. Apollo does a range of fibre centering rings that are stronger than card and are very useful for A-D impulse

rockets. Plywood is a very versatile material. It comes in various thicknesses and is particularly good for medium power rockets and clusters. Get a good quality plywood from a hobby shop, not the stuff you get from hardware shops. For most medium power rockets in the E-G impulse range 2-3 mm thick ply is adequate.

Shock Cord. There are two excellent material for making shock cords: elastic and Kevlar. Elastic is cheap, widely available from sewing shops, and is very good at absorbing the shocks of a parachute deployment. It's only weakness is that it can get scorched by the hot gas for the ejection charge, and this can weaken it after a few flights. Avoid using elastic that is coated in synthetic materials and always go for cotton coated elastic. Kevlar does not stretch as easily as elastic, but has the advantage that is fireproof. It is more expensive than elastic, but will probably outlast the rocket! A good tip is to use Kevlar to anchor the shock cord inside the rocket, but use elastic as the main shock cord.

Launch Lugs. Launch lugs can be made from many materials. Card and paper are often use for small models. You can buy lengths of card launch lug for 1/8 inch and 3/16 inch launch rods. For ¼ inch and above its better to use a stronger material such as plastic or brass. Lengths of plastic and brass tubes are available from most model shops.

Motor Hooks. Standard motor hooks for 13mm and 18mm motors are available from rocket shops. They are inexpensive and easy to use. A cheaper alternative is to use the flat wire from old windscreen wipers. This cuts and bends easily, and can be made to fit your project exactly.

Parachutes. The parachutes that come with model rocket kits are made from polythene. They are not good quality and tend to burn or tear easily. For large, lightweight parachutes try experimenting with dustbin liners, space blankets and other plastic sheets. These can provide inexpensive parachutes, but will only last a few flights. Nylon parachutes are much more durable. They can either be bought ready made or can be run up by anyone competent with a sewing machine. Good windproof nylon can be bought from a few specialist supplier of outdoor materials. The parachute cords should be of comparable strength and flame resistance to the parachute. Kevlar string is very good for medium sized parachutes, and good quality nylon kite string is a good alternative.

Glues. A good way to start an argument in rocketry is to ask for an opinion about which glue to use. Opinions are divided, and generally rocketeers hold strong views about glues. The main glues used by rocketeers are white glue (PVA), yellow glue (aliphatic), cyanoacrylate, plastic cement and epoxy. It is very important to read the safety instructions on the packaging. The properties and uses of each are:

- White glue has many applications, and comes in many forms. It is particularly good on low power rockets for all wood, cardboard and fibre joints. It is also very useful for filleting joints as it doesn't shrink when it sets. Steer clear of the white glues from art shops as they tend to have very poor adhesion; Evo-Stik Wood Adhesive is about the best white glue on the market.

- Yellow glue is stronger than white glue for wood, cardboard and fibre joints. It tends to shrink as it dries, so it shouldn't be used for fillets. Titebond Original Wood Glue is very good, and has held many rockets together up to G impulse.

- Cyanoacrylate has a few specialised uses in model rocketry. Cyanoacrylate comes in various thicknesses, the most useful of which is "thin" as it runs easily into joints before it binds. Joints made with cyanoacrylate tend to be brittle, so it is generally not used for structural purposes. A small drop of cyanoacrylate is sometimes used to tack parts in place while slower-setting glues set. Thin cyanoacrylate is also very good for stiffening tubes and cardboard.

- Plastic cement is useful for bonding plastics, and not much else. Keep away from tubes of the thick glue used for making plastic models as these do not provide very strong joints. Humbrol Precision Poly is very useful for many plastics, and its applicator allows small amounts to be applied precisely where they are needed. A more useful alternative is EMA Plastic Weld which is painted onto the joints (with a plastic-free brush) and sets fairly quickly. The author has yet to find a plastic that EMA can't join.

- Epoxies are a two-part adhesive that can be immensely strong, but are tricky to use. Epoxy can join many materials, but it is best to scuff the surfaces with sandpaper to get the best joint. Epoxy can add a lot of weight to a rocket, and are generally unnecessary in low and medium power rockets. Epoxies come in a number of setting times from 5 minutes to two hours. As a general rule the epoxies with longer setting times will provide stronger joints as the resin will soak deeper into the joint before it cures. The NHP and Devcon ranges are good epoxies.

Other Materials. There are other materials that are useful in certain circumstances, and this section gives a few ideas.

- Foam board is a sandwich of foam between two layers of cardboard. It has been used successfully for low power centering rings, and lightweight flat surfaces. It is not strong enough to be used as a fin material on its own, but has been sandwiched between two sheets of balsa to make very thick fins. The foam can melt if it gets hot, for example the trailing edge of fins, but a smear of white glue along the edge of the board has been shown to significantly prevent melting.
- Bristol board is a cardboard made from randomly oriented fibres. Unlike normal card it doesn't have a grain so it can be made to crease in any direction. It is useful for decorative features, such as fake air inlets.
- Polystyrene foam has no structural uses, but can be useful for padding delicate payloads.
- Styrene sheet is not much use for structural components but is very useful for making alignment jigs. These jigs can be used to hold pieces in place while white and yellow glue joints set. The sheet can be cut with a craft knife and steel rule, then glued together with Humbrol precision Poly.

- Metal repair tape is a sticky-backed aluminium foil. It is very useful for protecting flammable parts neat the rocket plume, for example cardboard tubes and centering rings.