DESIGNING AND MAKING WITH PRE-COATED METAL

WHAT YOU WILL LEARN

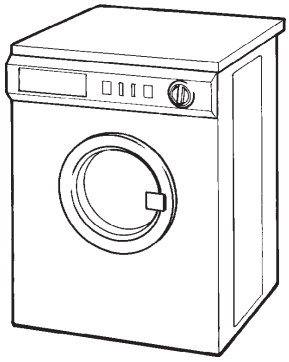
After completing this unit, you should understand:

- The importance of pre-coated metal in improving quality and reducing costs.
- How sheet metal can be given strength and rigidity by forming.
- How to mark out (and cut out) pre-coated metal.
- Basic methods of forming pre-coated metal.

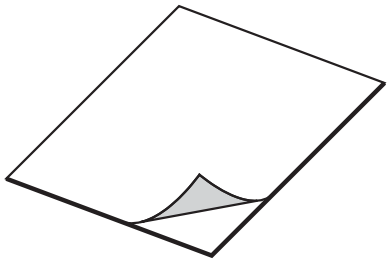
You should be able to:

- Work to a design brief and write a specification.
- Recognise design constraints when designing.
- Design and make products using pre-coated metal sheet.
- Making something that requires fabrication.

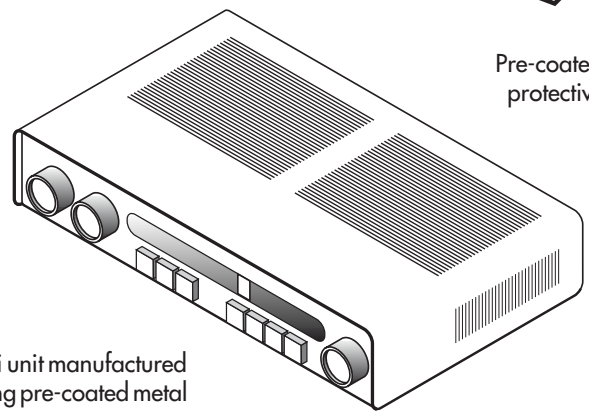
Traditionally, the metal sheet used in making products such as washing machines was formed into shape and then painted. Every manufacturer needed a "paint shop" which often used toxic materials and was environmentally unfriendly.



Pre-coated (or "pre-finished") metal sheet is now used to make a wide variety of consumer products. This has a tough and flexible coloured finish which does away with the need for painting after forming.



Pre-coated metal with protective covering

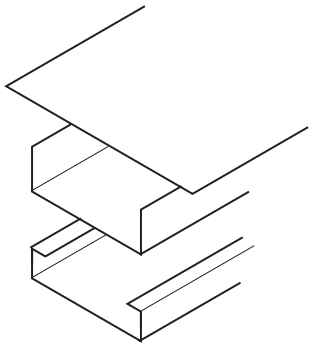


Hi fi unit manufactured using pre-coated metal

The advantages of pre-coated sheet metal include:

- **Cost** - without the need for a painting facility, manufacturers can reduce costs.
- **Time** - valuable production time is saved because the finished stage is eliminated.
- **Quality** - the coating process is carefully controlled, usually by computer. Pre-coating gives a quality "uplift" to finished products.
- **Environment** - pre-coating is environmentally friendly because many hazardous chemicals are no longer used in finishing processes
- **Design options** - designers can choose from a wide variety of finishes and they can specify finishes very precisely.

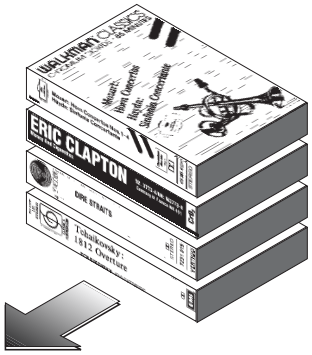
Pre-coated metal can be formed in a variety of ways *without any damage* to the pre-coated surface. For example, it can be cut, folded, punched, pressed - and rolled into complex sections.

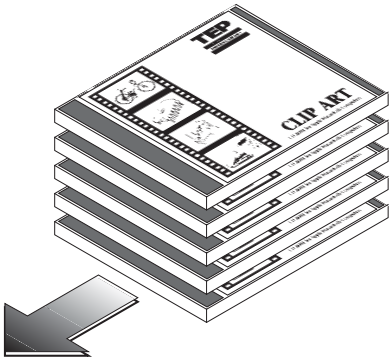


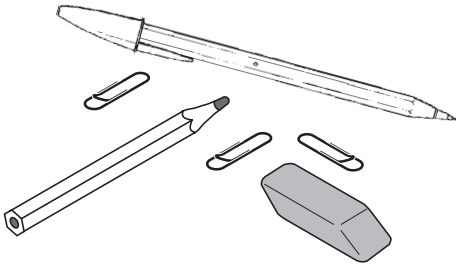
YOUR TASK

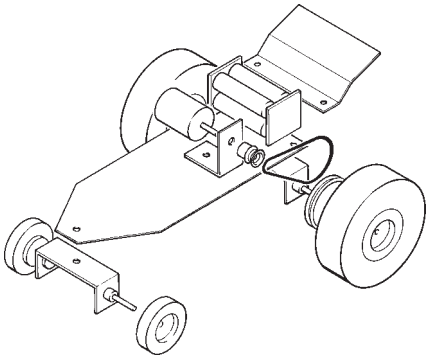
◀ DESIGN BRIEF

Design and make a three dimensional product of your choice that takes advantage of the properties of TEP's pre-coated aluminium sheet. You will need to do some research to come up with a need or context. Actual examples of use include: storage for CD ROMs, cassette tapes, point of sales dispensers, desk tidies, model chassis, fruit storage.









DESCRIBING YOUR TASK

SPECIFICATION

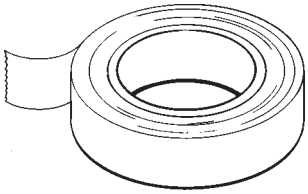
First, you need to draw up a design specification for your product. A specification is a more detailed description of what a product will be like, what it will do and who will use it. Here are some questions to help you produce your product specification:

- What is need for the product ?
- Who would use or benefit from the product ?
- Where would the product be used ?
- What would the product need to do; describe its intended function in some detail.

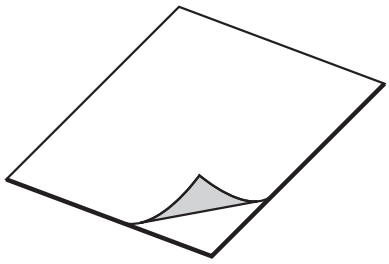
WHAT YOU HAVE TO WORK WITH

DESIGN CONSTRAINTS

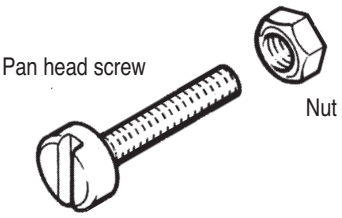
Before you can get on with any design work, you need to know what materials and other parts are available. You also need to know something about their properties and characteristics. The illustration shows some of the things available. You may have to find others.

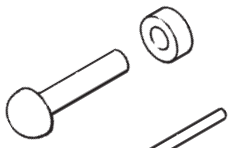


Adhesive tape

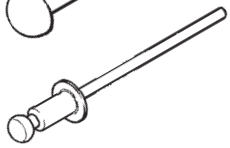


- Polymer pre-coated metal

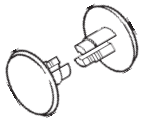




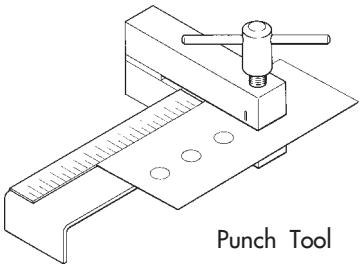
Two - part TEP rivet



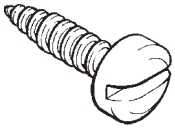
Pop rivet



Two - part bifurcated rivet



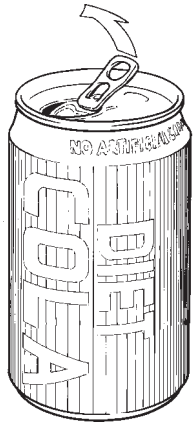
Punch Tool

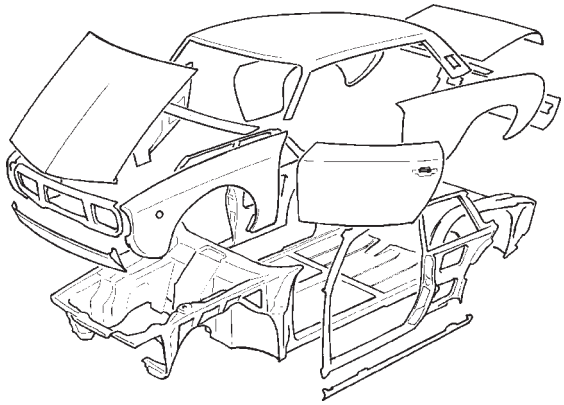


- Self-tapping screws.

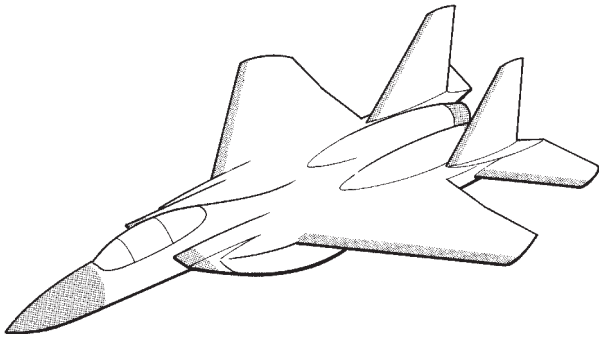
USING PRE-COATED SHEET

Thin flat sheet material of any kind is weak but can be formed into very strong structures. Examples range from the soft drinks can you can stand on (whose wall thickness is the same as thick paper) to car body shells of immense strength. Both of these structures get their strength from their geometry or shape.

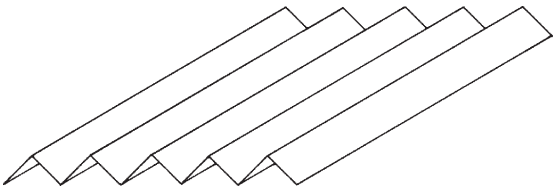


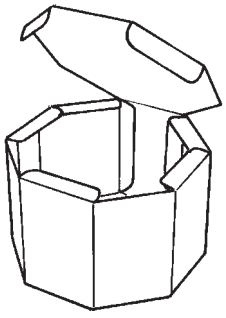


An aircraft is perhaps the most complex example of something which is made largely from thin materials - both folded and fabricated (parts joined together). You can probably make a long list of others if you think about products closer to home.



You can do several simple experiments to show how materials can be transformed by shaping them. A piece of paper (or any other thin sheet) can be made into a rigid plate that supports a load by folding it into a number of “V”s. It can also be folded into a box section and sellotaped. It is common to find thin metal sheet shelving folded over at its edges. This provides a combination of high stiffness and low weight.



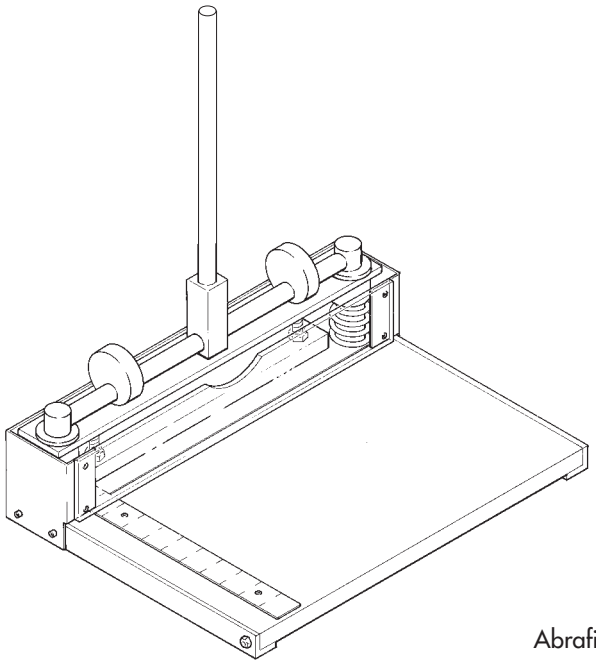


FORMING PRE-COATED SHEET METAL

TEP's pre-coated metal is 0.5mm thick and comes in a hard, springy condition and can be cut, folded, punched or pressed into shape. It is important to note that pre-coloured metal must be protected during a forming operation. If, for example, the press tool or folding unit is used, the sheet should be protected by paper on both sides.

CUTTING, FOLDING AND PRESSING SHEET METAL

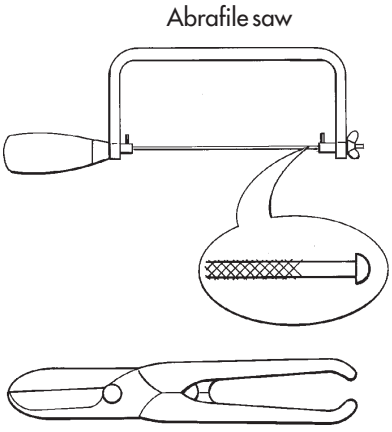
Sheet material is normally cut on a guillotine if possible. This produces a good straight edge without distortion.



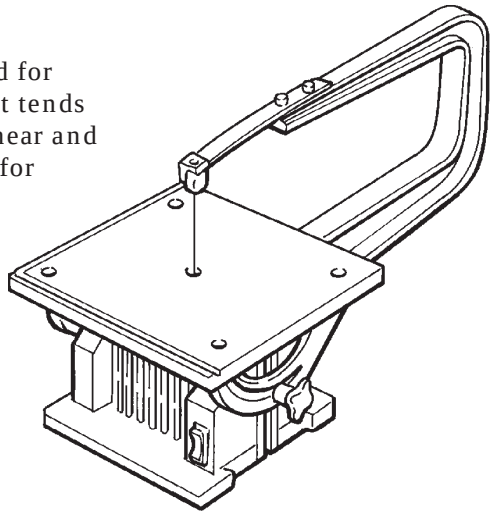
NOTE

TEP guillotine is capable of cutting up to 1mm gauge aluminium sheet or PCB material as well as plastic up to 2mm thick.

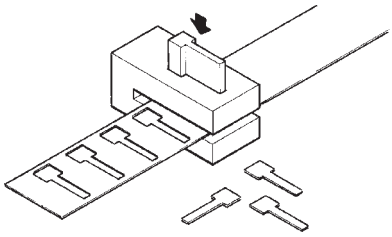
A PCB guillotine, shears or a saw can be used for cutting thin gauge aluminium sheet. Shears tend to distort the edge as they cut, so that after cutting the sheet needs flattening.



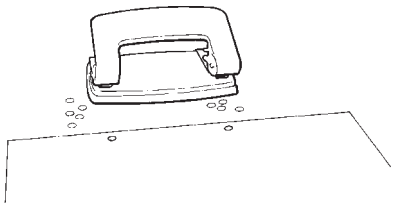
A vibrosaw can be used for cutting sheet metal but tends to be slow. Both the shear and saw methods are used for cutting round curves.



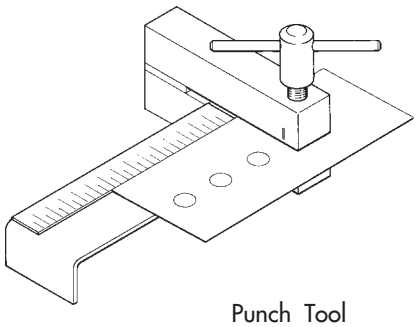
In industry, shapes are stamped out of sheet metal using a two-part stamping tool.



The hole punch used for stamping holes in paper for ring binders is an example of a two part tool. It stamps out discs of paper, although its main purpose is to make the holes!

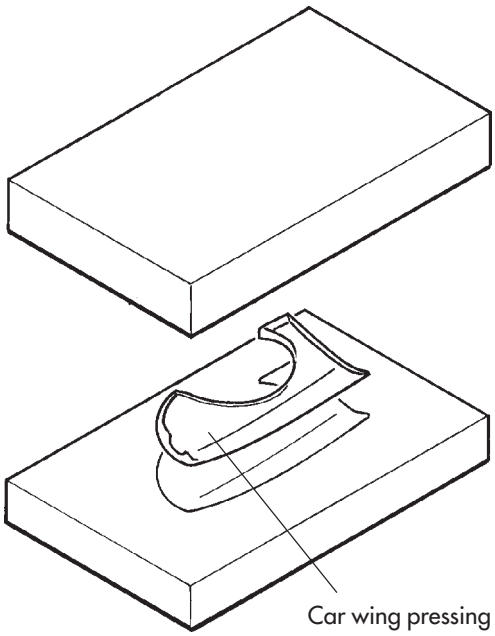


A strong paper punch can punch discs from sheet metal. The TEP punch tool offers an effective and accurate method of punching 4mm holes in sheet metal or plastic.



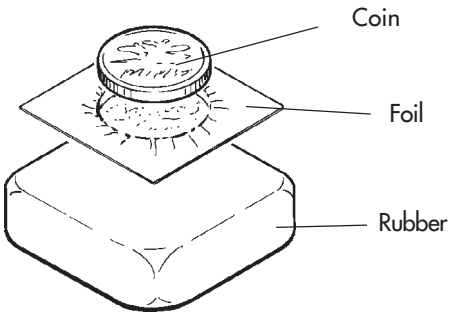
Punch Tool

There are many ways of forming sheet metal. A common way is to use a two-part forming tool one half of which is a mirror image of the other. Car body pressings are made using this type of tool.

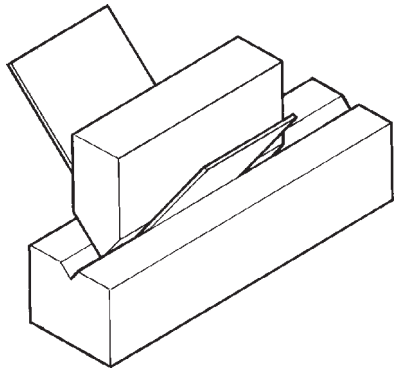


Another method of forming is to use a one-part metal tool like a shallow jelly mould and to press the metal into it using a special rubber block.

You can show this by pressing aluminium foil between a small coin and a pencil rubber.

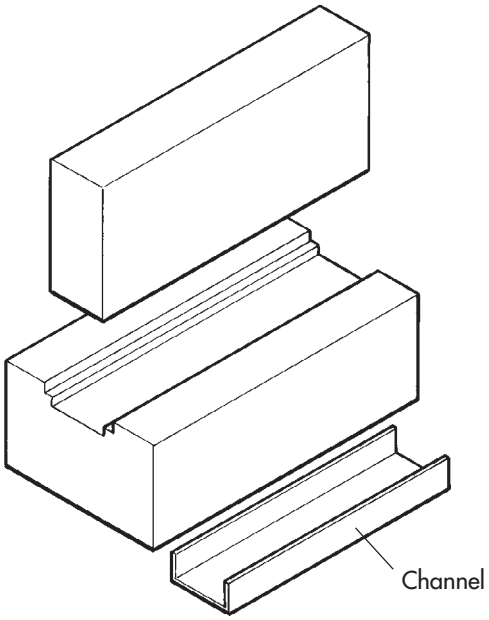


Often, sheet metal needs to be bent or folded along a line. This can be done using sheet metal folding equipment or a press tool. The illustrations show two press tools for folding metal.



In the first example the sheet is trapped between a 'V' section former and a 'V' section groove. (Sometimes the groove is replaced by a special rubber strip.) The angle of the bend given to the sheet depends on how hard the two parts of the tool are forced together. The pressure to make the tool work can be applied either in a flypress or in a metalworking vice.

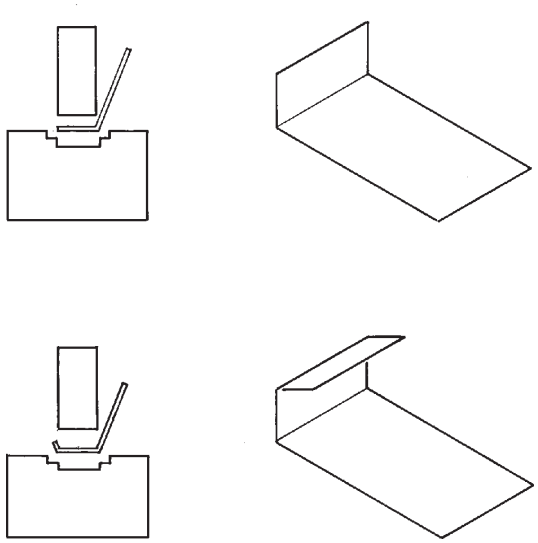
The second press tool is designed for several operations. If a strip of aluminium is placed along its length and the top press bar forced down, the strip folds up at the sides to create a channel.



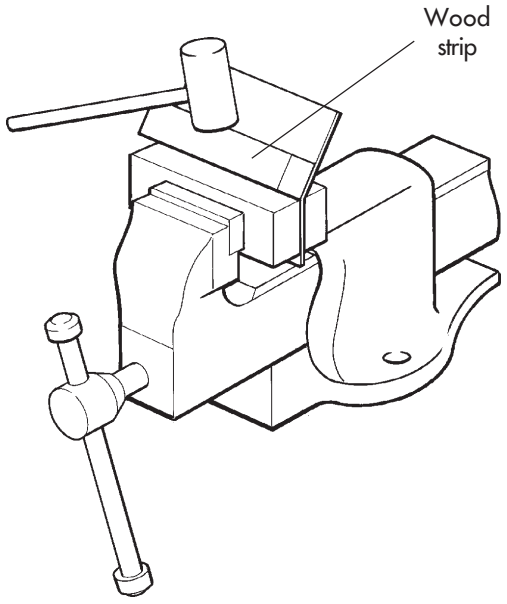
NOTE

The TEP 'universal' press tool comprises two extruded aluminium sections with locating pins. It will produce channel sections as shown or near 90° bends. It works very effectively with TEPs pre-coated metal.

Because of the strain hardening along the bends and the shape of the channel, the strip of metal is now much stiffer than it was originally. To bend one end of a larger sheet, place that end in the press tool. Depending upon how the sheet is placed, the result is either a plain bend or a bend with a lip (which provides more stiffness).



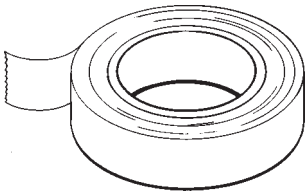
The angle of the bend depends on the clearance between the press bar and the bottom of the tool. The greater the clearance, the less the angle. If the clearance is fixed, the angle of bend depends on the gauge of the material being formed. If an angle of 90° is required and the press tool provides less than this, the bend can be increased by tapping with a mallet as shown.



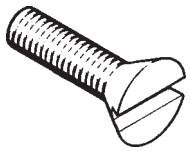
FABRICATION METHODS

Mechanical fastenings are used widely in metal fabrication. These include, screws and nuts, rivets (plastic and metal), and special patented fastenings. How you fabricate your design will obviously depend on the product and how it is designed. Increasingly, adhesive bonding is used for joining parts in industry - and this may present you with some excellent options. There are many advanced adhesives including:

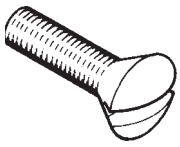
- Epoxy resins
- Structural adhesives - e.g. methacrylates
- Pressure sensitive adhesives



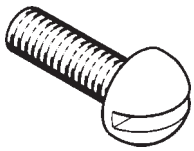
Types of fasteners



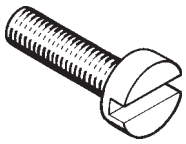
countersunk screw



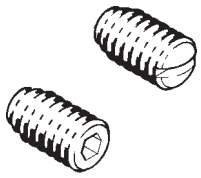
raised countersunk screw



round head screw



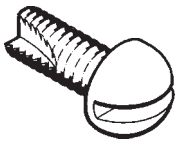
cheese head screw



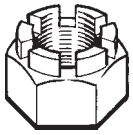
grub screws

hex socket or allen head screw

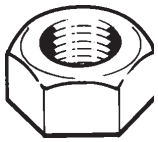
phillips or starret screw



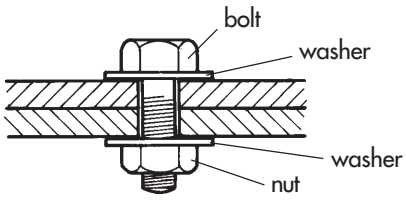
self tapping screw for plastics



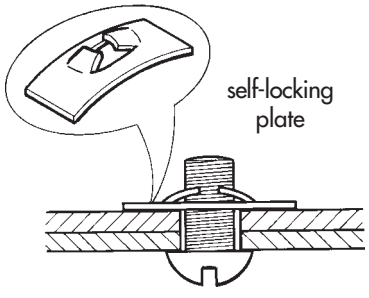
castellated nut



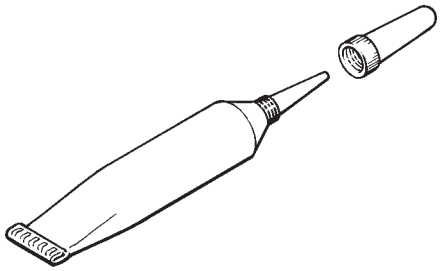
hex nut may be plain or with self-locking nylon insert



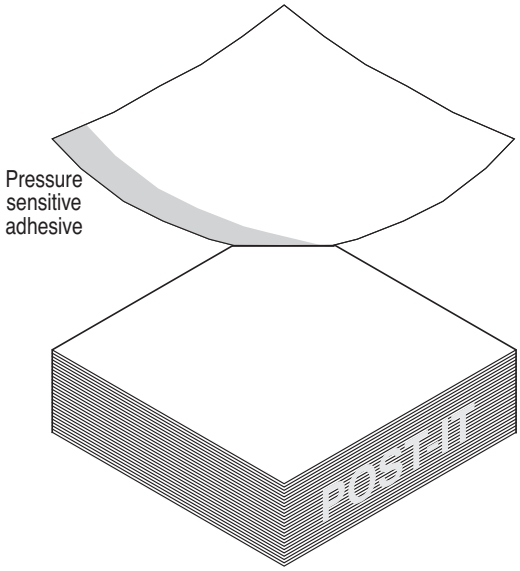
bolted assembly



Methacrylate structural adhesives are widely used. They can bond a wide variety of different materials, fill gaps and are not complicated to use. This type of adhesive is available as a one-part material whose curing can be accelerated, if necessary, by another chemical.



Pressure sensitive adhesives are those carried by a film - e.g. Sellotape, double-sided tape and even the new self-adhesive postage stamps. Pressure sensitive adhesives vary considerably in adhesive strength - e.g. from “post-It” notes to 3M’s ultra- high bonding (UHB) tape used to join aircraft parts together.



With pressure-sensitive adhesives, it is important to ensure that there is a reasonable surface area available and that the surfaces to be joined are cleaned - e.g. with methylated spirits. The double sided tape sold in most stationers has a rubber-based adhesive which is strong enough for most structural applications involving TEP’s pre-coated metal.

EVALUATING YOUR PRODUCT

There are a number of things to consider when evaluating the success of your design. Here are some important questions to ask:

- Does it meet the specification ?
- Does it use the pre-coated material effectively ?
- Is the product structurally sound; i.e. does it resist loads and forces ?