

Working with styrene.

Styrene has become well-established as a modelling material. It is unaffected by water, has no grain, and can be painted. It is available in flat sheets and structural shapes of different thicknesses and sizes. The most versatile is the flat sheet from which almost any part can be made.

Cuts - straight and curved.

Cutting styrene is a little like sailing a boat. With a knife, you don't so much cut the styrene as push it out of the way, as the boat does the water. And if you try cutting the styrene with a power saw, you'll probably find it melts together again behind the blade, as water runs together behind a boat.

You can cut styrene with a knife. You can either score it and snap it, or cut it right through. A small box cutter is very convenient because the cutting edge can easily be restored by snapping off the end. A craft knife has the advantage that it is slightly easier to control because the blade is fixed firmly in the holder. In pushing through the styrene, the blade forms a ridge either side of the cut. This can be removed in a couple of ways; either by running the back of the knife along the edge, or by extending the blade in a box cutter and bending it down on the styrene so that the cutting edge lies flush, and then skimming it along the sheet at the edge, cutting off the ridge.

Another way to cut styrene is to use an Olfa P-800 plastic cutter knife. This actually removes the styrene as it makes the cut and does not leave a ridge. It does leave an angled edge to the cut, which you may not want.



A good pair of scissors will cut styrene up to 0.030" thick. A pair of pruning secateurs are useful for cutting the structural sections.

Working with styrene

It is easy to cut straight lines by using a rule as a guide. A steel rule with a cork backing minimizes the chances of the rule slipping as you score the sheet styrene. Curves which are arcs of a circle can be cut using one of the tools mentioned in the pages that follow.

Curves which are not circular arcs are more difficult and, if you are not comfortable doing it freehand, one of the most useful tools is a set of French curves. They are templates which comprise several different radii. They come in two typical styles, one of which is shown below.



The other style consists of several rules of quite large radii, and look like straight rules which have been only slightly bent.

It is a little more difficult to cut 0.060" thick styrene. One of the better ways, and maybe the best, is to use a sheet metal shearing tool, such as the Eclipse Goscut 2000. This tool actually shears a slot in the plastic and is excellent for straight cuts, and reasonable for



cutting curves. These tools are long out of production, but you can sometimes find them on eBay.



A second way is to use a scroll saw. To prevent the plastic from melting and rebonding behind the saw blade it is necessary to keep the workpiece moving through the blade at a reasonable speed.

With practice you will find that you can repeat the scoring process with your cutting tool without the use of a rule, as the blade will follow the groove in the styrene. Two or three passes will allow you to snap 0.060" sheet with ease.

Styrene can be filed, but it will leave a burr of melted plastic along the edge. This is easy to remove just by running your fingernail along the edge.

The information available states that styrene dust is not toxic, but like any dust it is an irritant, so the wearing of a dust mask is recommended when filing or cutting.

Holes – Rectangular

Any size rectangular hole can be made by cutting an 'X', joining diagonally-opposite corners of the box, in the hole you wish to open in the sheet. Score the perimeter of the hole, and snap out the 4 triangular pieces one by one.



A nibbling tool will remove small rectangular pieces, from material up to 1/16" thick. Its most useful application is for making rectangular holes, or just sharp internal corners. The

finished hole must be bigger than the cutting head of the tool, and, of course, it's necessary to start by making a hole through which you can insert the head of the tool.

Holes - circular

Very small holes, say up to 1/8", can be made with a regular twist drill, or with a hole punch.



Forstner bit

There are a couple of options for larger holes. One is a step drill. These come in different sizes, and each drill will open out holes to different sizes. Another option is to use a Forstner bit. These are also available in a range of sizes, but each tool will only cut one size.



Larger circles & curves.

For even larger sizes, there is a Compass Cutter, a Button Cutter, or a



Compass cutter



Button Cutter

CircleScribe. Another useful tool will cut smaller circles than most, is a disc compass called the Circle Scribe. It appears to be available only over the internet from [RogatePaper](http://RogatePaper.com).



Another option seen recommended is to use a pair of drafting compasses with 2 points. The



best type is the one where the diameter is set by a screw, and has interchangeable points, not the type that you put a pencil into.

Discs and Rings

The above circular hole cutters can also be used to cut circular discs. The drafting compass, compass cutters and the Circlescribe all leave an indentation in the centre of a disc. It may be stating the obvious but if cutting a ring, you need to alternate between the inner and outer diameter, and cut through the outside diameter first, so you don't lose your centre point.

Very large radii.

For much larger radii or for thicker sheets of styrene, start with a piece big enough for the finished item. In the example of a very large circle, first scribe the circle and then cut, or scribe, four lines at right angles on the edge of the circle. Then snap off the four corners. Depending on the size of the circle you may want to repeat the process with the remaining 8 small tabs. At some point you will be left with small tabs which can be cut off with a knife. The last step is to smooth the edge by sanding it.

Bends and shapes.

Styrene will bend easily but not retain a permanent bend unless glued or heated, and the temperature for the latter is quite critical. Too low a temperature and there will be no change; too high and the styrene will melt and become badly distorted. There are a number of techniques available and you will need to experiment to find the one that suits you.

Boiling water.

There are a number of internet sites which recommend clamping the styrene sheet around a former and then dipping it in boiling water. This should work if the water is actively boiling, because the temperature at which the styrene begins to soften is 95°C.

Clamping the styrene around a former and then holding it in the steam from a boiling kettle or pan with the lid removed has worked. Take

proper precautions so that you are not scalded by the steam.

Holding it in a vice and running a hand-held steam cleaner over it has not been very successful.

Heated sand.

Another method that has been used is heated sand. If you have ever worn glasses you will probably be familiar with the opticians' little heated sand box when he, or she, has to reshape the arms of your glasses. Take an oven roasting pan, half fill it with sand, and place it in the oven. Use a food thermometer placed in the sand to obtain a temperature of about 240°F (115°C). The purpose in using the sand is to heat it to an even 240°F. For this to be effective, your oven should have temperature control. Set it initially to, say, 350°F to speed the heating. When the temperature of the sand reaches about 200°F, drop the oven temperature to 240°F. When the sand temperature is within a few degrees of 240°F it should be uniformly at that temperature. You need to fasten your styrene to a former of suitable material and shape and then plunge it into the sand for a few minutes. Allow it to cool before removing it from the former. You will probably need to experiment with how you clamp the styrene to the former. The styrene expands more than the wood typically used as a former. The difference can be enough to create a permanent kink in the styrene if the clamps are too far apart or too tight. The main advantage of this method is that the temperature is even and predictable, and the styrene cannot get hot enough to start melting.

It should be obvious that you need to wear heatproof gloves (oven gloves) when handling the hot sand pan or styrene.

Hot moulding using a butane/lighter fluid/heat gun heat source.

BEFORE STARTING, ALWAYS KEEP A FIRE EXTINGUISHER AND A SUPPLY OF WATER AT CLOSE HAND. USE SAFETY GLASSES; ENSURE ADEQUATE VENTILATION AND NO ADJACENT COMBUSTIBLE MATERIALS!



Cut a panel of styrene (usually 1/16" thick) that overlaps the area where it is to be fitted by at least 1/2" per edge. This is usually the location where distortion occurs, and thinner styrene also seems to distort more easily.

Cut formers that replicate the internal dimensions of the finished panel. It is assumed most shaped panels will be for the front of superstructures. On small models, to scales around 1:75 and above, often the internal deck contact edge, contoured to this size is adequate; supplemented by a former that also fits to either the top or bottom surface. On larger models more formers may be required.

Gently warm up the styrene whilst fitting it around the former. It may take several operations for this process to be completed. Once the general shape is achieved concentrate on the corners. The decreased radius there can be obtained by bending this area of the sheet around a suitable object such as a screwdriver shaft. This is also easier using a vice and pliers, which avoids burning your fingers.

This technique can also be used to make a mast shroud. Hold a length of wire of mast diameter in a vice and then heat it up. Once warm, a section of styrene can be wrapped around it and it will quickly take up the bend required to surround the mast.

Whilst this technique sounds fairly crude, it has been found that the edge of the styrene is where any distortion will occur. Once the correct contours are obtained, trim the overlap off the panel which will usually remove the distorted portions. A belt sander helps to keep all the edges level.

Reverse (compound) contours can be made by making up parts for each contour and gluing together.

With any of the above methods, if you are lucky, or extremely skilled, the bend will be in the right location, in the right plane, and of the right radius. Chances are it will be "about right" and you will need to glue it to some correctly-shaped ribs to hold the correct radius in the correct location.

An alternative to the ribs, if it works for your model, is to make the former into part of your

model, by glueing the styrene sheet onto the former. In this method, you need a former of the correct diameter or shape for your model.

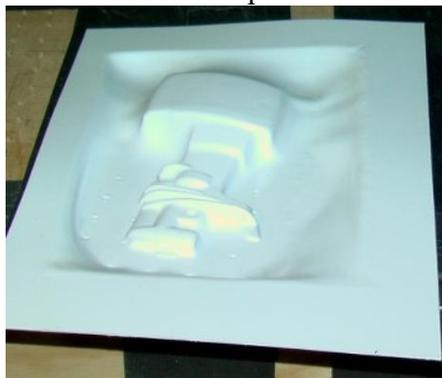
If there are cutouts for windows or hatches, cut only the horizontal edges i.e. the edges that go around the bend, before forming the bend. Cut the vertical edges after bending. If you remove the complete cutout, the vertical edges are likely to buckle outwards.

If you need a very sharp bend, such as a corner with a shallow angle, use the P-800 knife to cut a groove on the inside, and then bend along the groove.

Run glue into the groove to hold the shape.

Vacuum moulding

If none of the above techniques is sufficient to create what you need, then maybe you need to try vacuum moulding. This method allows you to form some quite complicated shapes. It is probably of most value if you need to make several identical fittings, say of lifeboats on a passenger ship. It is outside the scope of this article to provide instruction on how to do this, but there is lots of information available in print and on the internet.



It is possible to create moulded parts with some basic equipment. With a heat lamp as a means of softening the styrene, a shop-vac as a way of pulling a vacuum, and a homemade moulding box, If you have an existing part that you can use as a pattern, and you need a shell not a solid part, this method works well as shown.

What thickness?

As a general rule, 0.040" to 0.060" thick is good for decks, and 0.030" thick for everywhere else.



Thinner or thicker material can be used for details, and structural sections as needed.

What adhesive?

The best adhesives for glueing styrene to styrene are the Humbrol, Modelmaster, Tamiya, Revell etc. liquid cements, the types that come in a plastic bottle with long metal nozzle. One of the advantages of this plastic cement can also be a disadvantage. The cement creates a weld by first melting the two pieces of styrene, and then allowing the weld to solidify. If used on styrene thinner than 1/32" (0.75mm) the welded portion will often show through as a shallow dimple in the thin material.

Plastruct offer a number of liquid styrene glues. "Canopy" glue dries clear.

For glueing styrene to other materials, CA or epoxy work well. Other glues also state that they are suitable, such as Lepage's "No More Nails" and polyurethane (such as "Gorilla Glue"). All have their advantages and disadvantages. These adhesives can also be used for styrene to styrene, avoiding the dimpling effect noted above, but the joints are generally not as strong. Beware of the "starved dog" effect, where the skin is sunken between any internal ribs. Lightly sand the styrene surface to provide the glue with something to grip onto better.

The basic structure for deckhouses and superstructures is a rectangular box. You glue four pieces of styrene together at the corners and you have a four-walled deckhouse. Even if the corner walls are perfectly formed at right angles, you will discover that the walls develop a slightly hollowed out, concave shape as the adhesive hardens. This effect can be prevented by using thicker styrene, or internal bracing.

Almost all glues can form strings when you are applying the glues, and leave glue marks where you don't want them. The best method for countering them is to remove your applicator (whether it's a pin, a toothpick, or something else) vertically so when the string breaks it drops into the spot where you just applied glue.

What filler?

Bondo glass putty for autobodies is good for filling small gaps and imperfections. It contains a solvent which will melt the styrene, and in most cases it will not be a problem, but care is needed if you plan to use a lot of putty on very thin styrene. Another option is Vallejo Plastic Putty. Once dried it can be cut or sculpted, but not sanded.

Some words of warning.

Expansion.

Styrene has a higher coefficient of expansion, meaning it expands more when it gets warm, than most of the other building materials we use. For example, let's assume that you have a model which is 30" long, with a deck made from styrene glued to wood, and you build indoors where the average temperature is 20°C. If you take it outdoors where it is in direct sunlight and the model heats up to 50°C; then over the 30" length the styrene will expand 5mm more than the wood. Even if the model is in the shade, say on a hot day when it's 30°C, the expansion is still 1.5mm. This might not seem like a lot, but if the wood and styrene are not firmly bonded together, then the styrene is likely to buckle in places. The expansion is directly related to the temperature change and the length. If the styrene parts are separate from the wood, and free to expand and contract independently of the wood, no Styrene has a high coefficient of expansion, meaning it expands more when it gets warm, than most of the other building materials we use. For example, let's assume that you have a model which is 30" long, with a deck made from styrene glued to wood, and you build indoors where the average temperature is 20°C. If you take it outdoors where it is in direct sunlight and the model heats up to 50°C; then over the 30" length the styrene will expand 5mm more than the wood. Even if the model is in the shade, say on a hot day when it's 30°C, the expansion is still 1.5mm. This might not seem like a lot, but if the wood and styrene are not firmly bonded together, then the styrene is likely to buckle in places. The expansion is directly related to the temperature change and the length. If the styrene parts are



separate from the wood, and free to expand and contract independently of the wood, no problem. Also, if the wood and styrene are firmly bonded together, no problem. You must make sure they are firmly bonded, if you glue styrene to a different material.

CA glue and brittleness.

At least one modeller has reported problems when using CA glue:

“In most cases I use Medium CA for all my styrene glue joints. Never use Thin CA as it will make the styrene brittle as glass and will destroy thin 10mil sheeting on contact. I have no problems at all with Medium or Thick CA, or the use of a CA kicker.”

Effects of UV in sunlight.

Henkel, manufacturers of Loctite, make the following comment in their “Design Guide for Bonding Plastics”:

[Polystyrene grades] are susceptible to weathering and ultraviolet light degradation. Protective coatings or UV stabilizers are recommended for outdoor applications.” In our models, this typically means giving white styrene at least a coat of outdoor varnish.

Black styrene made by Evergreen Plastics states on the package that it is “UV resistant”, which the clear and white do not.

Lacquer paint caution.

Don't use lacquer paints on styrene unless the surface is well sealed.

Practical applications.

Example 1 – Superstructure front and rear.

The superstructures and deckhouses on many vessels are rectangular boxes, making them relatively easy to construct.

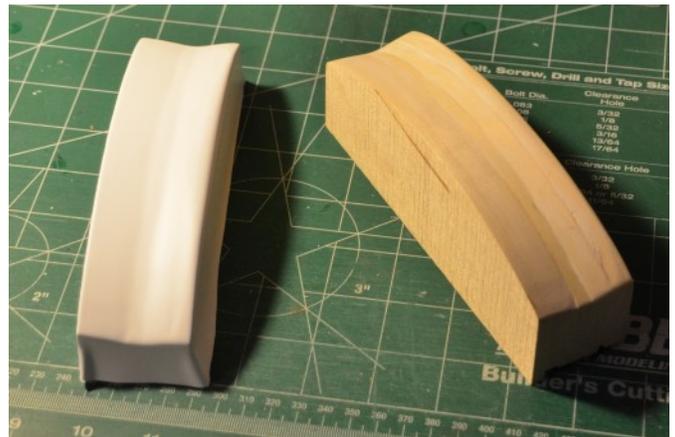
Some vessels will have rounded fronts or backs to the superstructure, and you will need to apply some of the techniques mentioned above. Here are a few examples.

The heat gun method was used to form the superstructure front on a model of the *Seaforth Conqueror*. The picture shows where two



separately shaped pieces were joined to create the reverse slope.

The next pictures show a superstructure front made by the vacuum moulding process. The first picture shows the former made from scrap wood using several layers to achieve a reverse slope. This is similar to making a ‘bread-and-butter’ hull. The resulting moulding is also shown.



The following picture shows the completed bridge incorporating the moulding.



