PEWTER CASTING

A TEP Approach

Casting in school has essentially focused on sand casting aluminium with the dirt, sand and high temperatures and the need for a dedicated work area. Many exciting projects have started off in a casting bay, are often large and put further demands on post casting, machining operations and with a wide range of additional processes. Health and Safety issues were and are significant too. While the excitement and attraction of pouring a crucible of silvery alloy into sand filled flasks was and is still there, it is worth taking a look at desktop casting using the simple low cost TEP system now available.

The productivity of aluminium casting is low and costs associated with it are too high for many of us delivering D&T in a single classroom with marginal funding. Cross gender appeal for getting dirty in a casting bay is not great these days and a real alternative already exists in using lead free pewter.

More about Pewter

Pewter has a wide variety of compositions, but generally has a high tin content which is hardened by additions of other elements. In most countries newly manufactured pewter is a lead free alloy usually being hardened with additions of antimony, copper, silver and bismuth containing over 90% tin. Tin is too soft a metal and the addition of copper (up to 8%) and antimony (up to 2.5%) provide a hardening and stiffening quality to the alloy making components more robust.

For many years various artefacts including plates were produced in pewter and many tales of food poisoning can actually be attributed to the lead in the pewter rather than the food on the plate.

Casting

Gravity casting in school produced moulds remains the lowest cost option and can produce dramatic results. There are a number of proprietary systems available with small furnaces and mould kits, however, TEP's superb starter kit utilises a simple aluminium laminated mould and comes complete with a ladle and a small quantity of lead free pewter. The melting points and respective eutectic points are low enough to allow a small propane torch or high output heat gun such as a paint stripper to provide more than enough heat to melt and maintain a pool of molten pewter. As with aluminium casting there is no wastage as all unused (unmoulded) pewter is recycled and re-used.

Fine detail work done industrially will often be pressure diecast or centrifugal castings that are expensive to set up for school use and not really necessary. Centrifugal casting gives the best results but may not suit most departments in terms of cost or complexity.

Moulds

Mould materials for casting can be as straightforward as using MDF milled out or hand cut to shape and then sandwiched together and clamped to give an odd side or flat side to the moulded part. MDF will degrade over time but many of our moulds have been re-used up to 50 times. An alternative is aluminium or acrylic, both can be used many times and of course acrylic scraps can be machined and sandwiched between aluminium or MDF sides with machine screw 'pinch' bolts.

Small detailed components are the most challenging and most rewarding but can be difficult to extract from an MDF mould. As with all pewter casting work the essential bonus is the repeatability and minimum of work required after casting to achieve creditable results.

Pewter can be plated, painted or polished but when polished will oxidise and dull fairly quickly. This oxidising patina that appears on pewter readily can be attractive and can be left unpolished. However, pewter's appearance can be deliberately dulled and darkened with chemicals but we would not advocate that here.

Vulcanised (RTV) rubber moulds and silicon moulds can be created. Vicky Smith from Helston, produced these Barbara Hepworth inspired pieces in silicon moulds. Silicone rubbers are much more prone to heat damage so using low melt pewters is really important in this case. Shapes can be quite complex and hand moulded initially in material like 'Milliput' prior to making female silicon moulds.

The opportunity to make components that support work across D&T is endless and includes: badges, jewellery, hair slides, playing pieces, medals, giftware, tableware and components for mechanisms such as cams, gears and linkages. As well as a wide range of supporting parts for product design work where a unique metal surface and appearance are required.

There is a great deal of attention focused on rapid prototyping techniques in industry and education. With a pewter casting facility in school as with the PODs thermoforming featured in the issue 9 we can come close to 'very quickly', if not rapidly developing sophisticated ideas into components and products.

In the MDF mould opposite, the runner or pouring hole is much larger at the top and funnels down to the fine detail cavity of the mould. This has two essential benefits: in providing a large enough hole to aim the pewter down when pouring and to provide a volume and pressure of pewter to feed and fill the main mould as finer details can easily be lost without that extra pressure. To make a simple and effective pouring ring to aid shaky hands pouring the use of 'blue tack' or plasticene can help around the 'runner'. Note that due to the free flowing nature of pewter unlike aluminium casting generally a 'riser' is not used.

Vicky Smith from Helston, produced these Barbara Hepworth inspired pieces in silicon moulds

CAD/CAM and Pewter Work

Pewter work lends itself easily to CAD and CAM mould making but this is not exclusive and cutting and shaping a laminate to sandwich between two side plates requires only a reciprocating saw or a carefully wielded coping saw. For CAD work 2D as well as 3D design options are equally valid and allow you to introduce the process at any stage through Keys Stages 3 or 4. Lots of new literacy can be introduced associated with moulds and moulding as well.

A set of standard blanks can be created for group work to speed up the design process, and an individual design can then be added to the centre in the form of an initial or other symbol on a badge or fob.

A simple design can be drawn by pupils using a 2D CAD package and then the design is then converted, by the software, into a 'G' code file, which will run a CNC milling machine.
(Note the two colours indicate different Z axis heights to create the casting 'pockets')

Producing the design this way from a 2D file causes the miller to "vector cut" which gives the definition needed for die-casting. Creating the 'G' code directly from a 3D model would result in "raster machining" giving a very poor quality casting surface. To make the die ready for pouring in the molten metal, a back plate is required; this is a blank block with a funnel shape machined in to it to assist in pouring.

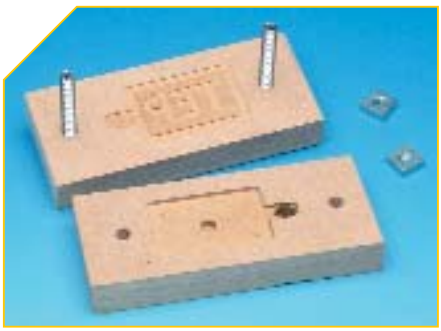
CNC milling machine cutting out the mould design

Continued overleaf

PEWTER CASTING

Continued

This school based pewter casting bay uses a hot air gun and provides a safe and well managed area for pouring hot pewter, clamping mould halves together and storing materials.



Use of pinch bolts to 'line up' mould layers

Shrinkage with such small components is not an issue and can be so small that getting complex shapes out of a mould can be a hassle. Registration of mould halves is crucial so using your own devised system or using pinch bolts as shown here is important and helps 'line up' multiple layers. Only teachers trained in casting safety procedures should supervise pupils for casting activities. If pewter is cast, only low-lead content or lead-free (white metal) should be used. The position and operation of fire and safety equipment is important and if you plan this activity in, although the hazards are low teachers must carry out a health and safety risk assessment. The CLEAPSS model risk assessment document may be useful. Unless MDF moulds are subject to excess direct heat and start 'smoking' (producing toxic fumes) the process is generally accepted as safe.

A whole new literacy set is uncovered teaching through pewter casting: Quality control, quality assurance, production plan, pattern, template, moulds, moulding, jigs, crucible, molten, gate, clamp, sprue, riser, release agent, flash, die, pressure, force, solid, solidify, batch and volume, eutectic, melting point, production, standard components, wastage, production line.

This process is one that will have cross gender appeal with its 'clean image' ability to make elegant, detailed small components and parts as well as near rapid productivity. Do take a look at the very low costs involved in setting the process up and integrating into Key Stage 3 and 4.

Here the two prototype hair slides have been cast in an open backed MDF mould (milled with a 3mm cutter) and then lightly polished. With care features like the pin holes at the end can be designed into the mould so that they are pre-cast. These castings have also been rolled gently in TEP metalworking rollers to make them curved

Speedy production of a number of parts is shown here in a strip of milled MDF cavities

Note the use of cold casting resin to fill cavities in the pewter casting to create an attractive appearance

An unusual and clever approach to integrating laser cutting and pewter casting is this innovative laminated mould including runner and mould support legs

Starter Kits and Pewter available from Teaching Resources:

- **Comprehensive starter pack** – stock number PC1 001

Parts are also available separately:

- **Ladle** – stock number T00 095
- **Mould Case** – stock number IT5 055
- **Low Melt Fusible Alloy** – stock number ES2 030
- **Pewter** (1 kg bar) – stock number PEW 001
- **2mm MDF** (approx. 20cms x 30cms) – stock number MDF 002

teaching resources

NOTE: A CNC machine is not essential; the MDF (or other suitable material) can also be cut out manually.