

FORMING METAL – BEATING

Beating is probably the oldest method of shaping metals and relies upon metal's malleability (being squashed and bent without splitting and cracking).

HOLLOWING

Hollowing is a procedure used to produce shallow bowl shapes from circular sheet metal blanks.

1. A circular blank of metal (copper or brass etc.) is prepared by **annealing** it to make it more malleable.



Annealing

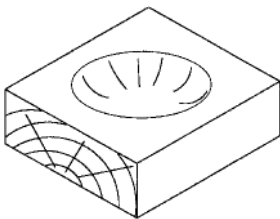
Annealing is carried out by heating the metal to a dull red. The metal is now more malleable, so it will not split when it is hit with the mallet.

The surface will now be black (burnt tarnish) and this needs to be cleaned off before hollowing. Either emery cloth can be used to clean it, or the still warm disc can be placed into a bath of dilute sulphuric acid.

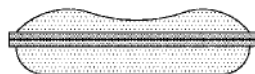
Note: If the metal is aluminium, it cannot be heated to red heat because it never glows red. Soap should be rubbed onto the surface, and the metal heated gently until the soap turns a dark brown, the correct temperature has now been reached for annealing. The burnt soap can be washed off with water.

To form the hollow shape, either a hollowed hardwood block, or a leather sandbag can be used.

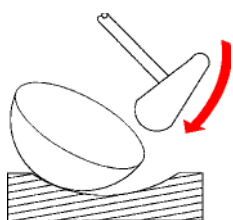
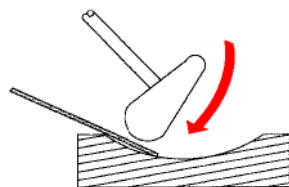
Forming block



Sandbag



2. The metal disc is placed at a shallow angle as shown and is hit with an egg shaped **Bossing Mallet**.

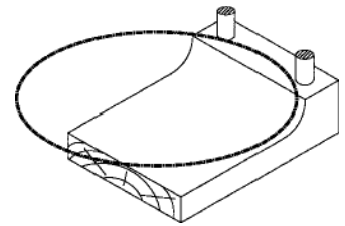


3. After each blow the disc should be rotated one space, so the next blow lands beside the first. Starting from the outer edge, spiral into the centre. The bowl shape will form automatically.

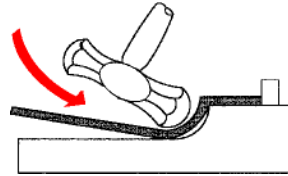
SINKING

Sinking is a procedure that can produce a shallow bowl with a lip around the top edge and a flat base.

The metal disc, shown in the diagram in transparent form, is placed against both dowel pegs. The edge on the top surface of the **sinking block** remains horizontal



and produces the lip.



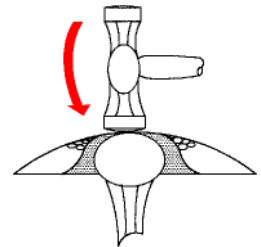
A **blocking hammer** is then used to create the hollow shape.

PLANISHING

Planishing is a procedure that is carried out after hollowing or sinking, it is used:

- to remove any unwanted bumps and to correct the overall shape.
- to harden the metal and make it more rigid.

A cut away view of a **Planishing Hammer** being used. The bowl is placed over a **Mushroom Stake**. Starting in the centre, the bowl is revolved one space after each blow. The blows should spiral outwards to the edge.



The surface becomes covered in little indents that can be left to give a textured finish, or removed, by smoothing the surface with an abrasive stone.

KEY WORDS

Hollowing: Bossing Mallet: Sinking: Planishing:

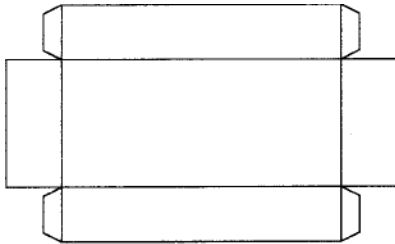
- Describe how metal should be prepared for hollowing.
- What tools can be used to form a bowl shape?
- Illustrate the hollowing procedure.
- What is the difference between hollowing and sinking?
- Sketch a product made by hollowing and a product made by sinking.
- Why should a hollowed product be planished?
- Give an illustrated description of the planishing process.

FORMING METAL – BENDING

Thin sheet metal (up to 1.5mm thick) can be bent, by hand, into boxes, trays and cylinders. The metal sheet needs to be prepared as a 'net' or 'development' before bending.

Note: It is a good idea to make a full size card model first, so that costly metal is not wasted if there is an error.

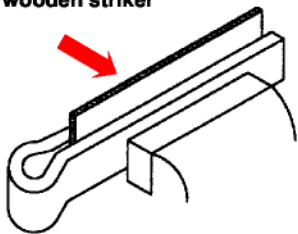
A typical net for a metal box



To make the edges more rigid and to make them less sharp, they can be folded to make a 'safe edge'.

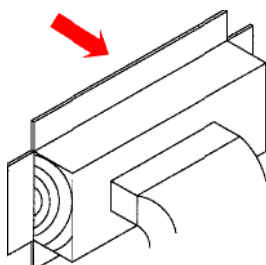


Hit with mallet and wooden striker



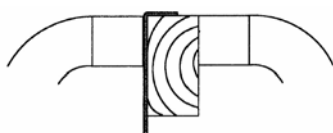
To bend an edge to 90° on a sheet of metal that is larger than the jaws of the vice, **folding bars** can be used to hold the sheet.

Hit with mallet and wooden striker



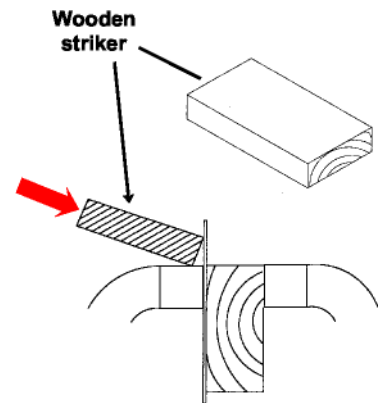
To enable both sides and ends of a box or tray to be folded, a wooden block can be cut to be the same size as the base.

Note: The wood has to be thicker than the height of the sides.



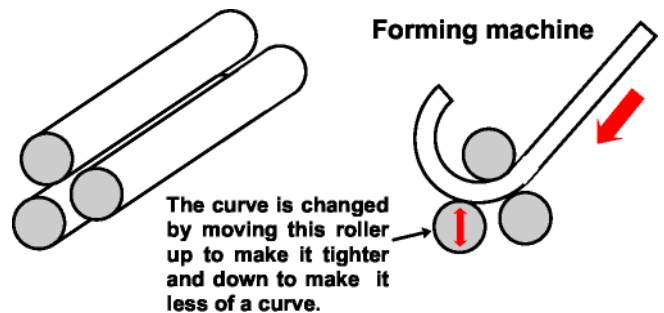
One edge bent to 90°

If the side is hit directly with a mallet it tends to end up with a wavy edge. It is better to hold a hardwood striker at a slight angle against the side and hit the striker with the mallet.



Forming a Cylinder

For bending curves, a machine that has three adjustable rollers is used. The tightness of the curve can be controlled by altering the position of each roller.



KEY WORDS Net: Folding Bars: Forming Machine:

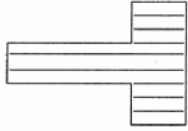
1. What thickness of sheet metal can be bent by hand?
 2. Draw a net of a tray made from sheet brass. The tray is to be 200mm long, 150mm wide, with 20mm high sides, when finished.
 3. Why should a card model of the 'net' be made?
 4. How can the edges of the tray be made safer?
 5. What advantages are there in using folding bars for bending the edge of a sheet of metal, instead of vice jaws?
 6. How can both the sides and ends of a box or tray be folded up?
 7. How can you avoid the edge of the sides becoming wavy?
 8. Illustrate how a cylinder could be made from a sheet of copper.
- A** Make a paper or card model of a net that would be suitable for making a copper container for a house plant in a 100mm diameter flowerpot, that is 95mm tall.

FORGING

Hand forging is one of the oldest methods of shaping metal and is associated with the work of a blacksmith. Today there are many computer controlled processes.

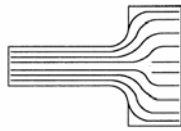
One reason for forging metal is to improve its strength. When it is hit it is squashed and becomes more dense. Also, a shaped product will have the 'grain' (layers of crystals) flow around the shape.

A machine cut shape with sharp internal corners



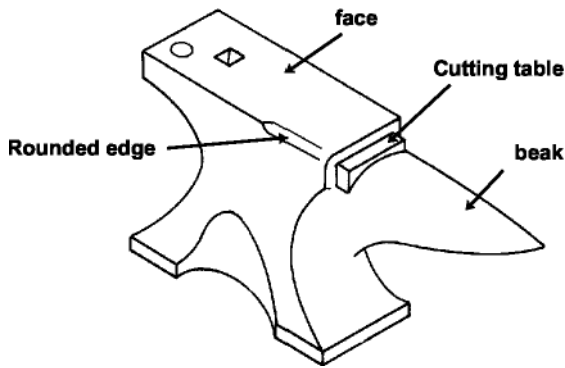
Straight grain lines that can be the source of a crack at the internal corner

A forged shape with curved (filleted) corners



Grain lines are closer together and follow the corner shape, giving extra strength.

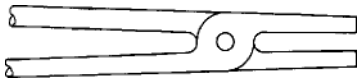
The heated metal is shaped on an **anvil** by hitting it with a heavy hammer.



Holding the metal

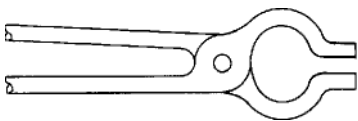
Tongs are used to hold the metal being forged, they come in large variety of styles and sizes, to hold different shapes of metal bar.

Open-mouth tongs



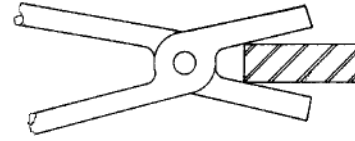
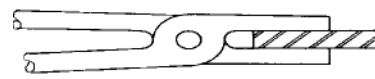
For gripping thick flat material

Pickup tongs



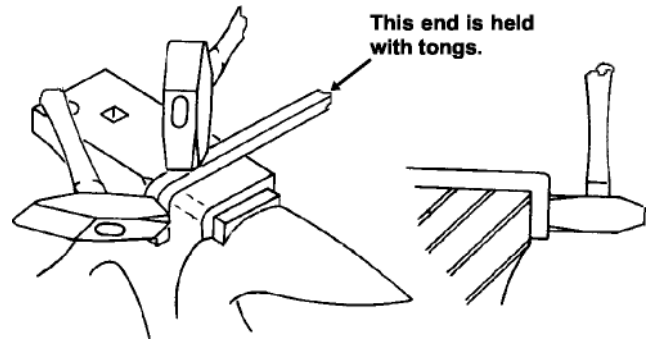
For gripping awkward shapes including round bars.

Note: It is important that the correct tongs are used to grip the hot metal firmly.



Bending

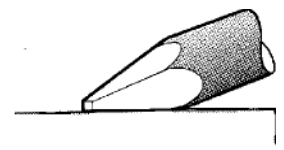
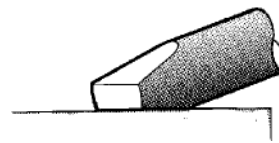
Bending a bar on the anvil, using the rounded edge of the face.



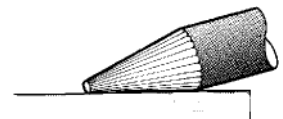
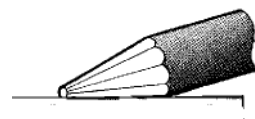
Drawing Down

To make a round bar pointed it has to be **drawn down**. Drawing down requires four stages to avoid the tip splitting.

1. Hold the bar at a slight angle to the anvil face and hit on one side, the anvil face flattens the other side at the same time.
2. Turn the bar 90° and hit again to make the point square in shape.

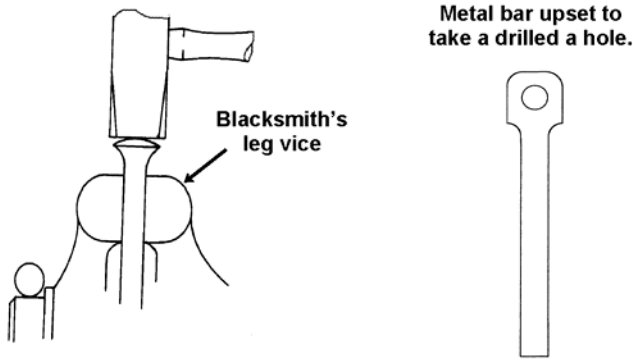


3. Hit each corner of the square shape to turn it into an octagonal shape
4. Continue turning the bar and hitting the corners until the point is round in shape.



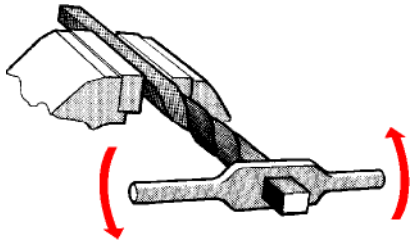
Upsetting

Upsetting is the term given to the process of thickening the metal. This is useful for maintaining strength when drilling a hole.



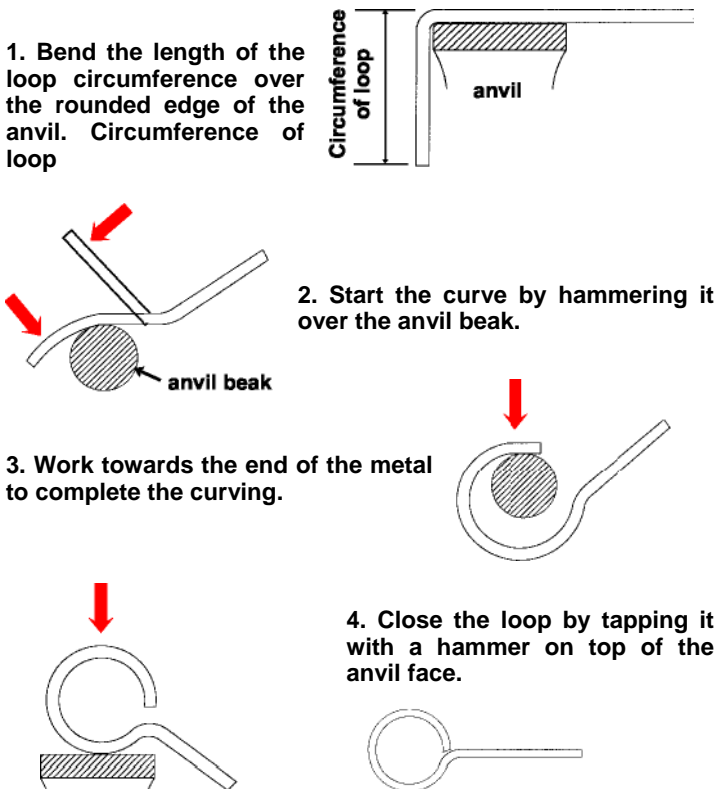
Twisting

Heat the bar to a bright red and then grip it in the vice and slide on a special twisting tool, or use a large tap wrench. Twist the metal while it is still red hot. Twisting will only occur between the vice and the wrench.



Forging a Loop

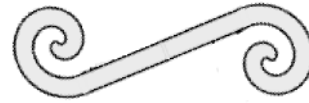
A loop is useful for the end of a handle to improve grip and to allow the object to be hung up.



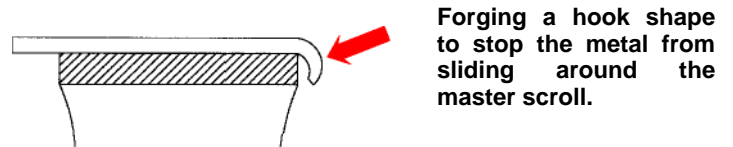
Scrolling

Creating scrolls from strips of wrought iron has been a traditional form of decoration for gates and screens. Today, the scrolls are made of mild steel and are still popular.

An 'S' scroll



To make identical scrolls a **master scroll** is used. The metal is heated to bright red in a forge and then tightly wrapped around the master scroll. To stop the metal from slipping the end is prepared by forging the end into a hook shape.



Forming the scroll by wrapping the hot metal around the master scroll.

Plan view of master scroll hook

front view of master scroll (shown without the piece of metal being formed)

Leg for holding in a vice.

KEY WORDS Anvil: Tongs: Drawing Down: Upsetting: Scrolling:

1. Explain how forging a component can make it stronger than sawing and filing it to shape.
2. Draw a blacksmith's anvil and label its parts.
3. Why is it very important that the correct size tongs are used when forging?
4. Show how the anvil can be used to bend the end of a bar of mild steel.
5. Illustrate how a point can be forged on a piece of round bar so that it does not split.
6. Explain the process of upsetting and why it is done.
7. When twisting a bar, how can you make sure that the twisting is exactly where you want it?
8. Illustrate the stages used for forging a loop.
9. Give an example of what is meant by a metal scroll.
10. How do you prepare a bar for scrolling on a master scroll?