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## The Zippo Lighter

The Zippo lighter is made up of two components which are manufactured separately: the outer case (made from brass) and the inside assembly (made from steel) which houses the mechanics of the lighter. A specialized mill would make the brass and steel sheets of the proper thickness and cut them to the required width. Brass is used because it has excellent corrosive resistance, is easily machined and provides a high class look.

Steel is used for the inner case because of its high strength and ductility. Originally, the outside case was also made from steel due to war-time shortages on brass (brass being required for military machinery), and painted black to prevent corrosion. An alternative material for the brass outer case would be bronze. Bronze also has high corrosion resistance, especially seawater corrosion. Bronze has a reddish brown colour, and so would give the zippo a very different look.

The coils of raw brass and steel used for the inner and outer cases respectively are rolled through presses in a process called 'deep drawing'. A punch pushes the sheet metal into a die cavity, resulting in a contoured part. For the outer case, the presses punch in the edges of each lighter and add some key details (manufacturer's name and date codes) onto the bottom. The holes in the lighter chimney are also punched all the way through the steel of the inside case. An alternative process that could be used is rubber pad forming. This is a metalworking process where sheet metal is pressed between a die and rubber block. This has a higher flexibility of operation and a lower tooling cost than deep drawing. After the pieces are drawn, they are trimmed and moved to the fabrication area where machines bend and fold them into their boxlike shapes. They are then spot-welded together with highly accurate welding machines.

A precision machine fabricates and welds the hinge to both parts of the outer case using a strong welding process called 'resistance welding'. The weld is made by conducting a strong current through the metal combination to heat up and finally melt the metals at localized points. Different fabrication machines construct the components of the flint tube.

Often, the exteriors are finished in other metals such as chromium or nickel. This is done in a process called electroplating. A small electrical charge is applied to cases suspended on moving hangers that pass through a liquid bath. This bath contains a conducting solution that is non-metallic with a piece of the plating metal inside. The opposite charge is applied to the bath, and atoms of the plating metal are drawn from the metal piece to the charged lighters. In this coating process, a thin layer of atoms are electrically bonded to all the surfaces of the case.

Machined parts (such as cam, flint, flint wheel) are then fixed to the top of the inner case assembly with rivets. This is an automated process. Holes for these rivets would have been punched in the case when it was first deep-drawn. Elements of the inner case assembly are inserted in the welded shell. Several small balls of cotton-type material are placed inside the fuel chamber that will contain the lighter fluid. A length of wicking is inserted and will be pulled through the chimney later. A felt pad with a pre-cut hole for the flint and lighter fluid is stamped on the bottom of the inner case. The wicking is pulled through its eyelet, and the inner case assembly is installed in the outer case assembly.

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Regardless of metal type, all cases receive final finishes. Many are polished to give a sparkling look. Others are given a brushed look or a texture. Diamond-drag rotary engraving cuts geometric patterns into some cases. This is used to remove the top chromium or nickel coating and expose the bare metal underneath. Two types of lasers are used to engrave the outlines of line drawings, logos and other designs on the sides of lighters. Still others have designs etched in them with computer-controlled etching machines. Many designs can be filled with colour using a spray painting method. To colour more elaborate designs, a sublimation process transfers colour by heat and pressure directly onto the surface coating.

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