



**Hawley
Collection**
@ Kelham Island Museum

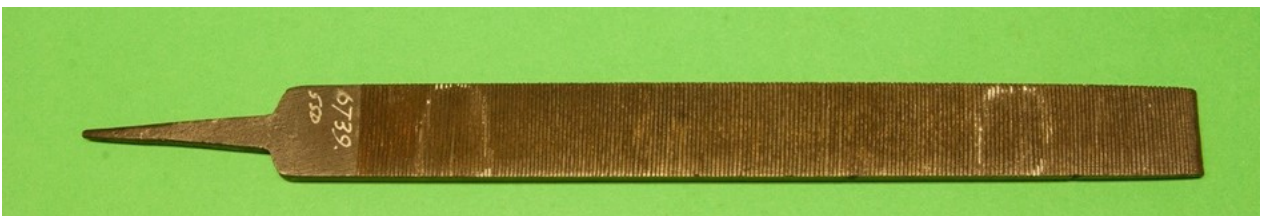
HOW IT WAS MADE

Hand Files

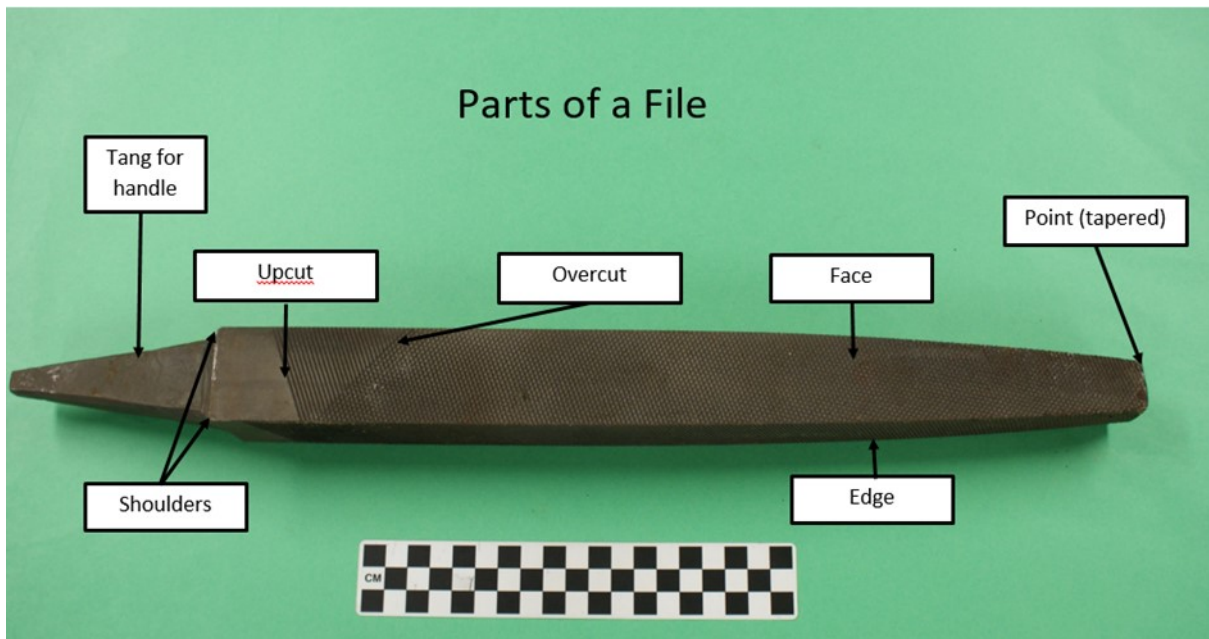
A file is a piece of hardened steel with many small sharp teeth cut into its surfaces which can cut into, smooth, sharpen and shape any material. Files only cut or smooth in one direction - on the forward stroke of the file across the material away from the person using the file.

Before the introduction of precision engineering of machine parts, files were important in putting together the mechanisms or working parts in items from watches to heavy engineering machinery. Component parts were roughly shaped by forging or casting, machined to an approximate size, then carefully filed to fit one another perfectly. Thus files were used by engineers and in all the metalworking trades, e.g. cutlers, silversmiths, clock and watchmakers, etc. There was also a large market for files for sharpening saw teeth. A type of file called a rasp (later complemented by a Surform), was used in trades working with softer natural materials like wood, horn, marble and bone.

Files were made and sold in different lengths, different cross-sections (e.g. round, square, rectangular, triangular, half-round) and with teeth cut on some or all of their faces and edges. They may also have just a single line of teeth – single cut – or two lines of teeth – double cut – cut into their faces and edges. With double cut files, the first cut is known as the ‘overcut’ and the second cut, the ‘upcut’.



Hand-cut float - single cut -T.006739



Engineer's three-square double cut file - T.006735

Sheffield was a major centre for file manufacturing. By the late 1700s crucible cast steel was being used by a number of trades to produce tools which needed high quality steel to give good cutting edges, e.g. saws and scythes, heavy and light edge tools. In turn these trades needed tools like files and rasps to shape dies (moulds), handles etc. Initially cutlers, saw and edge tool makers made their own files, but the increase in trade led to a division of labour. The file trade thus grew as cutlery and other trades grew in the 1700s and 1800s and the quality of Sheffield files became world famous (David Hey, 'A History of Sheffield', 2005).

Until at least the mid-1800s all files were cut by hand using a hammer and chisel. File cutting machines were not introduced in the UK until the 1900s and some files continued to be hand cut in people's homes into the mid-1900s. The last hand file cutter in Sheffield finished working around 1960 and the last machine file cutters – A. H. Ralston Ltd. – closed in 1991.

Stages in the Manufacturing Process

From 1760 onwards files were made from rods or bars of crucible cast carbon steel of around 1.2% carbon then later, from the 1860s, from Siemens open hearth steel. The amount of carbon differed for some files, e.g. steel for saw files for sharpening saw teeth had more carbon as saws were made of harder steel.

Forging and Tanging

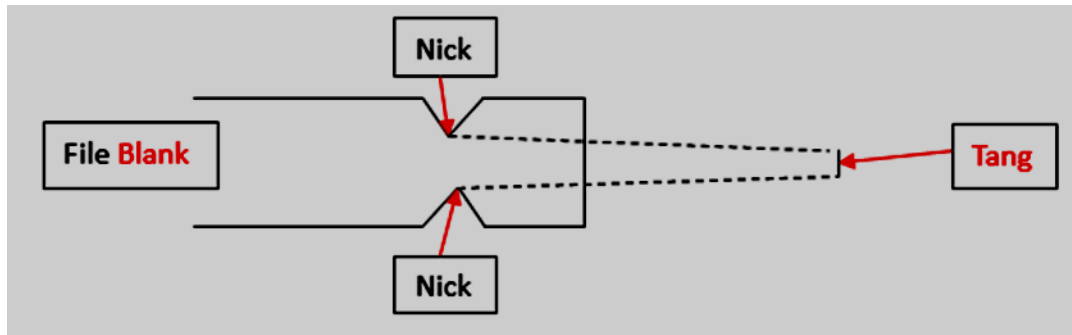
The forger first heated the steel rod in his fire. When it had reached forging temperature - 'bright red' - he placed the rod over his anvil and cut a length off for the file – the mood. This was then hammered into the desired shape for the particular file. Once shaped this was the file blank. For larger files two men were needed to forge the blank, a maker and a striker. The consistent blows of the forging hammer 'kneaded' the steel, this helped to refine it, breaking it down to give it a fine grain, capable of taking and holding a fine cutting edge. In later times it was possible to replicate this with modern heat treatment processes.

Most forgers specialised in forging one type of tool, and in the case of files, usually one length of file. Some would have been permanently employed at a firm's works, and others, out-workers, carrying out the work in their own homes or workshops on a piece-work basis, i.e. paid for each piece they produced.



File Forging early 1900s – PH.fil.016

A nick was then made on either side of the file blank and the tang was pulled out from the shoulder without disturbing the rest - see diagram. Some file blanks were also tapered in thickness as well as width getting thinner at one end.



When machines were introduced, pedal-operated forging hammers were used to carry out these processes, the file mood being placed between two dies (or moulds) in the hammer.

Annealing

Annealing or softening was necessary so that the steel was soft enough to allow teeth to be cut in the blank. The forged blank was annealed by soaking, i.e. placing in an open fire or a furnace to heat through over a long period of time at a constant temperature (up to 780-800° Celsius) and leaving to cool down slowly. Blanks were usually packed together in piles and covered in ashes, charcoal or sand.

Grinding

In the early days, all file blanks were hand ground on a sandstone grinding wheel. The grinder pressed the file onto the revolving stone. Grinding removed approximately 0.4 mm from the surface including any blemishes to produce smooth sides or faces. The grinder may also shape the point of the file blank if this had not been done by the forger. From the mid-1860s/70s specially designed machines were used to grind file blanks although files with a round or tapered body still had to be ground by hand.

Stripping

Stripping made sure that the sides or faces of the file were perfectly flat. This was important otherwise teeth of a consistent size and depth could not be cut in the file. Each blank was held in a stripping frame made of wood or metal. The frame allowed the file blank to be held firmly at either end but also to pivot within the frame. Another file blank was then rubbed forwards and backwards across the blank. Later stripping was carried out on mechanised abrasive belts.



Three-square file in wooden stripping frame T.004916

Cutting

The cutting was carried out using a special hammer and chisel. The cutting edge of the chisel could be between half an inch and 4 inches (2 – 20 cms.) in length. The hammer has a head made of iron with a steel face about quarter of an inch (6mm) thick. Instead of being the same width all the way along, the head has a hump/lump three-quarters of the way down its length on one edge and the face is at an angle to the handle/shaft, rather than parallel to it.



Variety of file cutting hammers with chisels, T.004923 & T.004924

The blank was held by leather straps on a lead bed on an anvil set in a stone or wooden stock. The cutter rested his left leg on a piece of stone, brick or wood, supporting the left arm on the raised knee of the left leg, with his right (and sometimes left) leg holding down the leather straps. The tang of the file was sometimes placed in a heft pipe or handle which was placed against the cutter's waist to further secure the blank during cutting.

Before a file was cut it was smeared with oil. The chisel was sharpened, held at an angle to the file blank leaning away from the cutter and slanted across the blank depending on the cut. When it was struck by the hammer, the cutting edge of the chisel lifted the surface of the blank or raised a tooth above the surface. The chisel was then repositioned against the last tooth cut and the process started again.

The action was repeated rapidly, at great speed. For this reason file cutters were given the nickname of 'nicker peckers' - the local name for woodpeckers!

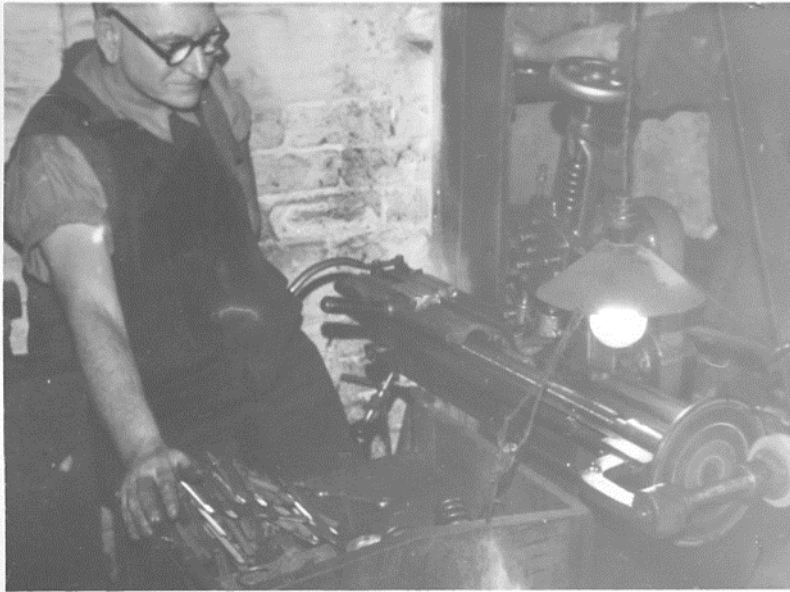


Cutting a file from - Vom alten Handwerk, 1925-1931

The edges were cut with just one single cut. When approximately two inches (5 cm) had been cut, the blank was moved forward away from the cutter by loosening and then tightening the leather straps. Faces could be double cut, i.e. first the overcut, then the upcut. In the centre of the two cuts a diamond pattern was created, the raised part of the diamond is the cutting point when the file is in use.

Files were cut from the point to the tang, and the tang was at the end nearest the cutter. When one side or face had been cut the file was turned and the next side cut - the lead bed prevented sides and edges already cut from being damaged.

At the end of the 1800s file cutting machines were introduced which had a chisel and a bed which moved underneath it, driven by belts. The file blank was placed on the machine bed and the operator used a pedal to move the bed, and a wheel to adjust the chisel to ensure the correct depth of cut as the bed travelled under the chisel cutting the teeth in the blank.



*Machine file cutting
PH.fi1042*

Cropping, Snaping and Marking

At the end of the file the teeth would not go quite to the edge of the face so this part was taken off or cropped by being placed in a metal guillotine. The end of the file was then ground on a grindstone making it smooth and slightly round or bevelled. The required trade mark for the company would then be punched onto the tang either using a mark punch and hammer (later a machine press) if this had not been done before cutting. A wooden handle would eventually be fixed onto the tang when the file was used.

Hardening and Tempering

The finished cut file was then hardened. This entailed first laying-on or brushing a paste onto the file to stop lead sticking in the teeth. The paste was made from a mixture of powdered charcoal/graphite, salt, water and either flour, horn dust or oatmeal – sometimes the waste or 'ends' from beer brewing. Later the cut files were dipped in the paste, which smelt horrible, especially in hot weather! The use of a paste continued when files were machine cut.

The cut file was then placed in a bath of molten lead which heated it. Lead was used as it was a good conductor of heat. (This heating could also be done in a blacksmith/smith's hearth or fire.) Tangs were never hardened, only the file itself. The file was held by the tang and dipped into the lead, the point going in first.

When it reached 'cherry red' it was pulled out and immediately quenched by dipping into brine (salt water) below 20 degrees to cool it.



FILE HARDENING SHOP.

File hardening shop, Thomas Firth Photobook, 1900s

By the end of these processes it was important that the cut teeth on the file were not damaged and the file was straight. Half round and three square files always had to be hand straightened. They were bent slightly into the shape of a semi-circle while still hot from the lead bath and put into the quenching bath at an angle instead of vertically like other files. Quenching then made them straight.

Other files when cool enough to handle after quenching, were checked for straightness by eye. Corrections were made by the hardener by placing the file between two bars coated with rubber tubing and gently leaning on it, or by tapping the file with a lead faced hammer.

Scouring and Proving (Testing)

The hardened files were scoured to remove any remains of the paste using coke dust and a brush. Some firms used half coconut shells with bristles for this as they could obtain them free from soap makers. The files were then dried and coated with oil, usually some sort of vegetable oil, Neat's foot oil or whale oil.

Tests were carried out for correct hardness and faults in the metal or cutting. Hardness was tested using a 'prover', i.e. a piece of steel hardened to slightly softer than the file itself. This 'prover' was rubbed across the cut file. If the file was too soft or blunt, the 'prover' would slide off, if the hardness was correct and the file sharp it would 'bite' into the 'prover'. Faults in the body of the file itself were detected by 'ringing' or tapping the file on a piece of metal. If it 'rang' there were no faults.

Packing

Files were wrapped in waxed or oiled paper and packed in boxes according to size, shape and cut - first in dozens (12s) and half-dozens, later in tens and fives.



PACKING ROOM.
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*Packing Room - Firth Brown
Photobook
PH. fil021*

If you would like more information about files and related items in the Hawley Collection, please contact us:

via our website: www.hawleytoolcollection.com

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