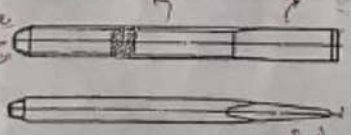
CHIPPING

(CHISELING)

THE PURPOSE OF CHIPPING IS TO SHEAR OFF WORK PIECES OR TO ROUGHLY REMOVE EXCESSIVE MATERIAL

1. THE MAIN TYPES OF CHISELS

1. *FLAT CHISEL* is used for cutting sheet and plate material and for surfacing work.



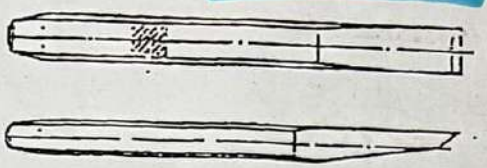
Cutting on a flat plate

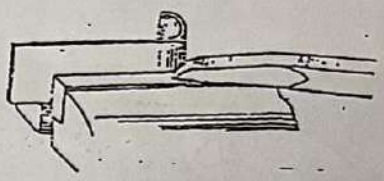
Shearing-off in a vice

2. *CROSS-CUT CHISEL* (cape chisel) is used for cutting keyways, slots and grooves. The cutting edge is slightly wider than the body; this is to ensure that the chisel does not bind in the cut.

Chipping grooves

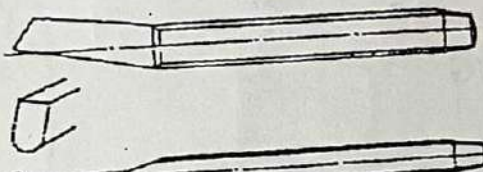
3. **SHEAR CHISEL** is used for shearing thin sheet metal.





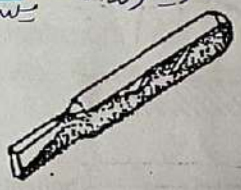
Shearing-off a strip of sheet metal

4. **HALF-ROUND CHISEL** is used for forming flutes and oil channels in bearings or pulley bushes. Also used for "drawing" a hole into correct position when it has been set out inaccurately in drilling.

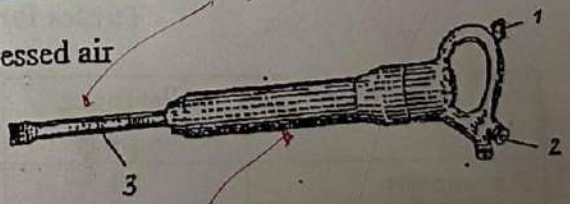


Chipping an oil groove

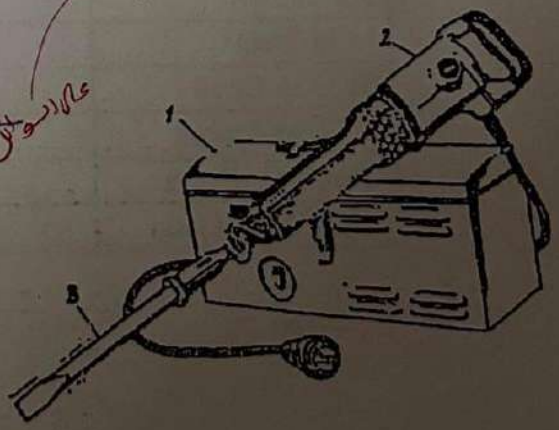
5. **FILLET CHISEL** (backing-out chisel) is used for cutting out predrilled slots.



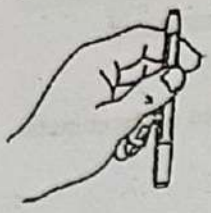
6. **PNEUMATIC HAMMER** is operated by compressed air supplied at a pressure of 5 atm.
1 = starting trigger, 2 = compressed air inlet, 3 = chisel.



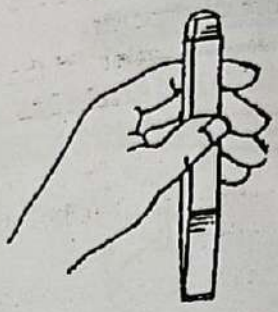
7. **ELECTRIC HAMMER** is operated by electric current.
1 = hammer case with switch box,
2 = hammer, 3 = chisel
1000 to 5000 blows per minute.



2. HOLDING THE CHISEL : Depending on its size the chisel is held



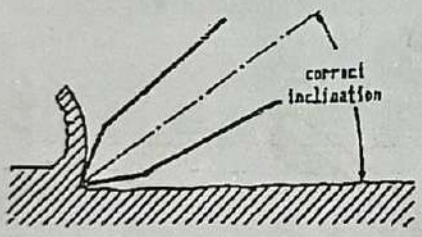
2 fingers
small chisel



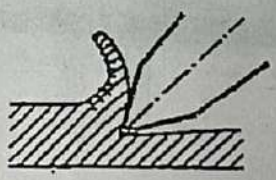
5 fingers
medium chisel

whole hand
large chisel

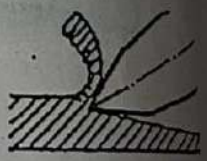
3. PROCESS OF CHIPPING



correct inclination of the chisel gives equal chip thickness.



inclination too small, the chisel penetrates too deep into the material.



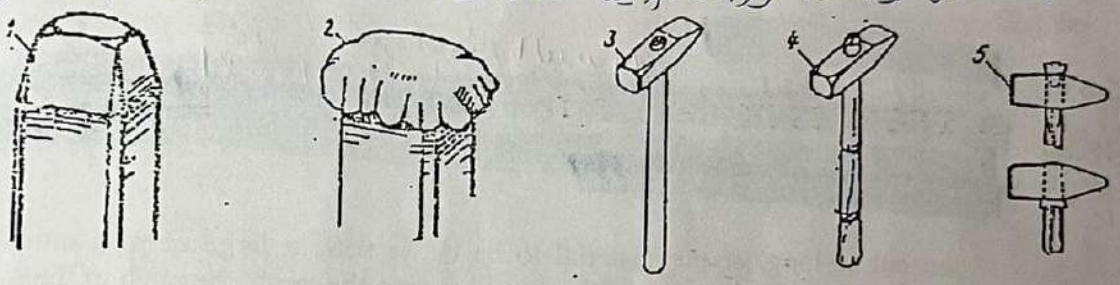
inclination too great, the chisel will slide off the work piece.

Tables for Chipping

Material	Clearance angle α	Lip angle β	Rake angle γ
Aluminum	10	≈ 40	40
Mild Steel	8	≈ 55	27
St 33 to St 50	8	≈ 60	22
St 70 and more	8	≈ 70	12
Cast Iron, Brass	8	≈ 72	10
Chilled Cast Iron	6	≈ 80	4

Safety Rules in Chipping:

1) Never use a chisel with a "mushroom head". Always grind the end back of the head so that the mushroom disappears.
2) When chipping, always wear goggles. If there are other men close by see that they wear goggles or that a shield is attached to your vise to protect them from flying chips.
3) Use a hammer that is heavy enough for the job. Make sure that the hammer handle is tight. Keep the hammer and the head of the chisel clean and free from grease or oil to prevent the hammer from slipping.
4) If the work is held in a vise, always chip toward the solid jaw of the vise. Never chip toward the movable jaw. Where possible, avoid chipping parallel with the jaws.



1 = correctly ground chisel head, 2 = mushroom head, 3 = hammer handle and hammer head in proper working condition, 4 = very dangerous hammer, 5 = poor practice of fastening hammer heads.

Sawing

Definition:

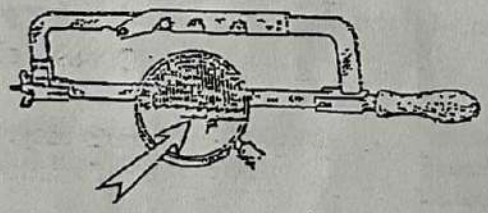
Sawing is a chip removing process used for separating materials by cutting a narrow groove by means of a saw.

Sawing with hacksaw

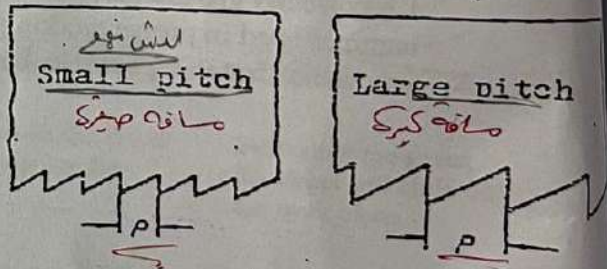
Principles of Sawing:

A saw blade is provided with many teeth, each of them being like the cutting edge of a chisel. When cutting, every tooth removes a chip, which is kept in the space between the teeth until the end of the cut.

If the cut is long, or the material to be cut is soft, a large chip quantity will be removed. To avoid clogging of the space between the teeth, the pitch of the saw blade must be large enough.

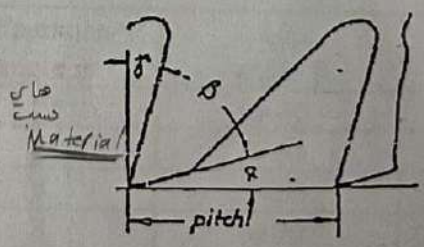


Hacksaw, p = pitch



The angles of a saw-blade tooth, used for cutting metals, are:

Clearance angle	$\alpha = 30°$
Lip angle	$\beta = 60°$
Cutting angle	$\delta = 90°$
Rake angle	$\gamma = 0°$

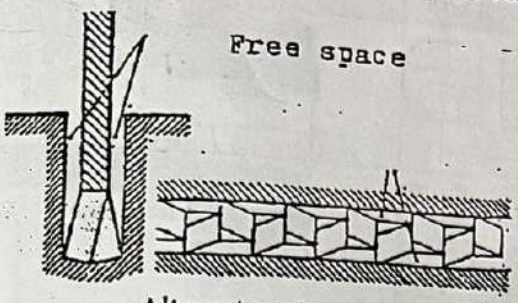


The comparatively large clearance angle α is necessary to make the space between the teeth large enough for the chips. By adding much rake the tooth would become too weak for cutting metals.

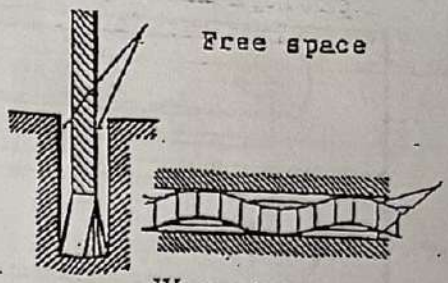
Saw blades used for cutting wood and circular saw blades are provided with a larger pitch. Clearance angles are from 5° to 15°, rake angles from 5° to 25°.

The teeth are "set" so as to make a cut wider than the saw blade and so prevent binding or sticking of the blade in the cut or kerf.

The set is obtained by having alternate teeth bent slightly outward, or by the blade being curved to a wavy form near the cutting edge.

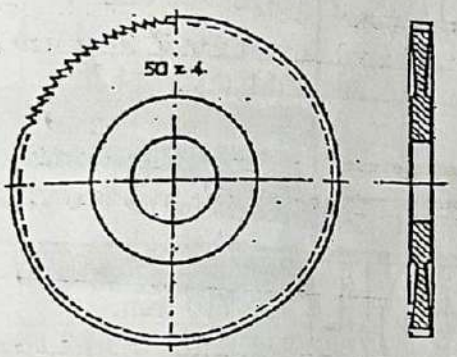


Alternate set

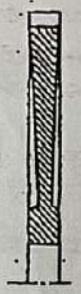


Wavy set

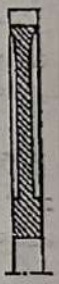
For circular saw blades a set is obtained either by alternate setting or by grinding the teeth to a tapered shape.



Circular saw blade



Tapered shape

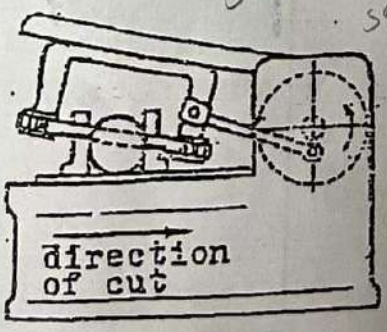


Concave shape

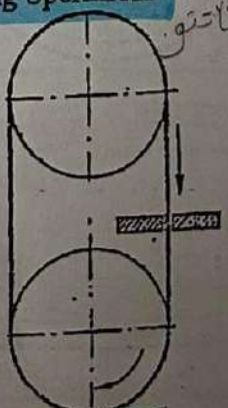
Sawing is used for cutting blanks to rough length, for making thin cuts preparatory to other chipping, filing or machining operations, and for cutting slots and grooves.

Sawing may be classified as hand sawing and power sawing. In hand sawing there is a reciprocating movement, the backward stroke being an idle stroke.

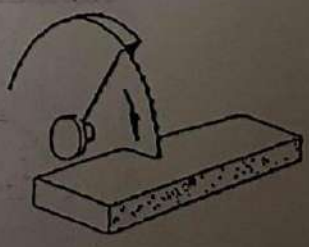
In power sawing, the power hacksaw is operated with a reciprocating movement too. A circular saw performs a circular motion and a band saw a straight lined motion, both of them yielding a continuous cutting operation.



Power hacksaw



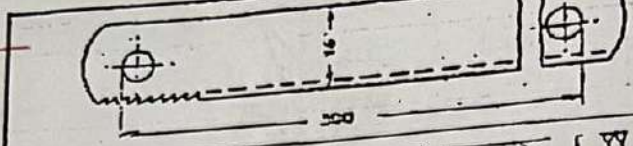
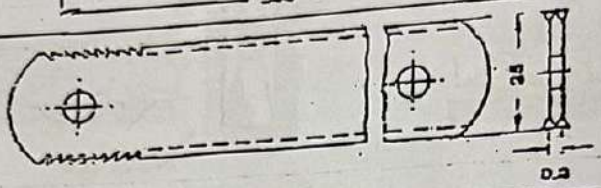
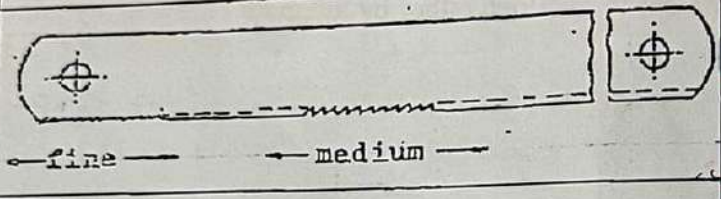
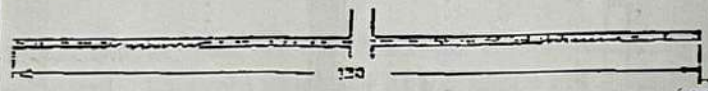
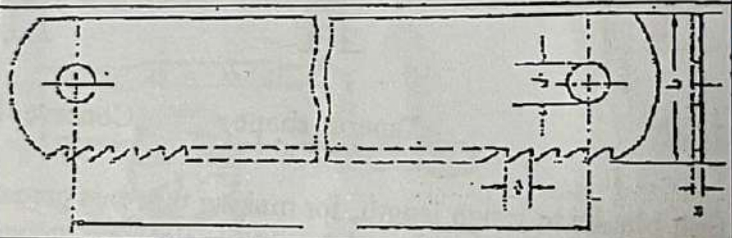
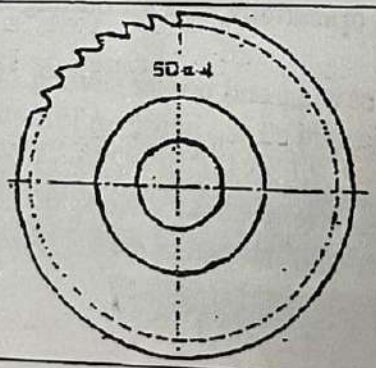
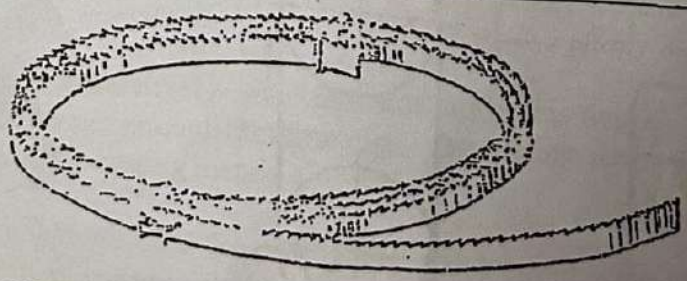
Band saw



Circular saw

Sawing Tools:

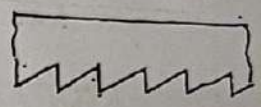
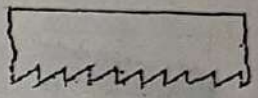
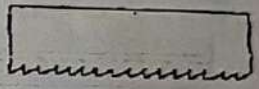
Saw blades are made of plain carbon tool steel or alloy tool steel. There are two types of saw blades, the all-hard and the flexible. All hard blades are hardened throughout whereas only the teeth of the flexible blades are hardened.

	Hacksaw blade. One side toothed, length 300 mm.
	Hacksaw blade. Both sides toothed, length 300 mm and 350 mm.
	Hacksaw blade. With fine pitch at the starting end, length 300 mm.
	Piercing saw blade. Made to various lengths and thicknesses.
	Powerhacksaw blade. Length 300-710 mm. Thickness 0.8 - 2.5 mm.
	Circular saw blade. Diameter 20-315 mm. Thickness 2-6 mm.
	Band saw blade. Made to various lengths and thicknesses.

Tables for Sawing:

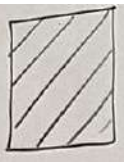
Hacksaw blades are made with a different number of teeth, from 14 to 32 teeth per 25 mm.

The harder the material, the finer the tooth-pitch.

	teeth/25 mm	pitch	
Soft materials aluminum, copper, plastics	16	coarse	
Medium hard materials steel	22	medium	
Hard materials tool steel, thin walled objects	32	fine	

Safety Rules in Sawing:

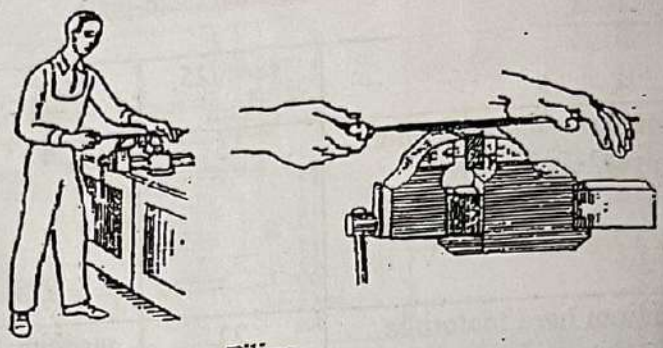
1. Secure the saw blades firmly and properly.
2. Secure the work in a vice, or with clamps.
3. Never use a hacksaw with cracked handle or one without handle.
4. At the end of a cut reduce the pressure on the hacksaw and support the piece being cut off so as not to allow it to fall on your feet.
5. Don't blow out the chips of the cut. They may get into your eyes.



Filing

Definition:

Filing is the process of removing a layer of metal from the surface of a workpiece by means of a file.

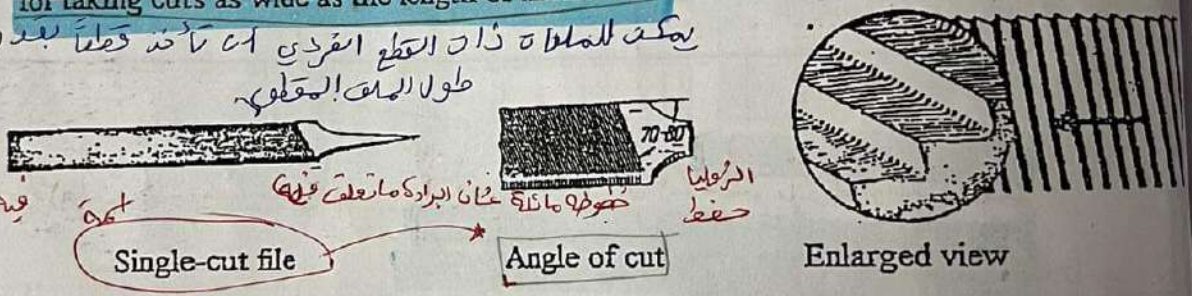


Filing

Principles of Filing:

A file is a piece of high-carbon tool steel having teeth cut upon its body.

A single-cut file **has a single series of cuts across its face. Single-cut files can be used for taking cuts as wide as the length of the file cut.**

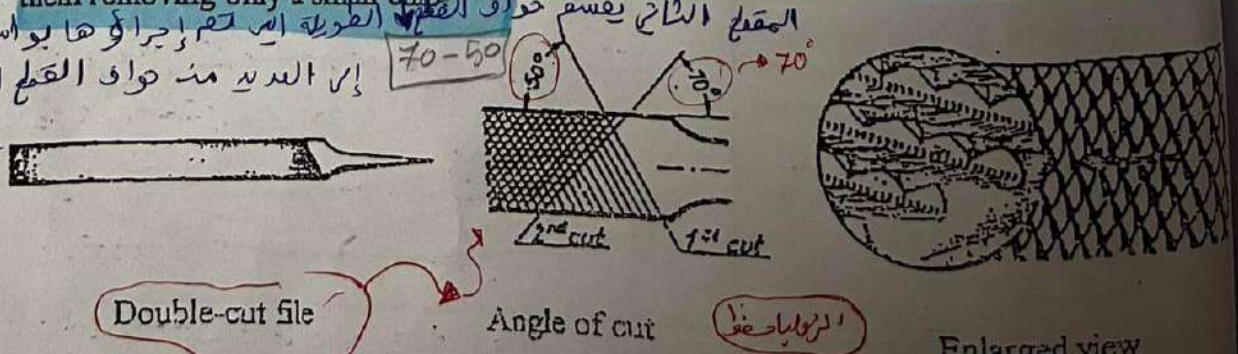


Single-cut file — Angle of cut — Enlarged view

They are used in filing soft metals which offer little resistance to cutting (brass, zinc, babbitt, lead, aluminum, bronze, copper, etc.). These files are also used in sharpening of saws as well as in working on wood or cork.

Single-cut files have their cuts made at an angle of 70°-80° with respect to the file axis.

A double-cut file **has two courses of cuts crossing each other. The second cut divides the long cutting edges made by the first cut into many small cutting edges, each of them removing only a small chip.**

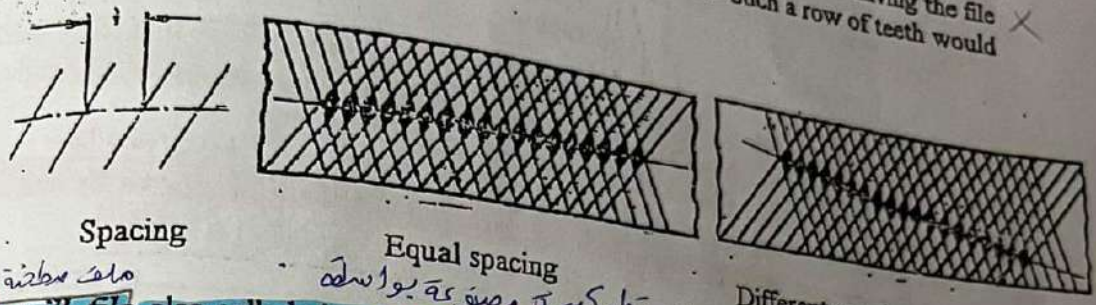


Double-cut file — Angle of cut — Enlarged view

Double-cut files are used in filing of hard metals (steel, cast iron) which offer considerable resistance to cutting. To work these metals with single-cut files would require much force, therefore double-cut files are used which remove short chips.

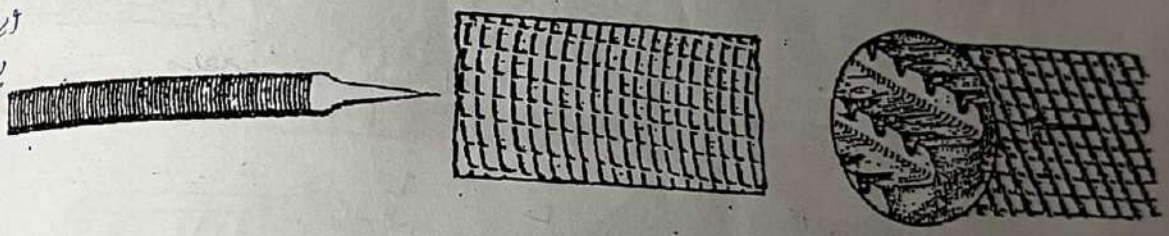
Double-cut files have their first cut made at an angle of 50° and their second cut at an angle of 70°.

The spacing of the first cut and the second cut is made different to avoid having the file teeth one behind the other in direction of the file axis. Such a row of teeth would scratch deep grooves on the work surface.



Spacing Equal spacing Different spacing

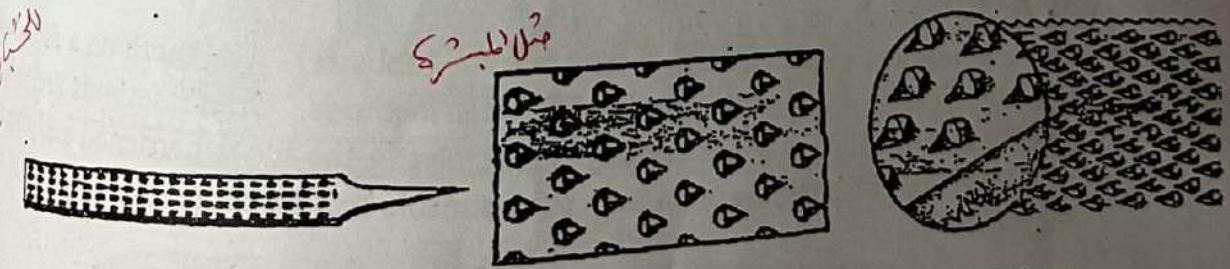
A mill file, also called vixen file, has large cutting edges made by milling. The cutting edge is usually curved and is provided with a rake angle. Chip breaking flutes separate the cutting edge into smaller parts. The chisel teeth give a smoother finish than the pointed teeth of a double-cut file.



Mill file Chip breaking flutes Enlarged view

Mill file are much used for drawfiling, and the bastard cut is fairly efficient for filing brass and bronze.

A rasp file has isolated projections and recesses which form relatively coarse and widely-spaced teeth shaped like pyramids.

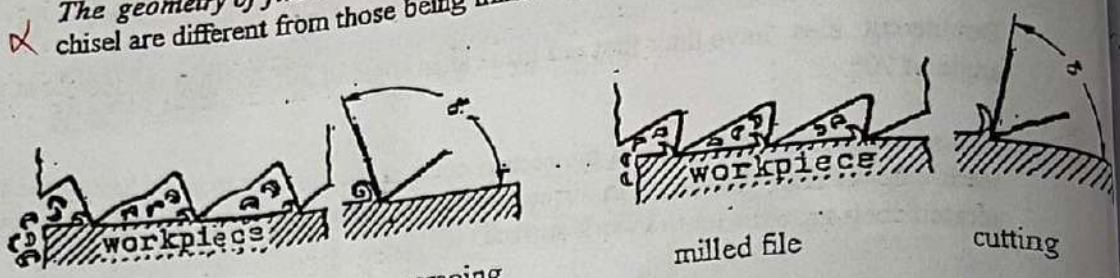


Rasp file Rasp cut Enlarged view

Such files are used in filing of babbitt, lead, zinc, leather, wood, rubber, etc. Soft materials would clog up the teeth of single cut files and stop further cutting action.

File geometry:

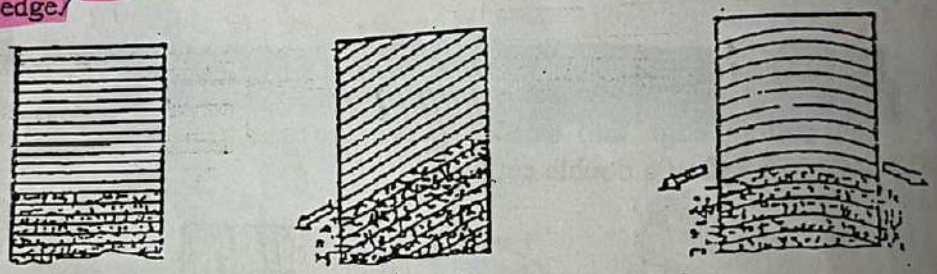
The geometry of file teeth depends on the method of production. File teeth cut with a chisel are different from those being milled by means of a milling cutter.



cut file scraping milled file cutting

A cut file tooth scrapes, the lip angle is large and cut files are therefore used for filing hard materials. A milled file tooth cuts, the lip angle is smaller and milled files are therefore used for filing soft materials or for finishing work

Chip escape is obtained either by inclining the cutting edge or by milling a curved cutting edge.



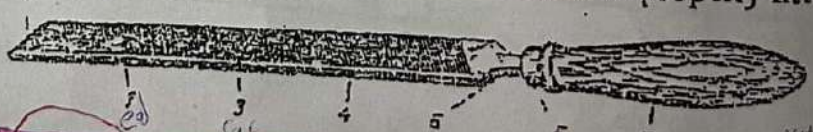
No chip escape Inclined cutting edge Curved cutting edge

Process Accuracy:

The accuracy of metal filing ranges from 0.1 mm to 0.01 mm. When fitting machine parts together there are occasions when a slight reduction in size is required, and the use of a machine tool is impracticable. In such cases the file is most useful. Further, in many classes of work such as diemaking, experimental work, and model work, surfaces must be finished and parts fashioned by filing. Filing may be classified as hand filing and machine filing.

Filing Tools:

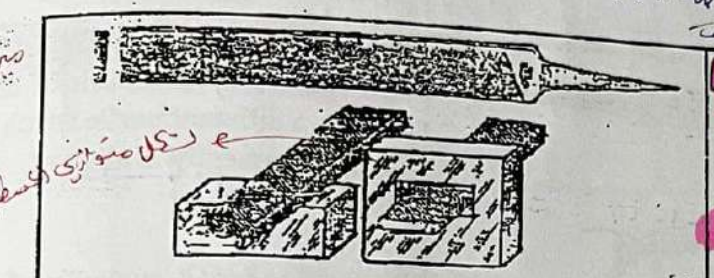
Files are made of plain carbon tool steel or alloy tool steel. The teeth on a file are cut with a sharp chisel either by hand or machine methods. Other methods are milling, grinding or broaching. After cutting of the teeth, the file is hardened and the tang tempered. The file should be provided with a suitable handle properly fitted.



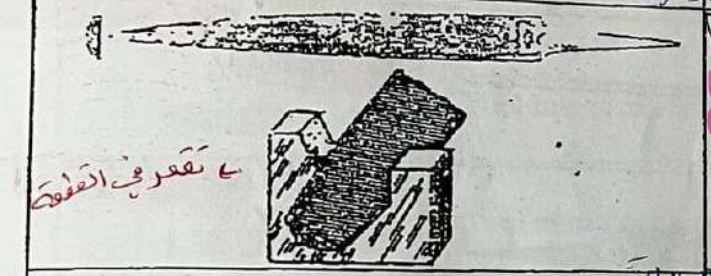
File: 1 = tip, 2 = edge, 3 = face, 4 = cutting edge, 5 = tang, 6 = ferrule, 7 = handle

Most files are made with one or two faces slightly convex lengthwise. There are good reasons for this. If when filing a broad surface all the teeth were in contact, it would require too much pressure to make it cut; this would mean practically double work and also make it more difficult to control the file. If the face of the file were straight, to produce a flat surface every part of the stroke would have to be perfectly straight. This is impossible.

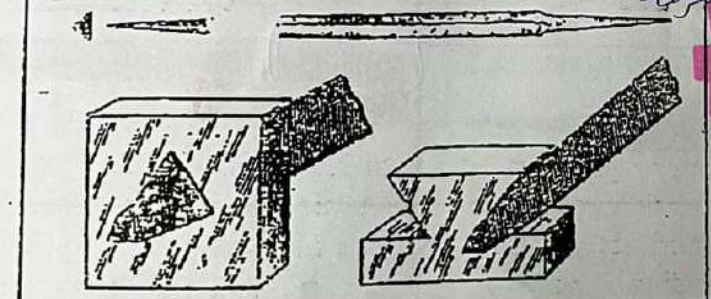
The safe edge of a flat file is the one on which no teeth have been cut (or where the teeth have been ground off). This edge keeps one side of a piece of work safe while filing an adjacent surface. As a matter of fact a sharper corner may be obtained with such a file.



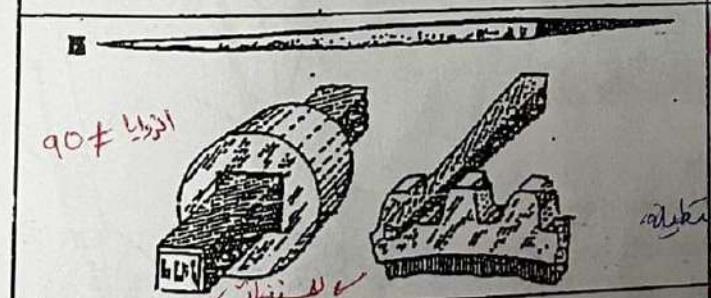
Flat file. Used by machinists, machinery builders, ship and engine builders, repair men, and toolmakers, when a fast-cutting file is needed.



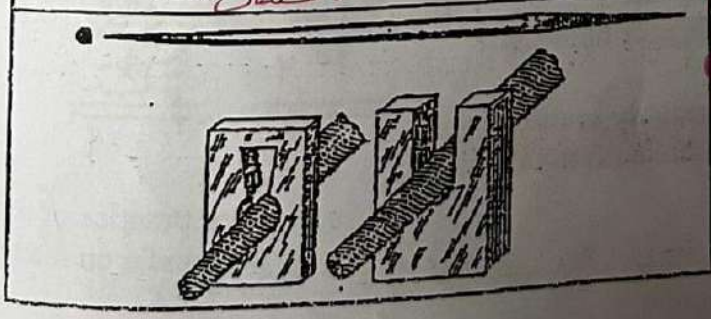
Half-round file. Used for filing concave surfaces as well as flat surfaces. The half-round file is one of the most useful files.



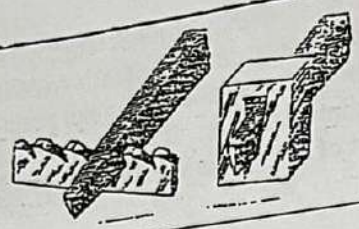
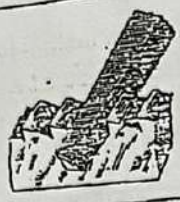
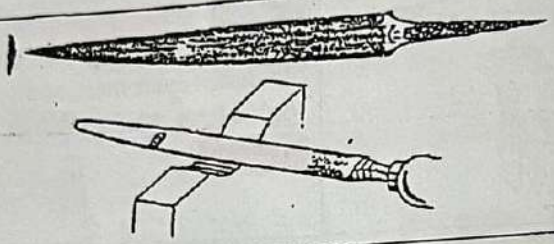
Three-square file. Used for finishing surfaces that meet at less than a right angle, for clearing out square corners, for filing taps, cutters in backing off. Three-square files are also used for sharpening saws, either by hand or held in a machine.



Square file. Used for filing small square or rectangular holes, for finishing the bottom of narrow slots. etc.

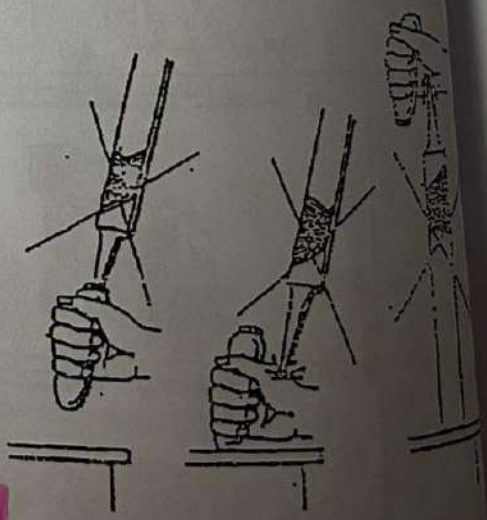


Round file. Used for enlarging round holes, for rounding irregular holes, and for finishing fillets.

	Knife file. Used for finishing the sharp corners of many kinds of slots and grooves.
	Rhombic file. Used for filing the sharp corners of many kinds of slots and grooves. This file is also called "feather edge file".
	Crossing file. Used in place of the half-round file. Each side of the file has a different curve which feature frequently is of great convenience.
	Needle file. Used in fine die work and finishing.
	Mill file. Used for filing soft materials.
	Rasp file. Used for shaping and finishing wood.

Safetv Rules in Filing:

1. Don't use a file with a broken handle or without any handle.
2. See that the bench is stable.
3. When filing objects with sharp edges, don't hold the fingers of the left hand under the file during the return stroke.
4. Never brush chips off with your hands or blow them off.
5. Always clamp the work securely in the vice.
6. Take care when fixing a handle on the file tang.



Poor practice of fixing a file handle on the tang

Tables for Filing:

The terms rough, coarse, bastard, second cut, smooth and dead-smooth refer to the distance apart of the parallel cuts on files and the Nos. 00, 0, 1, 2, 3, 4, 5, 6, 7 and 8 refer to the same things, No. 00 being the coarsest. These terms are relative and depend on the length of the file.

Term	Number	Cuts per cm
Rough	00	4 - 5
Coarse	0	5 - 10
Bastard	1	12 - 18
Second cut	2	20 - 40
Smooth	3	42 - 60
Dead smooth	4	65 - 80
Super finish	5 - 10	100 - 120

Surface Quality Finish Marks:

	Tool marks can be seen with the naked eye
	Tool marks can merely be seen with the naked eye
	Tool marks cannot be seen with the naked eye