

FACTFILE:

ENGINEERING & MANUFACTURING QUALITY CONTROL

UNIT 3.2.2 – USING MATERIALS, PARTS, COMPONENTS, TOOLS, EQUIPMENT AND PROCESSES



Hand Tools

Introduction

Students should be able to:

- identify, use and state the application of:
 - wood chisels;
 - mallets;
 - files;
 - hammers;
 - hand planes;
 - taps and dies;
 - hand saws;
 - adjustable spanners;
 - ring and open end spanners (metric only);
 - socket sets (metric only); and
 - allen keys.

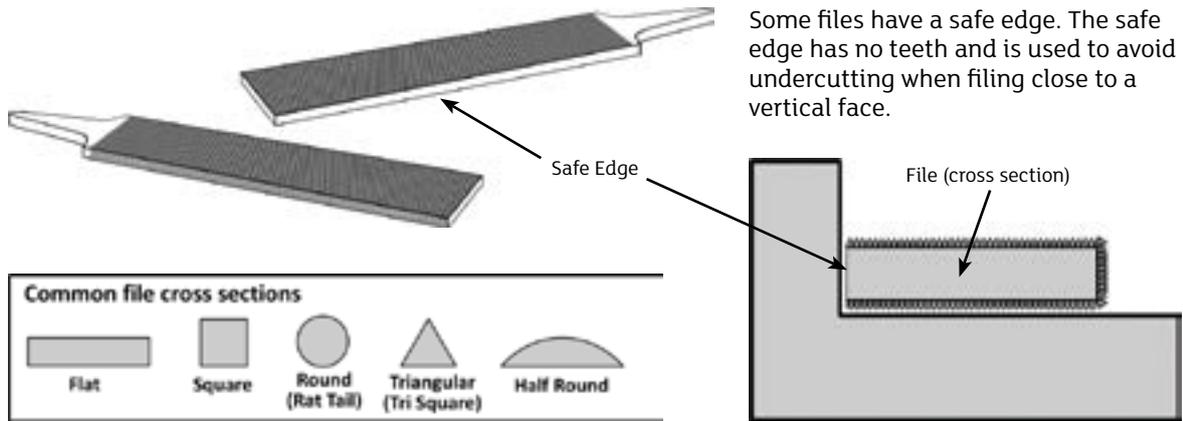
Files

A file is a cutting tool used to remove small amounts of material from a work piece, files are a common hand tool in metalworking and are available in various grades of cut from rough to very smooth.



Files are made from high carbon steel which is hardened and tempered and have a tapered end called a tang onto which a wooden handle is fitted. The faces of the file have groves cut into them to form the teeth of the file.





Some files have a safe edge. The safe edge has no teeth and is used to avoid undercutting when filing close to a vertical face.

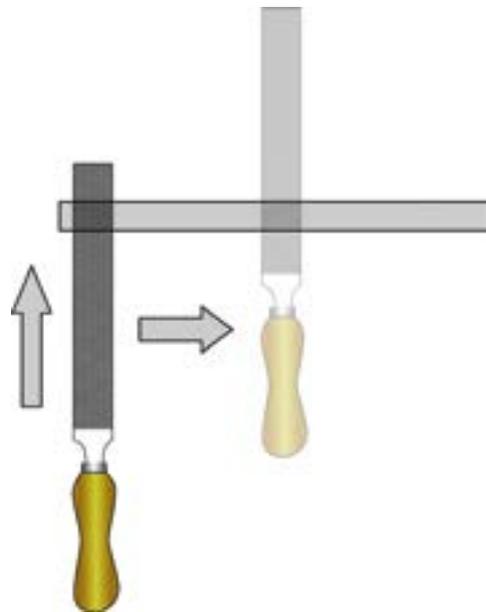
A file should never be used without a handle.

Files are classified by their length, shape and cut. Files are made in a range of cross sections to suit filing different profiles on a material surface, there are also many specialist file profiles suited to specific tasks such as sharpening saw blades and filing into acute corners.

Needle files are small files with a dead smooth cut that are used for very fine and intricate metalwork.



Using a file



Cross filing

Cross filing is a technique that cuts across the work piece with the file held at 90 degrees to the work.

The file should move forward and sideways simultaneously so that material is removed evenly over the whole face of the material, this method will produce a much flatter and even surface.

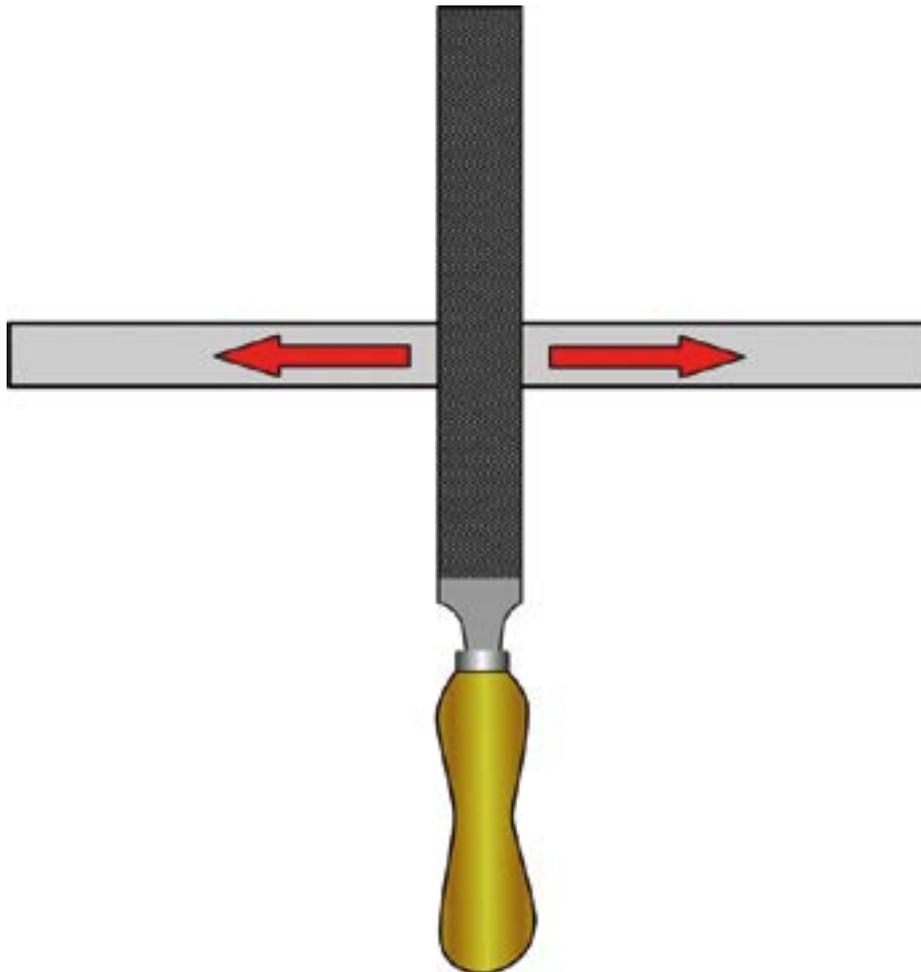
A file will only cut on the forward stroke so no downward pressure is required on the return stroke.

Draw filing

Draw filing is a finishing process where a smooth file is held at a right angle to the material and drawn along in a motion parallel to the longest edge of the material.

Draw filing produces a series of fine cuts on the surface that give a high shine and uniform appearance to the face of the work piece.

Files should never be rubbed or hit together as this will blunt the files and can cause chips to break off causing possible injury to the eyes. The file handle must be fitted securely by tapping it firmly on the bench.



Hammers and Mallets



© Brand X Pictures/Thinkstockphotos

Claw Hammer

The most common hammer for general woodwork, it has a curved claw with a Vee shaped cut out that can be used as a lever to remove nails.



© Dcwcreations/iStockphoto/Thinkstockphotos

Ball Pein Hammer

The pein is the name given to the back end of a hammer. The ball pein hammer is normally used by engineer's for shaping metal and closing rivets.



© VvoeVale |iStockphoto/Thinkstockphotos

Cross Pein Hammer

The Cross Pein Hammer is mainly used for shaping metal. The pein is a tapered flat blade with a flat end that is at a right angle to the handle. The cross pein is often used to start panel pins.



Image © Jupiterimages|BananaStock RF/Thinkstockphotos

Mallet

The mallet is made of wood and is used to tap wood joints together without bruising or damaging the wood. The mallet is also used with wood chisels.

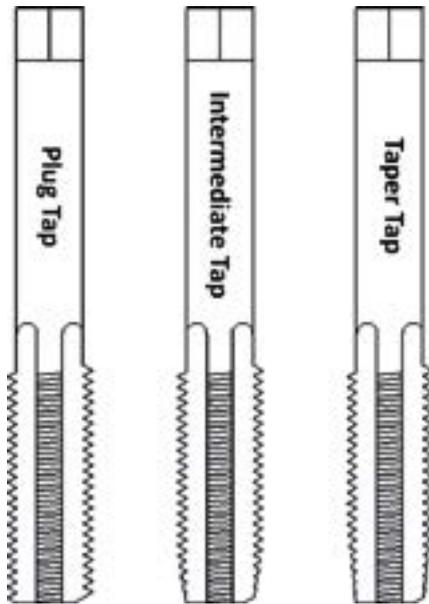


Image © Zoonar RF/Zoonar RF/Thinkstockphotos

Rubber Mallet

The rubber mallet is used when assembling tightly fitting parts such as cabinet parts and in mechanical assembly when a metal faced hammer would cause damage to a surface.

Taps and Dies



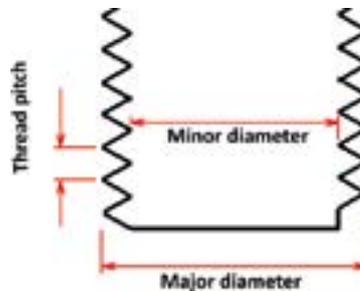
Taps are used to cut internal threads (threads inside a hole) and are available in a range of thread diameters and pitches.

Taps are labelled with the thread type and diameter, for example –

M10 x 1.25

This means the tap will cut a metric thread with a 10mm outer diameter and a pitch of 1.25mm. The pitch of a thread is the distance from one thread to the corresponding point on the next thread.

A tapping hole must be drilled prior to cutting the M10 thread. Each thread has its own tapping drill diameter. The diagram below shows the pitch major and minor diameter for a metric screw thread.

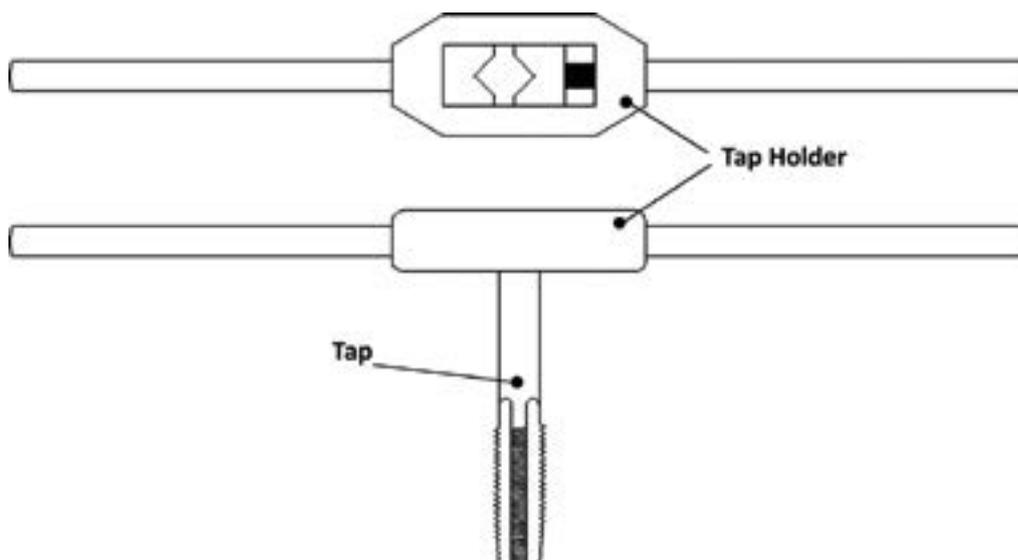


There are three taps in a set, a taper tap has a long tapered section which makes it easier to start the cutter.

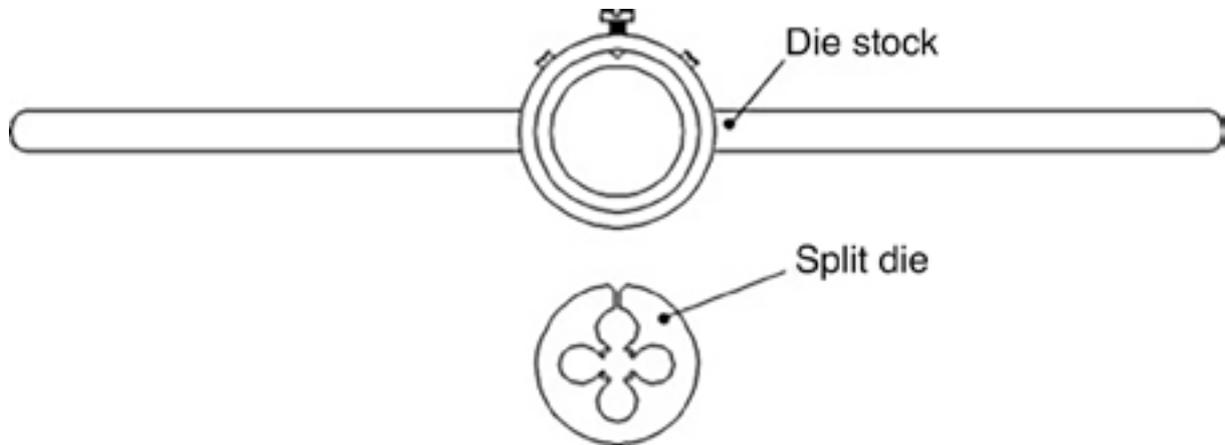
The intermediate tap has a short tapered section and is usually satisfactory for through holes.

The plug tap is usually used to finish blind holes and will cut a fully formed thread over its full length.

Taps are held in a tap holder which grips the square end of the tap and allows the user to turn the tap.



Dies are used to cut external threads (threads on the outside of a bar). A split die is a die that can be opened and closed by a small amount to adjust the fit of the thread. On the first pass the die should be opened using the adjustment screws, this will cut an oversize thread and will make the cutting process easier. The die can then be adjusted in small increments to obtain the required fit in the threaded hole before the final pass to finish the thread. A good quality cutting compound should be used when cutting threads.



The diagram above shows a split die and a die stock which is used to hold and adjust the die.

Hand saws

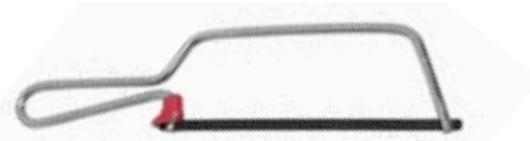
The hacksaw is made up from a sturdy handle with a tubular frame and uses disposable blades. Hacksaw blades are available in a range of sizes. Fine grades of blade (32 TPI) are used for thin materials and coarser blades (14 – 18 TPI) are suited to cutting thick metal. The blade is fitted to cut on the forward stroke and tensioned by means of a wing nut on the end of the frame.



© nonillion /iStock/Thinkstockphotos

TPI stands for teeth per inch and refers to the number of teeth in each one inch (25mm) section of the blade, the higher the TPI the finer the blade. Hacksaws are generally used for cutting metal but in some trades they are used to cut plastic pipe and other materials.

Junior hacksaws are smaller hand saws used for tasks such as trimming rivets and screws to length. The junior hacksaw is usually fitted with a 32 TPI blade which cuts on the forward stroke. The blade is tensioned by the spring steel frame.



© George Doyle /iStockbyte/Thinkstockphotos

Tenon saws are most commonly used for cutting wood joints such as mortise and tenon joints. A tenon saw has a fairly short, stiff blade with a brass spine running along its back this enables the user to make straight, precise cuts on the forward stroke of the saw.

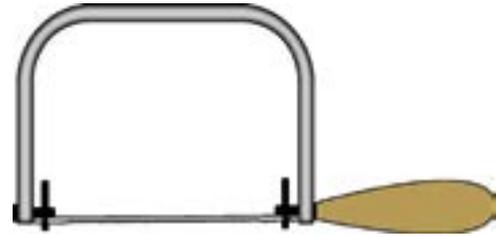
Compared to other wood saws, tenon saws have more teeth per inch which means they will cut through materials slower than saws with fewer teeth, thus giving you more control over the depth and direction of the cut and a neater finish.



© Photography Firm/iStock/Thinkstockphotos

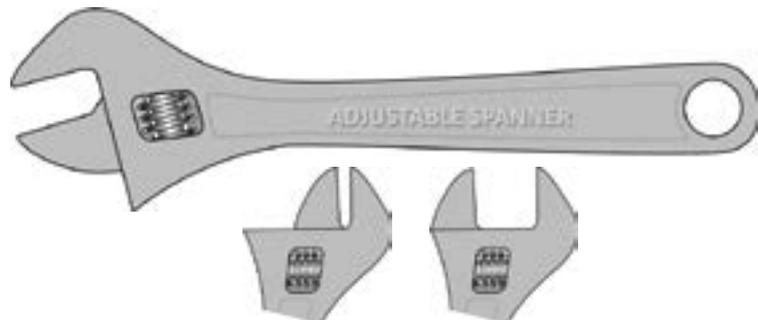
Coping saws are designed for cutting intricate shapes or curved lines. They should not be used to cut material any thicker than 25mm. A coping saw can also be used to cut shapes in the middle of a piece of material. This is done by removing the blade from the saw, drilling a hole in the material, threading the blade through and reattaching it to the saw.

The blade of a coping saw should be inserted in the frame with the teeth pointing back towards the handle. This is to ensure that the saw cuts on the pull stroke, rather than the push stroke. A coping saw blade usually has between 12 and 20 teeth per inch.



Spanners

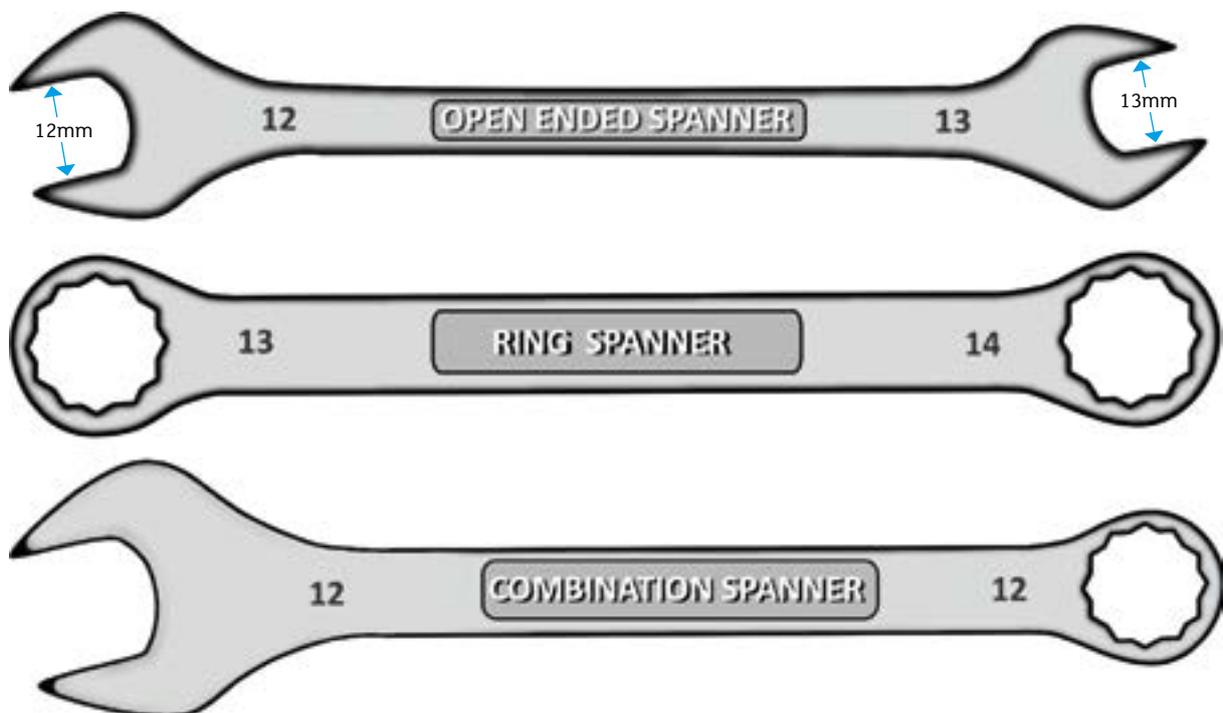
The adjustable spanner is an open ended spanner with a moveable jaw which can be adjusted via a threaded nut. Adjustable spanners are useful in a small tool kit as they can fit almost any hexagon nut.



Spanners come in three basic formats, open ended, ring spanner and a combination of both and are designed to fit a specific size of nut or bolt.

Open ended spanners and ring spanners have different sized ends. Metric spanners increase in whole millimetres increments. Combination spanners have a ring on one end and an open end on the other with both ends the same size.

Some ring spanners are offset.



Sockets sets

Sockets can be used instead of spanners. Socket sets contain a number of sockets and usually include a ratchet and one or two extension bars. Each socket is designed to fit a specific bolt or nut. The ratchet has a square drive which fits into the socket to enable it to tighten or undo a bolt or nut. The ratchet action which can be reversed, allows the bolt or nut to be tightened or loosened in small movements without the need to disconnect the ratchet and socket from the nut or bolt. Sockets are very useful in confined spaces.



© GetUpStudio/iStock/Thinkstockphotos



© moxumbic /iStock/Thinkstockphotos

Allen keys

Allen keys come in a range of sizes. They are used to tighten Allen head screws and bolts which have a hexagonal socket in their head.

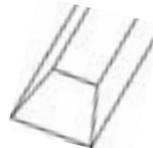
The large surface contact between the socket and the key enables a large torque to be applied to the bolt.



© Björn Forenius/iStock/Thinkstockphotos © Björn Forenius/iStock/Thinkstockphotos

Wood chisels

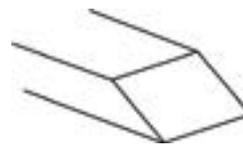
Bevel edge chisels are the most common chisel used in the work shop. They are bevelled on the sides to allow maximum access to dovetails. Bevel chisels can be used with a mallet to chop away waste material or with a pairing motion to trim surfaces right into corners.



Cross section of bevel chisel

Mortise Chisels

Mortise chisels get their name because they are chiefly used to cut mortise joints and have a steel hoop on their handle to withstand repeated mallet blows. The mortise chisel has a thick blade with a cutting edge that is usually ground to an angle between 30 and 40 degrees.



Cross section of mortise chisel

Hand planes

Planes are used for removing waste material and smoothing the surface of wood. They can when used correctly produce a very smooth surface finish.

There are many different planes designed to suit specific applications but the most common planes are the Jack Plane, Smoothing Plane and block plane. They look similar but differ in size and application.

A plane must be set up correctly to obtain the best results. The plane has a lever to adjust the side to side angle of the blade and a screw mechanism to adjust the depth of cut of the blade. The blade must be removed from the plane when it needs to be sharpened. An oil stone is used to sharpen the blade.

The block plane

The block plane has its blade set at a much lower angle than other planes and is designed to fit in the palm of the hand. The block plane is used to plane the end grain of boards, it is said that this plane was originally designed to trim cut marks from butcher blocks. The block plane is also used to produce bevels on corners.

The smoothing plane

The smoothing plane is used to reduce wood to size or for finishing a wood surface it can produce a finer smoother surface than glass paper.

The jack plane

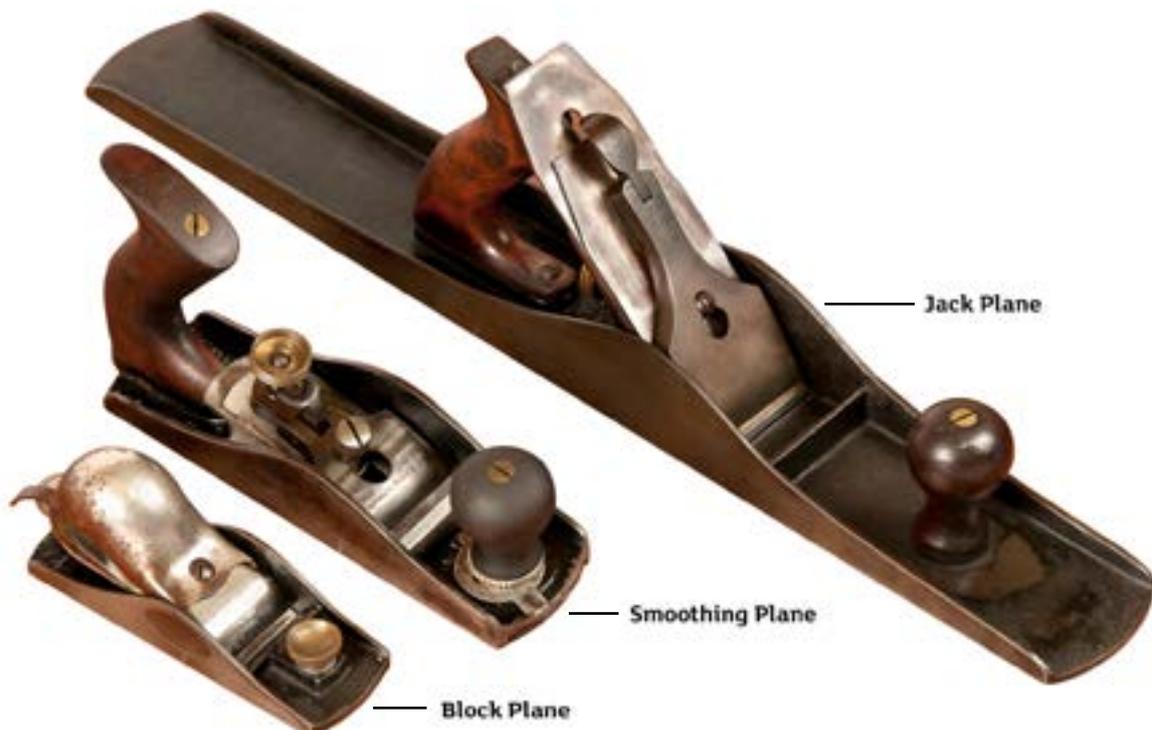
A jack plane is a general purpose bench plane used to reduce a piece to the desired size and for initial smoothing of wood.

It is longer than the smoothing plane, so is better suited to taking off the high points along the length of the wood rather than following any undulations, thus giving a straighter edge. Jack planes are used to create flat surfaces on boards.

Using the plane

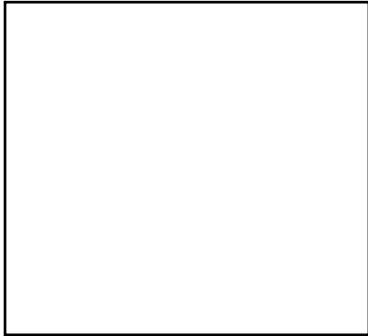
The direction of cutting with a plane must follow the direction of the wood grain to obtain a good finish, cutting against the grain will produce an uneven and rough surface.

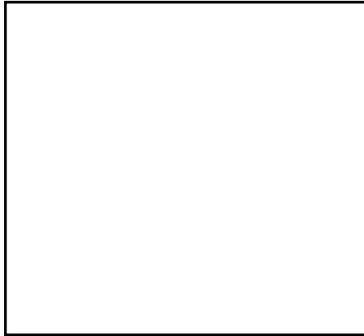
The blade must be adjusted so that the depth of cut allows the wood shaving to bend and flow out of the plane. Setting the depth of cut too deep may result in splitting where the cutting is too thick to bend and will cause the wood to split in front of the blade.

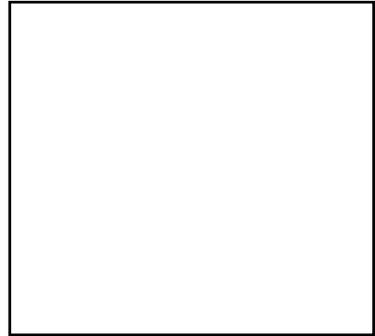


Revision Questions

1. Draw the cross sections of the five most common files and name each one.











2. Explain the purpose of the safe-edge of a file.

3. What filing technique is used to finish a surface?

4. Why must a file never be used without a handle fitted?

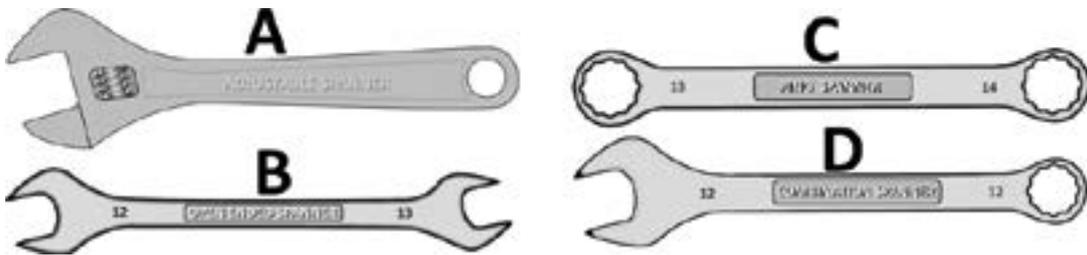
5. Explain the term 'Tapping a hole'.

6. Using a diagram, explain how the pitch of a thread is measured.

7. What equipment is used to cut an external thread?

8. How can you tell which direction to plane a piece of wood to get a smooth finish?

9. Name the types of spanners shown below.



- A _____
- B _____
- C _____
- D _____

10. What type of chisel would be suitable for cutting into the corner of a dovetail joint?

11. Outline the purpose of a block plane, a jack plane and a smoothing plane.

Additional resources

Fundamentals of Filing

<https://www.youtube.com/watch?v=C3Glnmby0d0>

Learn to use a Tap & Die to Cut Threads

<https://www.youtube.com/watch?v=r6Ijd9o-C10>

Mortise and Tenon Joints

<https://www.youtube.com/watch?v=KOEYimvaQz4>

Hand planes 101

<https://www.youtube.com/watch?v=-CLk7vbwPgs>

