

AS LEVEL Section A

FACT FILES

Technology & Design

For first teaching from September 2011

For first award in Summer 2012

Method of Processing
Materials Part 1



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design

1.6 Method of Processing Materials Part 1



Learning Outcomes

Students should be able to:

- Demonstrate knowledge and understanding of:
 - wasting to involve workshop hand tools, manual and CNC machine tools;



Course Content

The process of taking something away from a material is called wasting.

It is given this name because the material which has been removed such as the shaving and dust are generally thrown away as waste.

Shaping by wasting can be done by using machinery or hand tools and on various different materials.

The terms wasting and moulding are often used in the processing of materials but there is a clear difference:

Wasting – processes that produce waste, e.g. planing, milling.

Moulding – results in a change in shape with the aid of a moulding using solid or molten material.

Wasting by hand

Hand tools

If wasting by hand depending on the material being processed and the task being carried out the most appropriate hand tools should be used to ensure that the wasting is done properly.

The following tools are use when wasting by hand:

- Chisels
- Saws
- Files
- Planes

Chisels

A chisel is a tool with a purposely shaped cutting edge and a handle. Chisels are used primarily to cut wood and metal. Chisel blades must be sharp for them to do their task effectively and efficiently. Oiling chisels helps stop rusting.



Saws

Saws are hand-operated, with a thin metal blade with a sharp toothed edge, used for cutting wood, metal, plastic or other hard materials.

There are different types of saws:

1. Crosscut Saw
2. Tenon Saw
3. Dovetail Saw
4. Coping Saw
5. Abra File



Files

Files are regularly used in the workshop to smooth and finish rough edges. Files are made from high carbon steel which is heat treated. Treating means that the files become tougher than the steel or other materials they are used on.

Files can be used on various materials including metals such as aluminium, brass and steel.

Different types of files include:

- Half round file;
- Round file;
- Square file;
- Three square file;
- Triangular File; and
- Flat file.



Planes

A wide variety of planes are available which have a range of different purposes. The body is generally made from wood or high grade cast iron with the cutters being tungsten made from vanadium steel. Planes are generally used to smooth rough surfaces or to plane down the thickness of a piece of wood to the required size.



Different types of planes include:

- Jack Plane; and
- Smoothing plane.

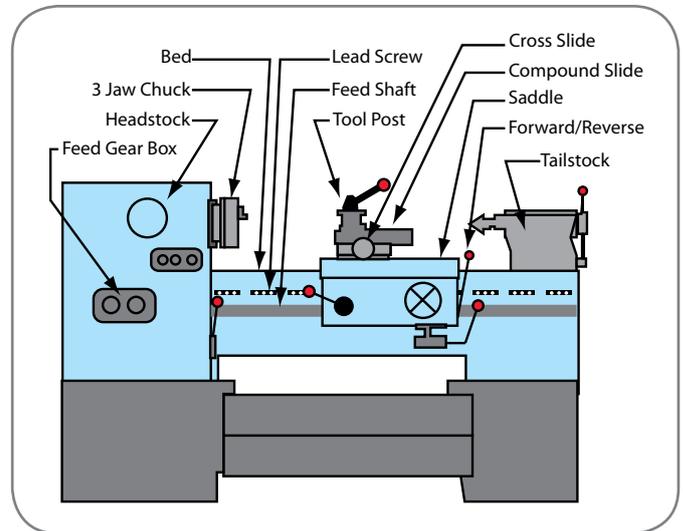


Machine wasting

There are 3 types of machines used for shaping material by wasting.

- Lathes;
- Pillar drills; and
- Milling machines.

Lathes



A lathe was first designed to shape metals; however, with the introduction of plastics and other such materials, with other key properties and characteristics, lathes are now used in a wide range of applications and on different materials.

Lathes, like the one shown above, have four main elements:

- **Lathe bed** – very rigid, made from cast iron. The lathe bed keeps the other parts of the lathe in position.
- **Headstock** – contains the gears (various speeds achievable), motor and drive.
- **Tail stock** – used to hold tools such as drill bits, to support long work and allows the centre of the bar to be found.
- **Saddle** – slides along bed.

Lathes are used to create cylindrical components from metals and plastics materials through a process called turning.

CNC (computer numerically controlled) lathes

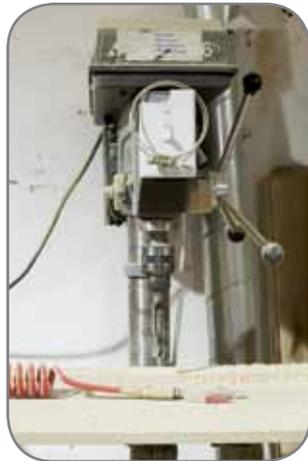
This machine gives greater accuracy because the tools are controlled by a computer, you can achieve within .0001 inches as long as your tooling is sharp and the conditions of the spinning material on the lathe are set to optimize the cutting process. This enables tedious, monotonous work to be completed easily.



Pillar drills

Pillar drills are used for drilling accurate holes in metals, woods and plastics. The key advantages of the pillar drill over the hand-held drill are:

- It will drill with more accuracy;
- It will drill larger holes; and
- Specific angles can be drilled.



Drill bits are cutting tools used to create cylindrical holes. They come in a range of sizes and materials for different types of jobs.



Some of the basic drilling operations are:

- **Countersinking** – drilling a cone-shaped recess at the top end of a hole allowing screws to sit flush on the surface
- **Tapping** – cutting internal screw threads
- **Reaming** - machining holes to size to provide a better tolerance of the diameter and to improve surface finish.



Milling machines

A milling machine involves the movement of the work piece against the rotating cutter, meaning it will be able to cut on its flanks as well as its tip. A milling machine is a high torque, powerful machine used for the complex shaping of metal, plastic or wood parts. Its general form is that of a rotating cutter which rotates about the spindle axis, and a movable bed to which the material is clamped. The cutting tool remains stationary while the material on the bed moves to accomplish the cutting action.

Milling machines are available in two forms which refer to the orientation of the cutting tool spindle.

- Horizontal
- Vertical



Others forms of machine wasting

- **CNC Router** is a machine that creates objects from various materials. It can be designed on the computer with a CAD/CAM program, and then cut automatically using a CNC router to produce a finished part. It is accurate and fairly quick.
- **Ultrasonic machining** – It uses a high frequency electrical signal that is converted into oscillating mechanical motion through electric motors. The high frequency motion causes the cutting tool to expand and contract in a pulsating manner. Cutting takes place at the highest point of amplitude or expansion of the tool. Suitable for very hard materials such as glass, ceramics and precious stone. It is being used in the medical, automotive, aerospace and optics industries.
- **Spark Erodin** – An electrical current is discharged between two electrodes which are in the presence of a dielectric liquid, this produces the spark. It is the repeated action of this discharge which causes the removal of material (hard metal) from the workpiece and shapes the object in the desired accurate fashion. It is used in automotive and engineering industries.

- **CNC Laser** - Very accurate and suitable for various materials. Generally very fast and complex shapes can be achieved easily.



Revision questions

1. Distinguish between the terms **wasting** and **moulding** as applied to the methods of processing materials.
2. Why would a file be heat treated?
3. What are the advantages of using a CNC lathe?

