

# Materials Processing

## Description

**Materials processing** is defined as the series of steps or “unit operations” used in the manufacture of raw-**materials** into finished goods. The operations involve a succession of industrial processes with various mechanical or chemical procedures, usually produced in large quantities or batches.

The purpose of cutting, forming, joining and surface processing of materials is to make products suit our needs.

## Major Types Of Materials Processing

1. Material forming
2. Material cutting
3. Material joining
4. Material surface processing

## Material Cutting

Material cutting refers to the cutting or removal of excessive parts of the materials. For example, to cut material into desired dimensions, to drill holes or to make a trench. Materials can be simply cut by hand tools. To enhance the effectiveness of cutting, machines can also be used.

### 1. Hand cutting

There are various types of hand tools that can be used for cutting. They include hammer, handsaw, file, hand drill, plane etc. Fig. 13 shows some hand tools for cutting. Some portable small-scale machines (e.g. portable power hand drill) are also very common for speedy material cutting. Table below outlines the use and examples of applying hand tools for cutting.

Hand tools for cutting	Usage	Examples of tools	Examples of materials
Hammer, chisel	Cut material with neat edges	Mallet, chisel	Timber
Saw	Separate materials into two parts	Wooden saw, steel saw, coping saw, portable jigsaw	Timber, metal, plastic
File	Have slight cut on material surface	Flat file, half-round file, square file, round file, triangular file	Timber, metal, plastic
Drill	Drill holes on material surface	Hand drill, portable power hand drill	Timber, metal, plastic
Plane	Have deeper cut on material surface	Jack plane	Timber
Tap	Produce internal thread in round holes of metal with the aid of tap wrench	Taper tap, second tap, plug tap	Metal
Die	To produce external thread on metallic cylinders with the aid of die holder	Circular split die, combination die	Metal

## 2. Machine Cutting

Cutting machines can cut materials rapidly and efficiently. These machines include lathe, drilling machine, sawing machine, milling machine and grinding machine. All of them carry specific functions.

### a) Lathe

The major function of a lathe is to cut cylindrical workpieces made of materials such as timber and metal (Fig. 1). Fig. 2 shows different parts of a lathe. Cylindrical workpieces are clamped by the chuck and rotate at a high speed. Cutting can be done by moving the turning tools clamped in the stock according to the shape of the workpiece. Lathes are categorized as woodwork and metalwork lathes



Fig. 1

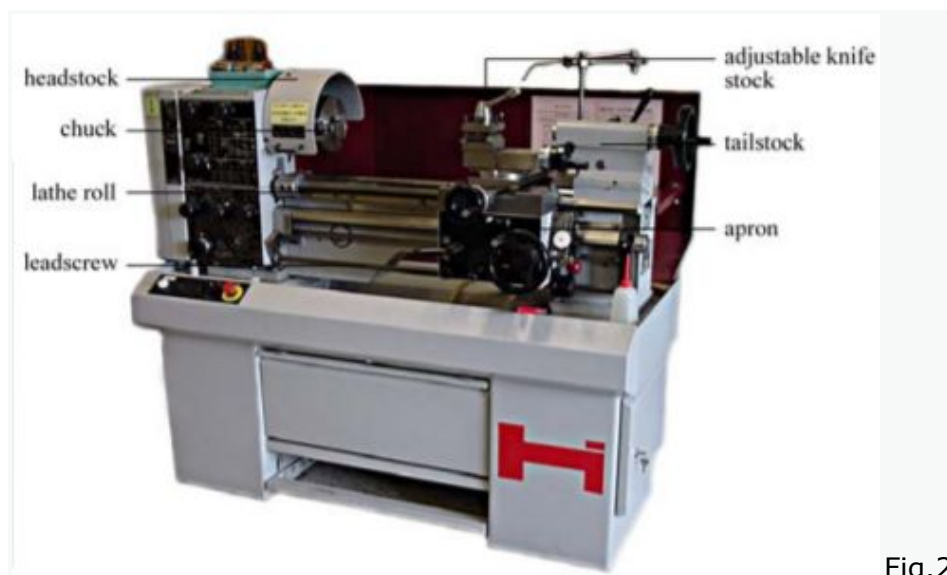


Fig.2

## b) Drilling machine

The main function of a drilling machine is to drill holes with different diameters by using bits. Drilling machines are categorized into table and floor (Fig. 3). Fig. 4 shows different parts of a drilling machine.



Fig.3



Fig.4

**c) Sawing machine**

Sawing machines are mainly used to cut workpiece into pieces by using saw blades. They are categorized as jigsaws, hand-sawing machines and hack-sawing machines (Fig. 5). Table 2 lists the properties of different sawing machines.

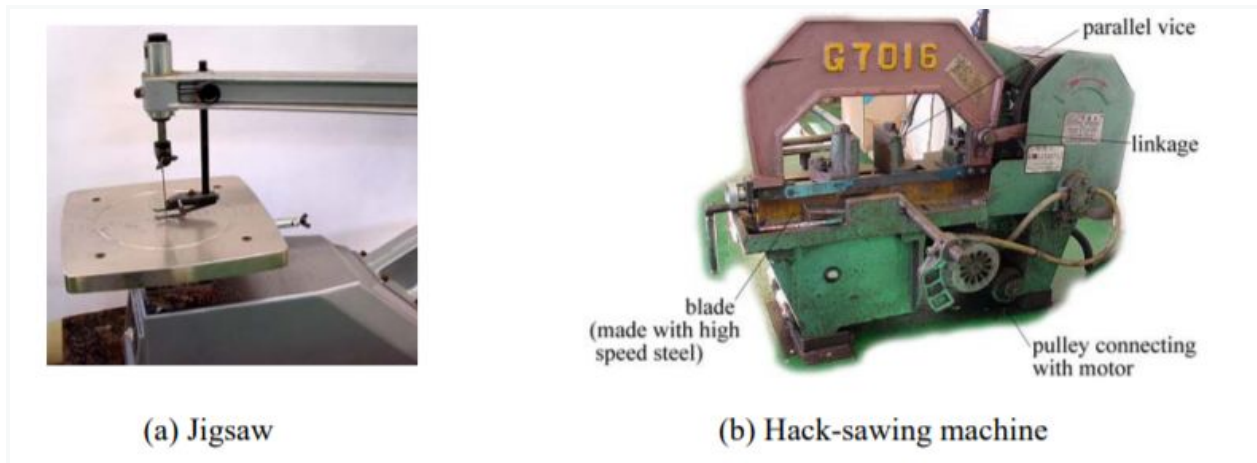


Fig.5

Sawing Machines	Characteristics	Compatible Materials
Jigsaw	Saw-teeth should face downwards. It is used to cut curves.	Cardboard, plastic sheets, etc.
Hand-sawing Machine	Used for cutting straight lines or curves, but not suitable for workpieces which are small in size or great in radius.	Timber, acrylics, etc.
Hack-sawing Machine	Blades are made of high speed steel, greater motor power. Used for cutting large-scale workpieces.	Metallic materials such as copper, aluminium and mild steel.

Table.2

#### d) Milling machine

Milling machine is mainly used for cutting various surfaces (e.g. planes, bevels, troughs, pockets (fig.7) and cams) of materials including timber and metals. Fig. 6 shows the different parts of a milling machine.

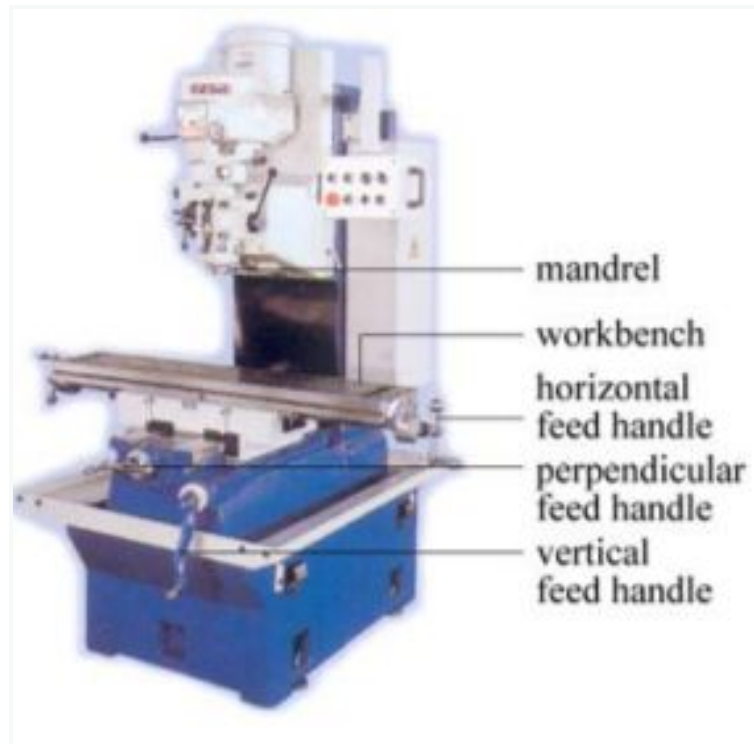


Fig.6

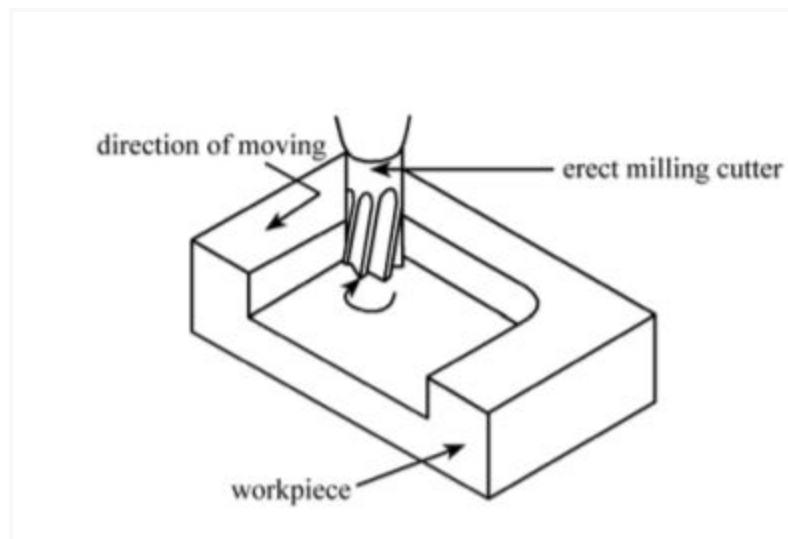


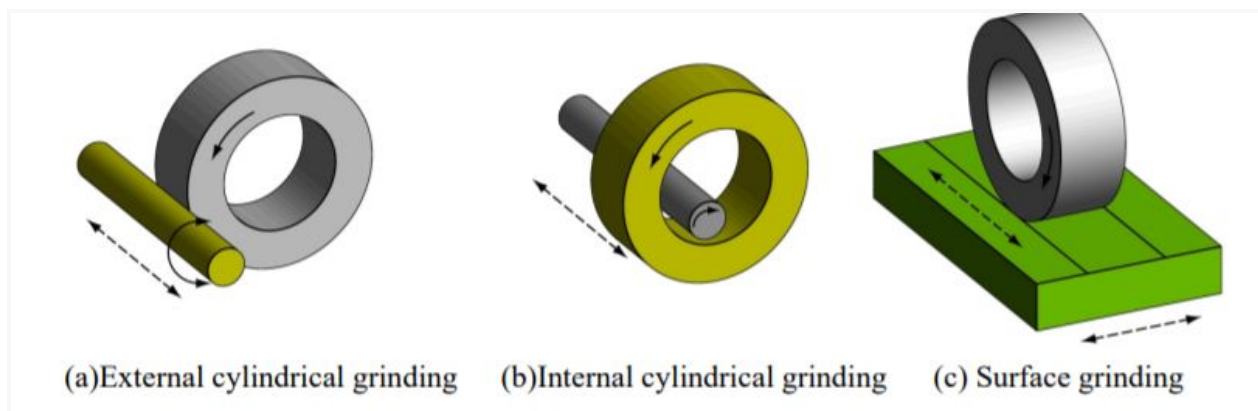
Fig.7

### e) Grinding machine

Grinding machines are used to abrade metallic workpiece by using abrasive wheels in order to raise the preciseness and smoothness



of the surface. Grinding wheels cohere hard abrasive sands. When the wheel rotates at high speed, the sands remove tiny metallic chips like the action of small teeth. Abrasions can be categorized into non-precise ones and highly-precise ones. Non-precise abrasion is to abrade workpiece under great force of the abrasive wheel and it is mainly used to remove protruding objects on rough workpiece such as metallic cast products. There is no need to consider the preciseness of this kind of abrasion. However, highly-precise abrasion should have a good calculation on the abrasion size.



## Assignment

### 1. Give definitions of the following terms

- A. Bevels
- B. Workpiece
- C. Drill bit
- D. Milling Bit
- E. Mild Steel

NB; You will have to research online for some of the terms