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Machining (Part 1)

1 - General

Among the various processing techniques of the material, shaping by removal of material, which means machining, has an expensive job both by the fleet of machines mobilised and by the cutting tools used or the inevitable loss of material by the formation of shavings, however, it is the most reliable method of producing complex forms with precise tolerances (see Figure 1).

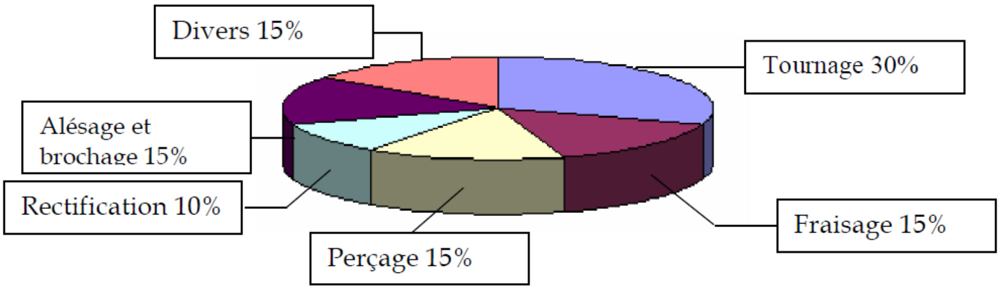


FIG. 1 The different machining processes.

1.1 - Definition

Machining consists in giving a rough part its final shape by removing material, depending on the type of tools and the way of working, various classifications can be made.

2. Filming

2.1 Shooting Process

Turning is a process of mechanical manufacture by cutting (removal of material) using tools with a single edge. The part is driven by a rotational movement (**cutting movement**), which is the main movement of the method, the tool is driven by a complementary translational movement (rectilinear or not) called **advance movement**, making it possible to define the profile of the part (see FIG. 2).

The combination of these two movements, as well as the shape of the active part of the tool, make it possible to obtain machining of forms of revolution (cylinders, planes, cones or complex forms of revolution).

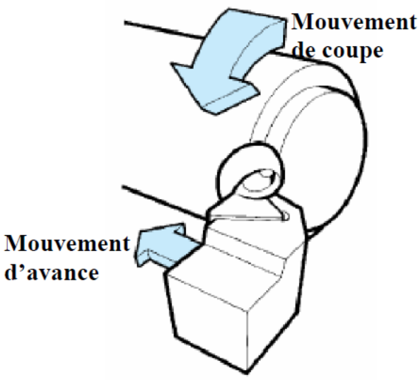


FIG. 2 Movements related to the shooting operation.

Turning (see FIG. 3) also makes it possible to shape the inner shapes by drilling, bore, tapping, etc.

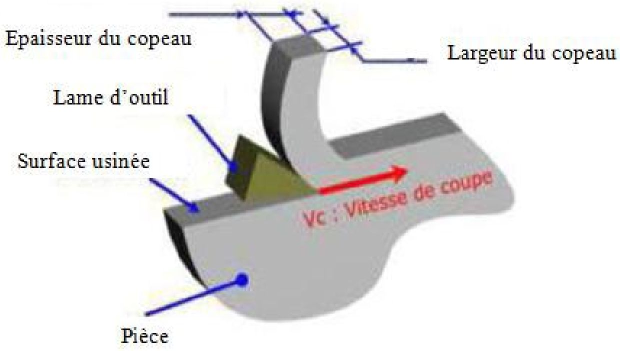
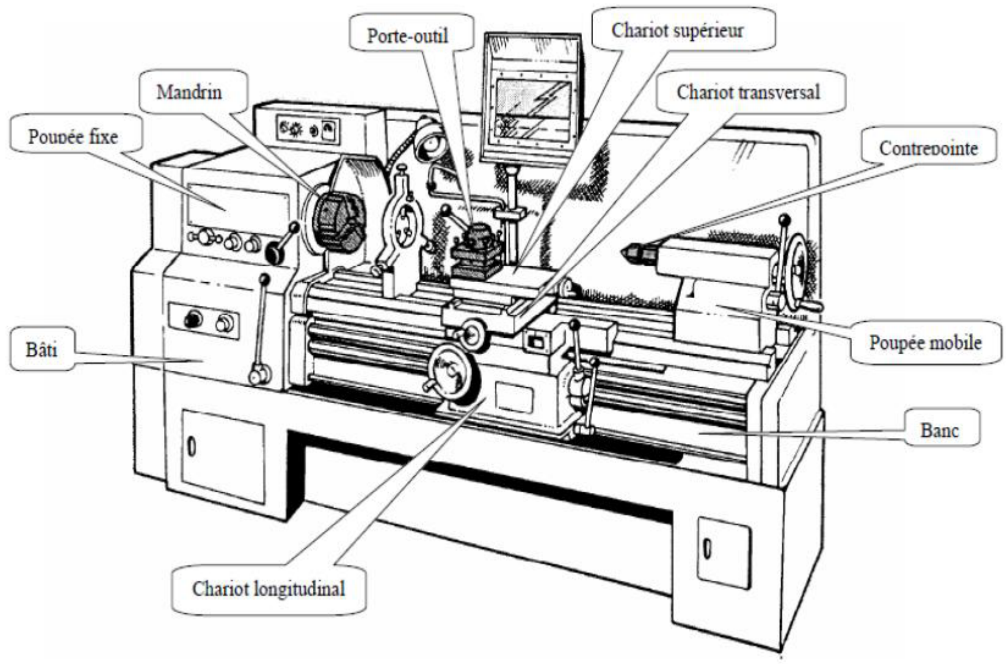


FIG. 3 Shooting **principle.**

2.1 Turning machine tools

The most common machine tools used in turning are (see Figure 4):



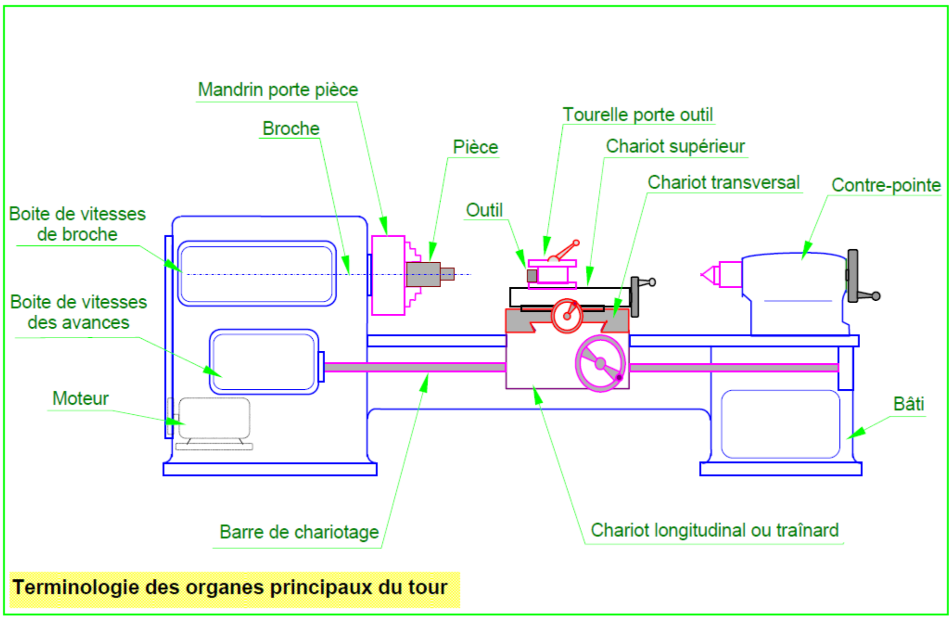


FIG. 4 Components of a turn.

2.1.1 Parallel towers

These machines are used for single or small and medium series work on very simple parts. These towers are not very flexible. Only the surfaces whose generatrices are parallel or perpendicular to the axis of the spindle can be produced during envelope work.

2.1.1.2 Semi-automatic spins

2.1.1.3 Automatic turns

a. Single spindle towers for machining one part at a time with several tools acting simultaneously.

b. Multi-pin lathes for simultaneous machining of several parts at a time, passing each cycle in front of a different tool This type of tower comprises, for example, six pins, six tools, one per pin, work at the same time and perform a different operation.

2.1.1.4 Numerically controlled towers

These turns are of a computer working from a program specific to the part which allows the simultaneous displacement of two axes, including the successive positions, to reach any generatrix of a part.

These towers are equipped with a tool magazine and possibly a part loading system, these towers are well suited for unit work or small repetitive series.

2.2 Definitions of Major Shooting Operations

2.2.1 Carriage

Carriage is the operation which consists in machining an outer cylindrical or conical surface.

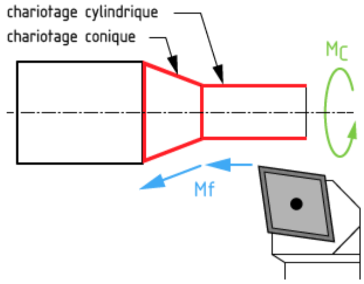


FIG. 5 Cylindrical and conical carriage

2.2.2 Training

Straightening is the operation of machining a plane surface (external or internal) perpendicular to the axis of the spindle.

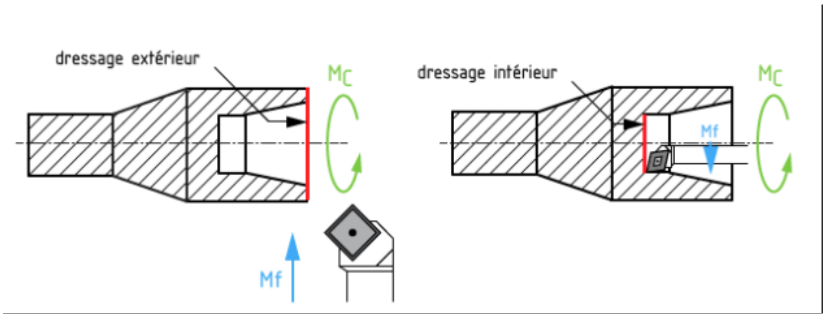


FIG. 6 Exterior and Interior Dressage

2.2.3 Drilling

Drilling is the operation of machining a hole in the room (opening or blind) using a forest. Often, the axis of the hole is confused with that of the room.

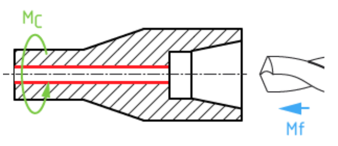


FIG. 7 Drilling

2.2.4 Bores

The bore is the operation which consists in machining a cylindrical or conical surface of quality inside a part.

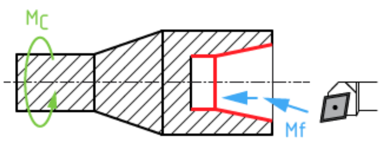


FIG. 8 Cylindrical or conical bores

2.2.5 Grooving

Grooving is the operation of machining a groove (combination of 3 planes) inside or outside. The latter can be used, for example, for housing a circlip or an O-ring.

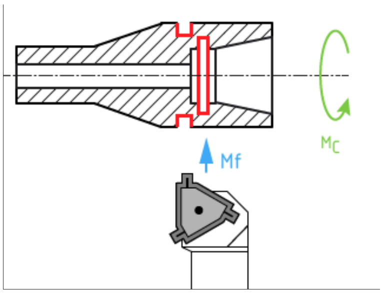


FIG. 9 Internal and external grooves

2.2.6 Chamfering

Chamfering is the operation which consists in machining a cone of small dimension, so as to eliminate a sharp angle.

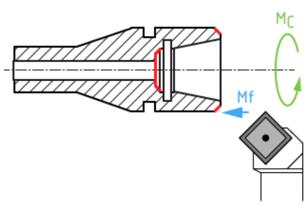


FIG. 10 Internal and external chamfering

2.2.7 Cutting

Cutting is the operation which consists in machining a groove up to the axis of the part in order to detach a section.

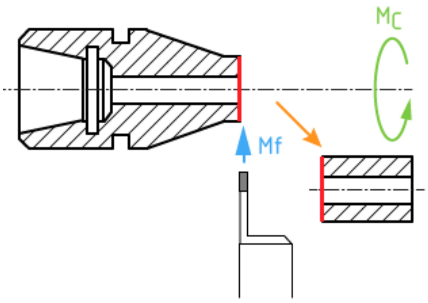


FIG. 11 Cutting

2.2.8 Thread

The **thread** is machining consisting of making an external or internal thread.

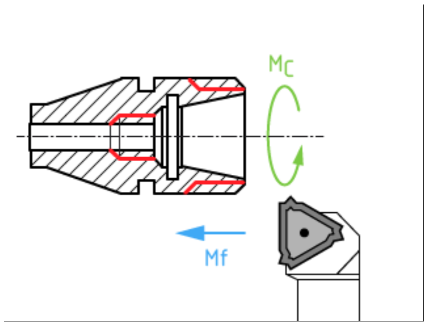


FIG. 12 External or internal threads

2.3 Cutting Conditions

Before carrying out a turning operation, it is necessary to choose the cutting conditions in order to obtain a good result (precision, surface state...): there are several criteria which make it possible to define the cutting conditions, in particular:

- The type of machine (mechanism, speed range,...)
- The power of the machine
- The material of the tool (ARS, carbide...)
- The machined material (steel, aluminium...)
- The type of operation (drilling, carriage, surfacing...)
- The possible use of lubrication (intended to cool or reduce friction).

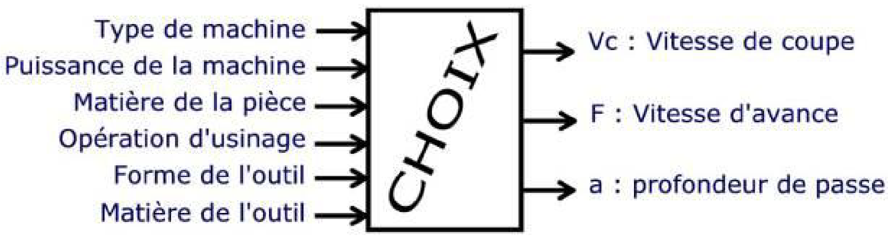


FIG. 13 Choice of cutting parameters.

The cutting movement animates the piece (rotating piece). The cutting speed Vc is deduced $_{\text{therefrom}}$. The advance movement is a translational movement of the tool with respect to the part, from which V_f is deduced.

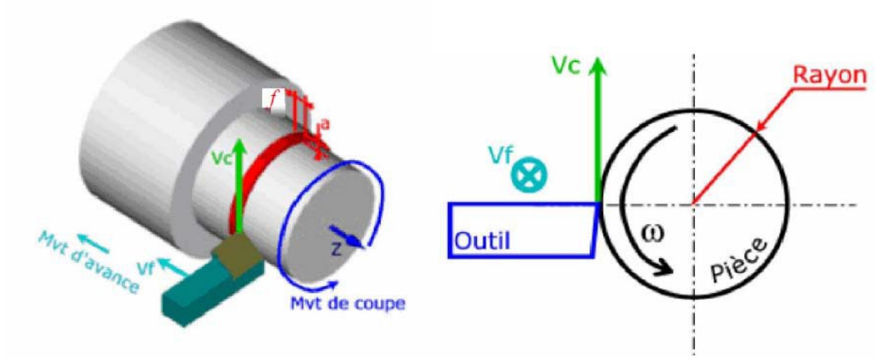


FIG. 14 Cutting conditions during shooting.

2.3.1 Cutting speed

The room is drawn away on the turn at some speed ω (rad / s) (is: 2πN (tr / min), this angle speed being announced by the brooch of the machine via the door room Fig.14 14.

Taking into account the diameter of the part at the machining point situated on a diameter *D*, the relative speed of the part at this point with respect to the tool (assumed to be fixed with respect to the machine) is:

$$\text{Vc (m/min)}=\frac{D}{2}(m)\times\omega(red/\min)$$

The speed of rotation is expressed by the following relation:

$$N(tr/\min)=\frac{1000\times v_c(m/\min)}{\pi D(mm)}$$

2.3.2 Advance speed

The advance speed V_f *(mm/min)* in FIG. 14 is the speed at which the machine moves the tool relative to the frame.

The advance per revolution *f* (*mm/rpm*) is the value of the displacement of the tool, when the part performs a revolution.

2.3.3 Pass Depth "a"

The pass depth denoted *a en* (*mm*) corresponds to the length of the cutting edge engaged in the material, in the case of orthogonal cutting, and to the difference between the radius of the part before and after machining, in the case of turning. The cutting depth is always measured perpendicularly to the direction of advance and not along the edge of the tool.

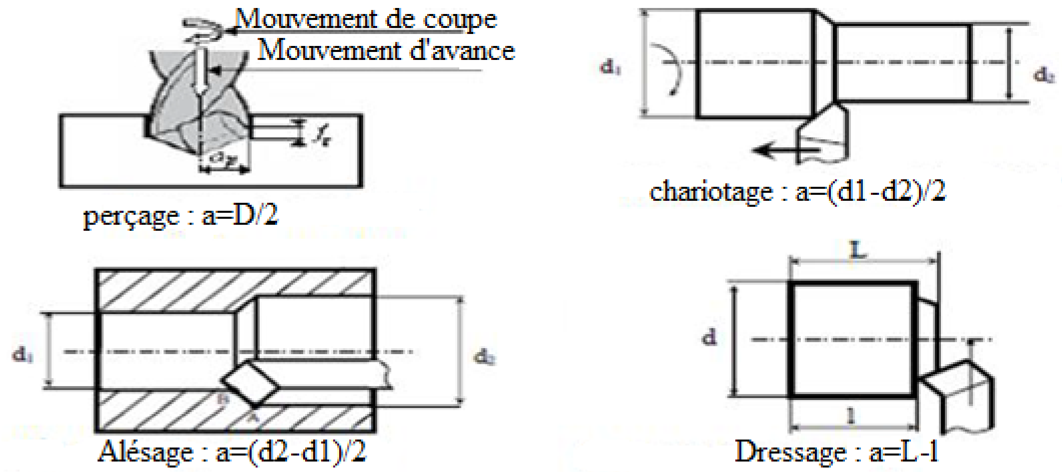


FIG. 15 Depth of pass