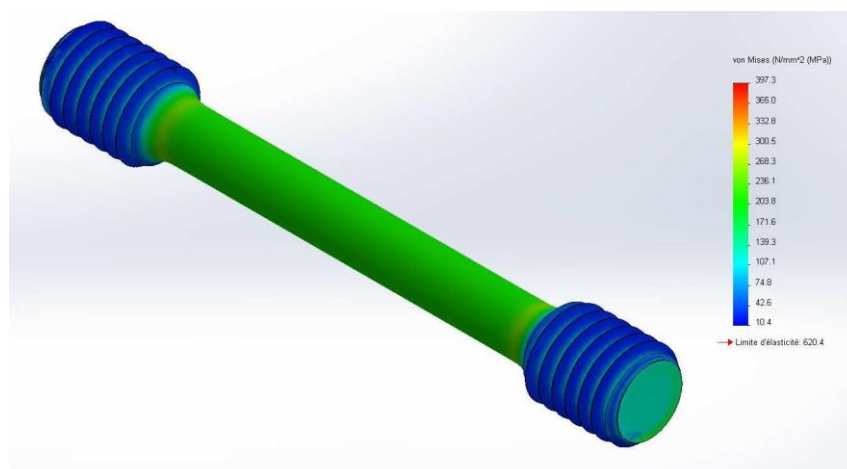


E.E.V.E.E.

Strength of materials



1. Introduction:

The RDM study is a sometimes necessary step between the design and the realization of a part. She permits :

- to justify its sizing
- to determine the choice of materials
- to limit its cost.

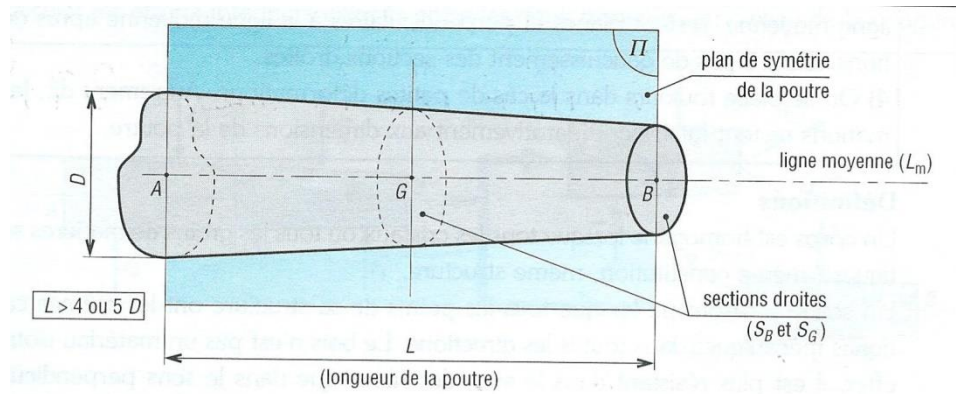
It will also make it possible to evaluate its possible deformations, and thus its lifetime.

2. Beam concept:

RDM is an experimental science, whose relationships are based on a model called a beam.

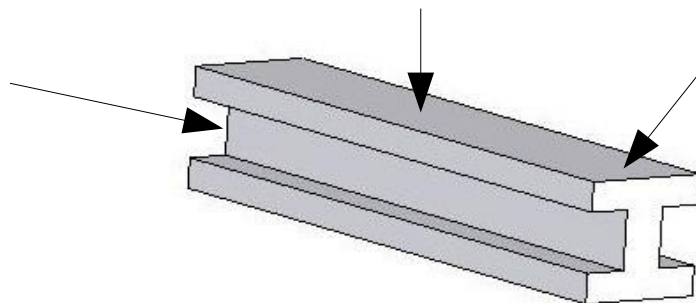
Beam is a solid whose section varies gradually.

The middle line of the beam is the place of the centers of surfaces of successive straight sections. The straight sections are the flat sections and perpendicular to the middle line of the beam.



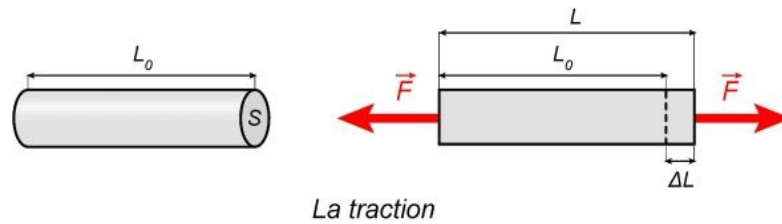
3. Concept of solicitations:

The beam below is subject to external forces. The direction and direction of these efforts relative to the mean line define the type of solicitation that the beam undergoes.

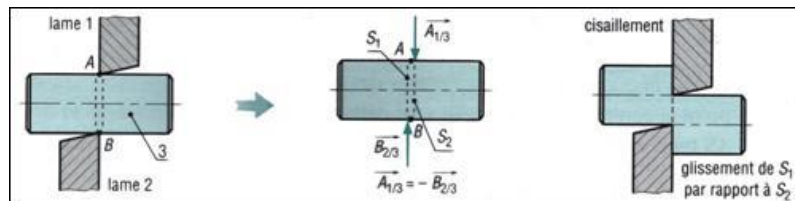


Simple solicitation

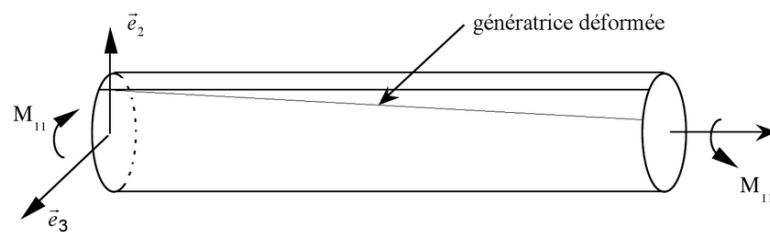
Traction:



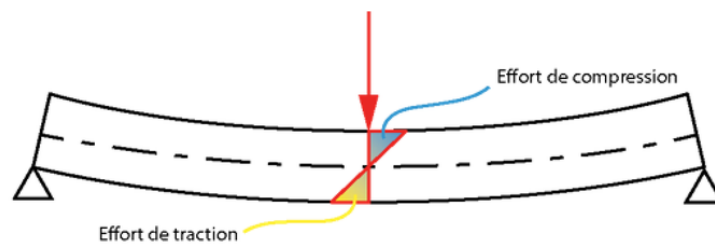
Shear:



Torsion:



Flexion:



4. Concept of constraints:

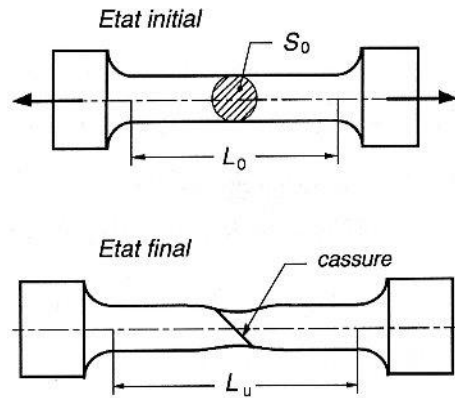
Constraints represent cohesive efforts in a solid that allow the material to withstand stresses. Constraints arise from interaction between small parts of the material (crystals, molecules, etc.).

TRACTION

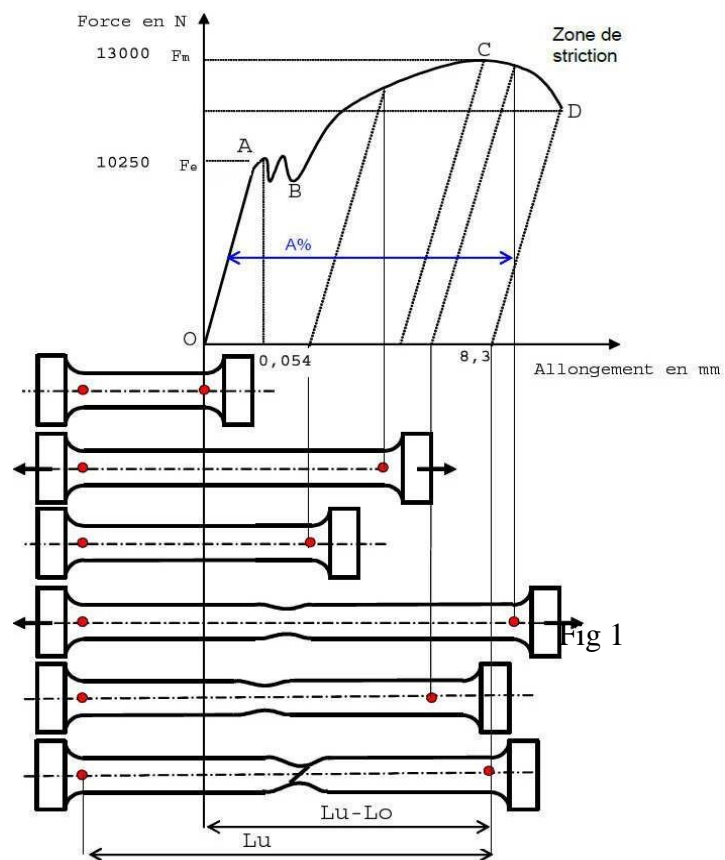
Principle and diagrams

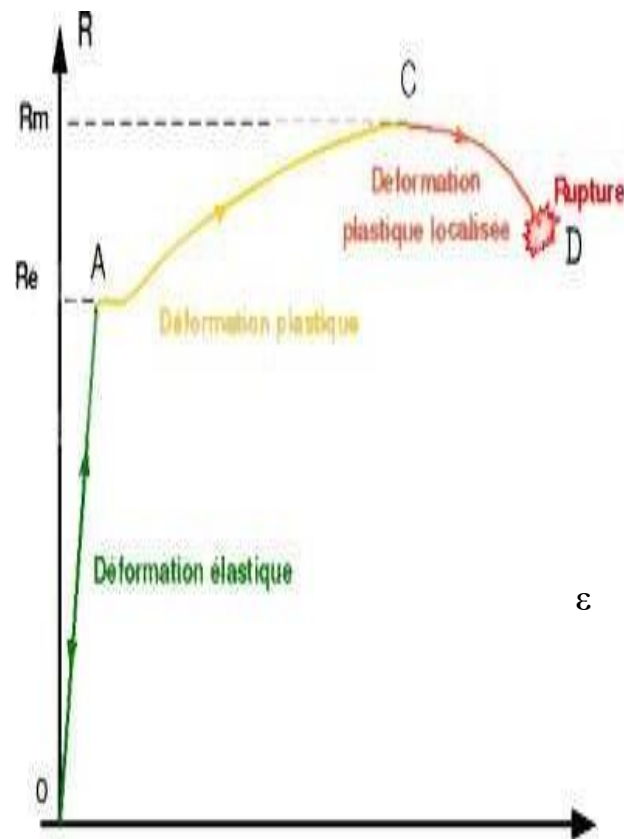
The tensile test consists in exerting on a standardized specimen increasing forces which will progressively deform it until rupture.

From this test, a number of characteristics of the material are deduced.



The traction machine imposes on the test piece an increasing elongation $\Delta L / L_0$ and at the same time measures the resultant force with a dynamometer. A diagram is thus obtained according to the materials.





We can distinguish three phases of deformation:

- ✓ From 0 to A: It is the elastic phase, where the deformation is reversible and proportional to the effort.
- ✓ From A to C: The permanent and homogeneous deformation is called plastic deformation. The material is cracking. The deformation is irreversible.
- ✓ From C to D: The deformation is no longer homogeneous, it occurs on a part of the specimen, this phenomenon is called necking or localized plastic deformation.
- ✓ D: Break point of the specimen.

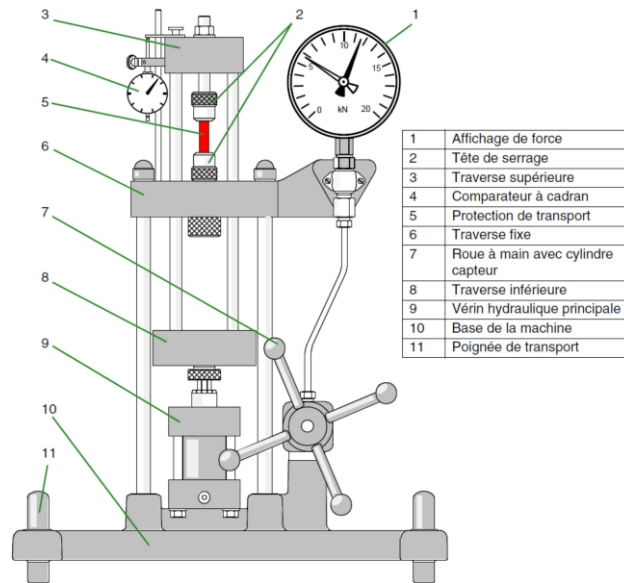
We can also note two characteristic constraints:

$$\text{Constraint} = F / \text{initial section} \text{ in } \text{N} / \text{mm}^2$$

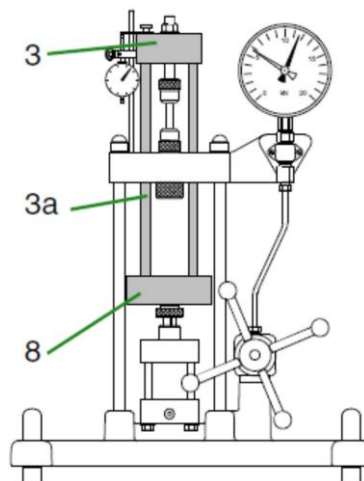
- ✓ Re: the elastic limit stress of the material.
- ✓ Rm: the maximum stress, ie the tensile strength (maximum force applied to the specimen)

The testing machine:

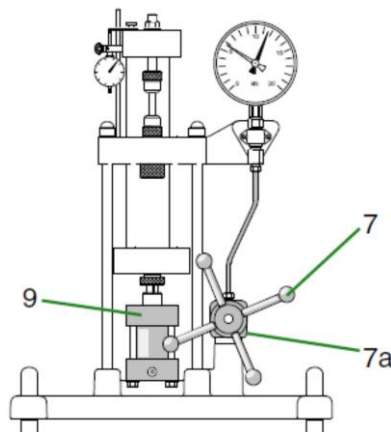
Never exceed 20kN under penalty of deterioration of the machine



Various tests can be performed on this machine. For traction, the test piece will be fixed in the upper part of the machine (red test tube in the figure opposite).



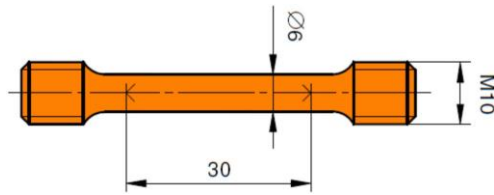
The test piece is fixed between the fixed crosspiece 6 and the movable upper cross member 3 (gray zone in the figure opposite).



The force is generated hydraulically by manually operating the steering wheel (handwheel). The piston 9 makes it possible to convert the hydraulic energy into mechanical translation energy.

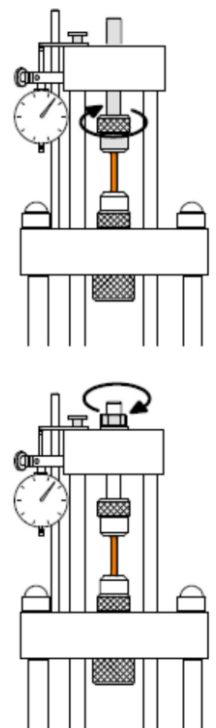
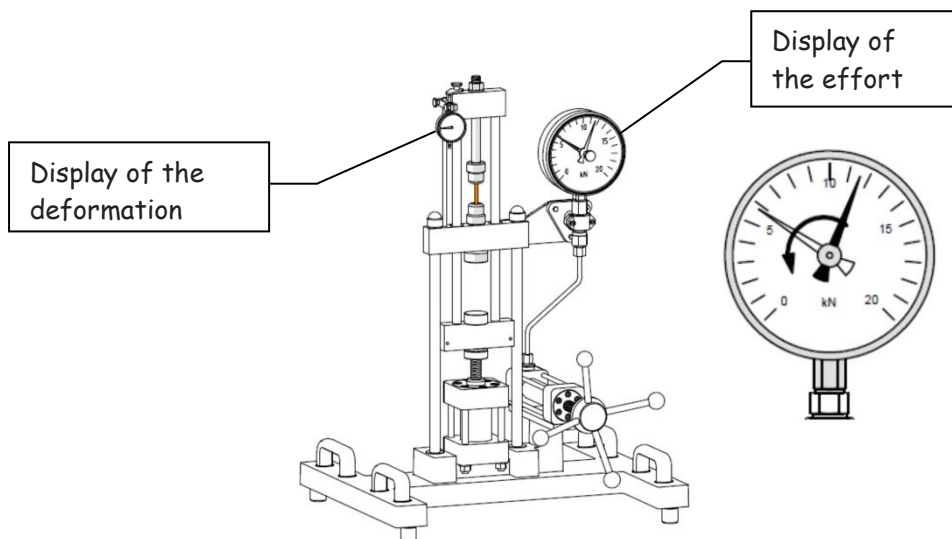
Operating mode:

A cylindrical sample with a length of 30 mm and a diameter of 6 mm is used. Different specimen materials are provided: annealed steel, copper, brass and aluminum.

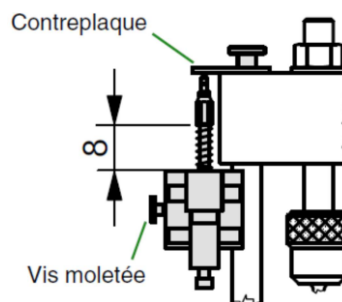


Preparation of the test

- Screw the pulling sample into the lower clamping head by hand until it stops.
- Screw the pulling sample into the upper clamping head until it stops, turn the clamping head by hand.
- Tighten the nut at the upper clamping head by hand until the clamping head is fixed without play in the upper cross member.
- Pre-force the specimen very slightly with the steering wheel.
- Set to zero the pointer resulting from the display of the force (in kN).



- Fix the displacement sensor for the acquisition unit WP 300.20 against the counter plate with a measuring distance of approximately 8 to 10 mm and lock it with the knurled screw.

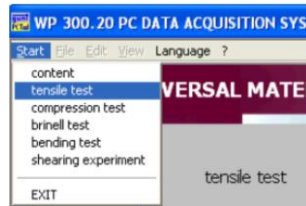


- Launch the GUNT software

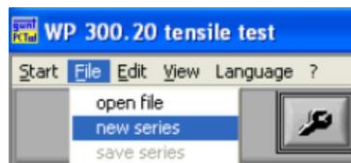


- Launch the software module for acquisition of the tensile test data via the menu

Start → tensile test



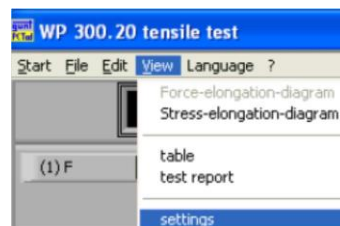
- Create a new project



- Enter a name for the test in the "Name" field in the next dialog window. You can choose it freely. In addition, you can add a comment in the "Comment" field, for example to note special features.

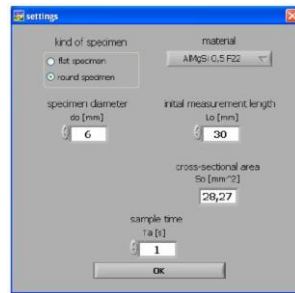


- Using the View Settings menu, open a dialog window where you can specify details about the pull sample and the data acquisition interval.

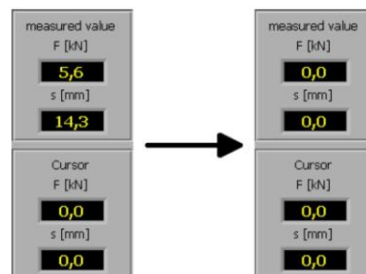


- In the "Specimen Type" field of the "Setup" dialog box that opens, check the type of draw sample used, either for a flat sample or for a round sample. Generally, round samples are used.
- Select the material of the tensile sample in the "material" field or enter a missing material via the define entry of the drop-down menu.

- Enter the tensile sample measurements in the fields
 - Diameter of the test piece d_0 in mm
 - Initial length L_0 in mm



- The preparation of the project is finished. Now you have to calibrate the sensor values.
- Preload the sample slightly (max 0.5kN) to decrease the influence of games

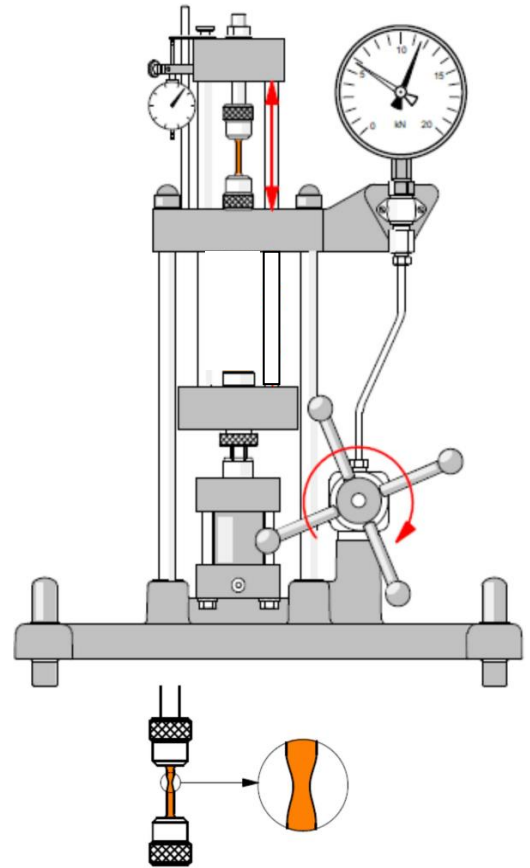


- Put all the displays of the software to ZERO
- Start data acquisition



Realization of the test

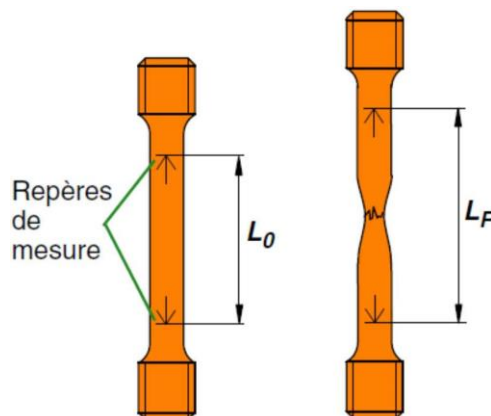
- The traction sample is loaded slowly by turning the handwheel regularly. Avoid any shock or shock;
- Observe the shape of the curve generated on the computer monitor
- Observe the section of the specimen at all times;
- Observe the elongation either on the comparator or on the monitor;
- Observe the value of the force either on the dynamometer or on the monitor;
- During necking, the force no longer increases but is reduced rather;
- Depending on the material of the tensile sample, the sample breaks off slowly or abruptly
- Raise the maximum force



- Disassemble the test tube.

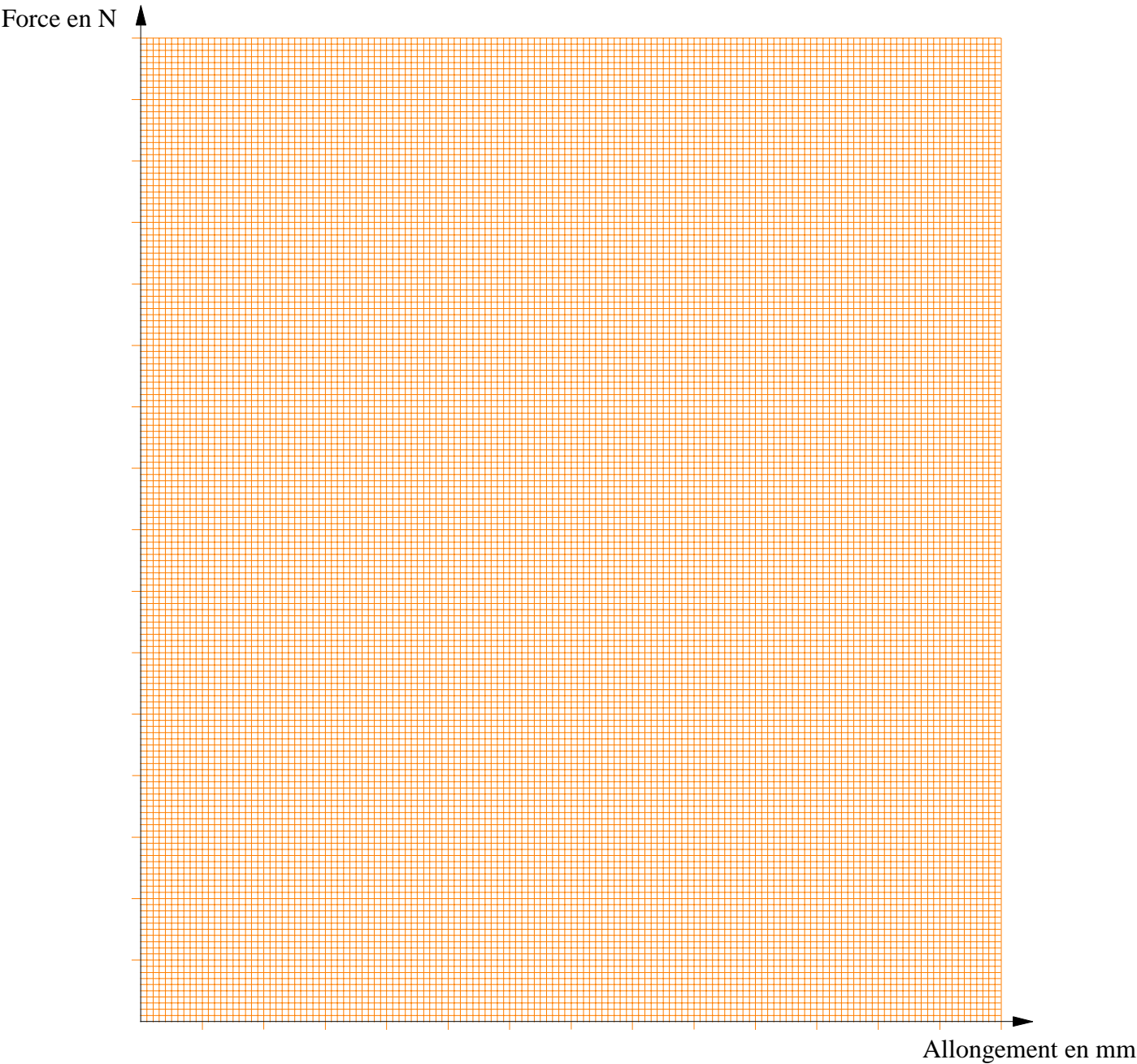
Results of the test

To determine the length L_F (final or ultimate length L_U) of the tensile test piece after the rupture, the two ends of the sample are joined exactly at the breaking point and the distance between the two measurement marks is measured.

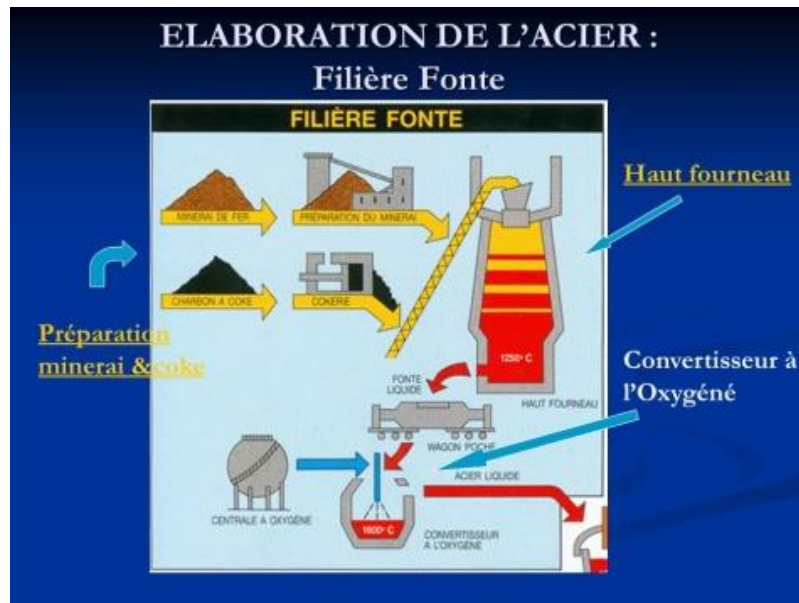


On note les valeurs obtenues dans un tableau.

Sample N °	Material	Fe in N	Fm in N	L ₀ in mm	L _F in mm
1	Steel				
2	Aluminum				
3	Copper				
4	Wood				



From ore to steel

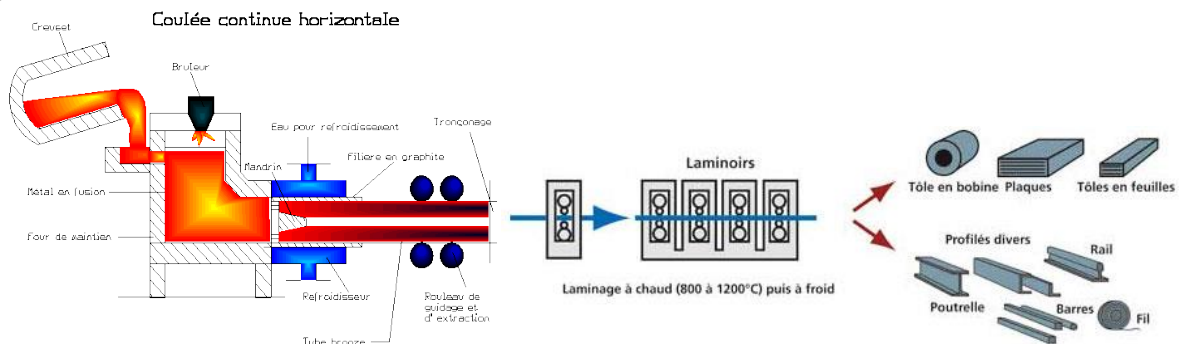


To transform the ore into cast iron, it must be melted. Coke (for combustion) is then mixed with the ore that has been previously prepared.

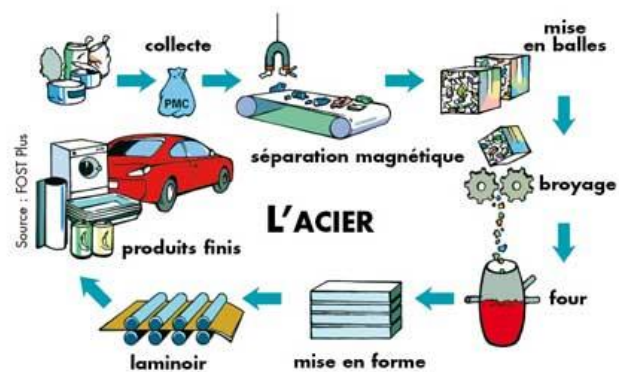
When the blast furnace reaches the temperature of 1250 ° C, we get melting.

The melt is then melted at 1600 ° C to be purified of the carbon contained in an oxygen converter. We get steel.

After various operations: continuous casting, rolling and / or drawing, and machining we obtain a finished Product.



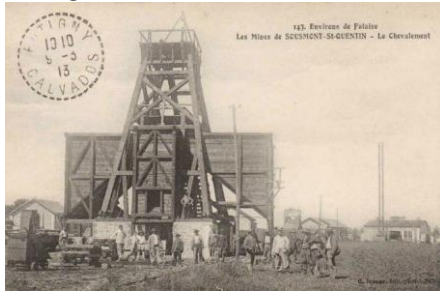
Steel: 100% recyclable



The iron and steel industry in Calvados

- ✓ The ore:

Soumont Saint Quentin

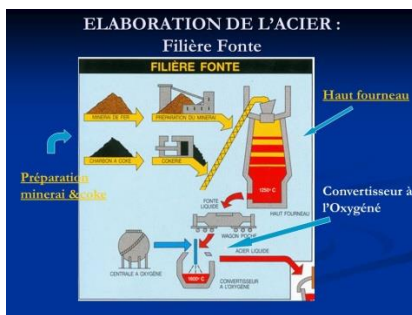


iron-ore

In 1902, the Soumont-Saint-Quentin Concession was granted, covering an area of 773 hectares, making it the largest iron mine in the West. It is the SMS (Société des mines de Soumont) which is responsible for production. The activity will cease on July 28, 1989, following the decision of the SMN (Société métallurgique de Normandie), a single client of the mine, to use other types of ores.

- ✓ Blast furnaces:

Colombelles



The Metallurgical Society of Normandy (SMN) was a Lower Normandy company launched in 1917 and closed in 1993, headquartered in Mondeville, but mainly located in the town of Colombelles, in the agglomeration of Caen.

- ✓ Non-ferrous metals:

Dives sur mer



copper ore

The industrial era will mark Dives-sur-Mer in depth and forge a new identity. The railway and the port are assets that seduce the engineer Eugene Secretan and in 1891 the creation of a metallurgical plant turns the city into a thriving industrial city. It operates a copper drawing patent Elmore and Secrétan and will become the French Electrometallurgical Society, later Cegedur and Trefimetaux as and when the diversification of its fabrications: copper, brass, aluminum, duralumin, nickel silver, plastic ... The plant will employ up to 2,000 workers and will still have close to 1,000 workers when it is closed in 1986.