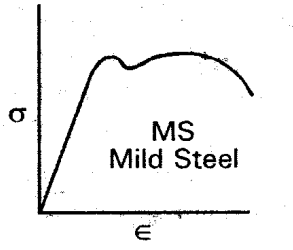
TYPICAL STRESS STRAIN CURVES FOR EASY DEFORMATION

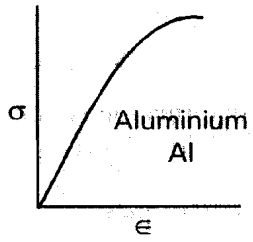
Different stress- strain curves

Some typical stress strain curves are shown below

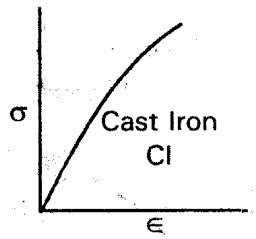
Different stress strain curves
There exists relationship between stress and strain for all materials and it is very useful information for a design engineer and metallurgist alike. It clearly exhibits the behavior of the material. In order to understand the same we shall now look into stress strain curves of various materials. A study of these will help us in understanding the mechanical working process in a better way. The following figures represents pictorially the features of stress **and strain** behavior.



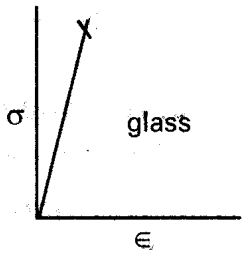
a) Highly ductile material



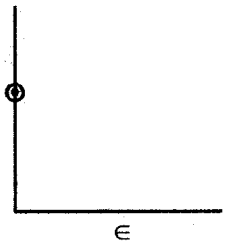
b) Mildly ductile material



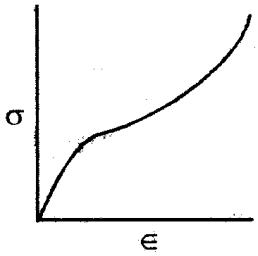
c) Brittle material



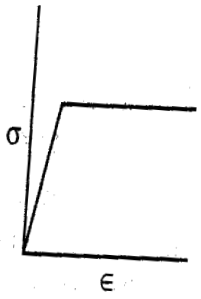
d) Highly brittle material



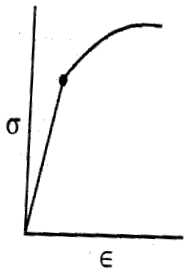
e) Highly Rigid material



f) Polymer material



g) Linear elastic - perfectly plastic material



g) Linearly elastic - Non linearly plastic material

Typical stress strain curves for easy deformation

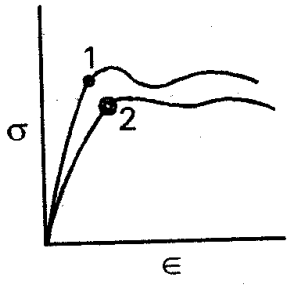
In Mechanical working of metals it is important to know that efforts are to be made to make the metal undergo deformation easily with less effort. The following figures illustrate what are the typical characteristics involved in the material.

For easy deformation of metal the stress strain curve should have:

1. Lower yield point.
2. Gentle slope.
3. Larger elongation behavior.

1. Stress strain curve should have Lower yield point.

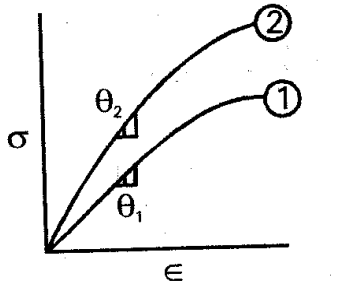
The load required for deformation is directly proportional to the yield point. Hence, if the yield point is high, higherload is required and lower the yield point of the material, lower is the loads required for deformation.The material with lower yield point can be easily shaped.
In the figure material 2 has the lower yield point as compared to 1. Hence, it is easier to deform material 2.
Whenever a material is heated to higher temperature the yield point is reduced and it becomes easier to deform.



σ-∈ Curve for easy deformation

2. Stress strain should have Gentle slope.

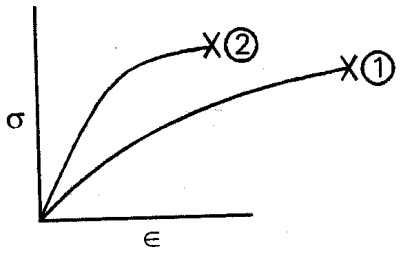
The stress strain curve should have lower gradient ie., gentle slope. It means the stiffness of the material must be low.
Stress strain curve with lower gradient will have gentle slope. Gentle slope needs lesser strain rate and hence lower rate of loading.
In figure material 1 has lower slope as compared to 2. Hence, material 1 is easier to deform.



Slope of σ-∈ Curve

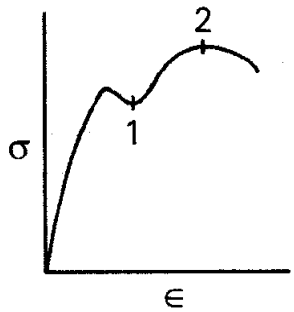
3. Stress Strain curve should have Larger elongation behavior.

A material with larger elongation will undergo more deformation without undergoing fracture, and it is extremely to shape the material.
In the figure material 1has larger elongation as compared to2. Hence, material1 can be easily deformed.



σ-∈ Curve with larger elongation

Strain hardening Type :
Some materials undergo strain hardening which means higher loads are required for deformation and more resistance is offered by the material. In the stress strain curve the strain hardening portion is represented by 12. If the slope12 is high, strain hardening of the material is more and it becomes difficult to deform.
By heating the material it can be softened and strain hardening is eliminated.



σ-∈ showing strain hardening

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