

## Table 5.2. Mechanical properties

1. **Elasticity** : ✓ It is the property of a material by virtue of which it is able to retain its original shape and size after the removal of the load.

✓ **Examples** : Steel and rubber.

✓ This property is desirable in materials used in tools and machines.

2. **Plasticity** : ✓ It is the property of a material by virtue of which a permanent deformation (without fracture) takes place, whenever it is subjected to the action of external forces.

✓ **Examples** : Clay and lead.

✓ This property is of importance in forming, shaping and extruding operations.

3. **Ductility** : ✓ It is the property of a material by virtue of which it can be drawn into wires before rupture takes place.

✓ Ductility of material can be measured by the percentage of elongation and the percentage of reduction of area before rupture.

ex → enable it to be drawn out into thin wire  
copper, silver

✓ **Examples** : Gold, platinum, silver, iron, copper, and aluminium.

✓ A knowledge of this property is important during fabrication operations.

4. **Malleability** : ✓ It is the property of a material by virtue of which it can withstand deformation under compression without rupture. *Enable it to be drawn out in to sheet*  
 ✓ **Examples** : Gold and lead. *ex → Aluminium, Copper*  
 ✓ This property is of importance in forging and rolling operations.
5. **Brittleness** : ✓ It is the property of a material by virtue of which it will fracture without any appreciable deformation.  
 ✓ **Examples** : Cast iron and glass. *opposite to ductility*  
 ✓ This property is desirable in machine parts which may be subjected to sudden loads.
6. **Hardness** : ✓ It is the property of a material by virtue of which it is able to resist abrasion, indentation (or penetration), machining, and scratching. *Enable it to resist Penetration, Indentation, abrasion*  
 ✓ It is measured by the resistance of the material it offers to scratching. *ex → stellite, Ceramics*  
 ✓ **Examples** : Diamond, quartz, and glass.
7. **Toughness** : ✓ It is the property of a material by virtue of which it can absorb maximum energy before fracture takes place. *Enable it to be twisted, bent, stretched when load applied* *ex → Titanium*  
 ✓ It is measured by the tenacity and hardness of the material.  
 ✓ **Examples** : Mild steel, brass, and wrought iron.
8. **Stiffness** : ✓ It is the property of a material by virtue of which it resists deformation. *Metal can resist deformation when external load applied*  
 ✓ Modulus of elasticity (i.e., ratio of stress to the strain below elastic limit) is a measure of stiffness of a material.
9. **Resilience** : ✓ It is the property of a material by virtue of which it stores energy and resists shocks or impacts.  
 ✓ It is measured by the amount of energy that can be stored per unit volume after being stressed to elastic limit.  
 ✓ This property is desirable in materials used for springs.  
 ✓ The maximum energy which can be stored in a body upto the elastic limit is called the **proof resilience**, and the proof resilience per unit volume is called the **modulus of resilience**.

10. **Creep** : ✓ It is the property of a material by virtue of which it deforms continuously under a steady load.

✓ This property is considered in designing I.C. engines, boilers, turbines, etc.

11. **Endurance** : ✓ It is the property of a material by virtue of which it can withstand varying stresses.

✓ The maximum value of stress that can be applied for an indefinite times without causing its failure is known as **endurance limit**.

✓ This property is desirable in the design and production of parts subjected to vibrations.

12. **Strength** : ✓ It is the property of a material by virtue of which it can withstand or support an external force or load without rupture.

Withstand (or) Resist external applied load without failure ex → Plain carbon steel

✓ This property is very important while designing various structures and components.

(a) **Elastic strength** : It is the value of load corresponding to transition from elastic to plastic range.

(b) **Plastic strength** : It is the value of load corresponding to plastic range and rupture.

13. **Impact strength** : It is the property of a material by virtue of which it can resist or absorb shock energy before it fractures.

14. **Fatigue** : It is the property of a material by virtue of which it deforms under the fluctuating or repeated loads.

Failure of metal to repeated with normal load of fatigue