

High carbon steel

These are also termed as hard steels and contain carbon varying from 0.6 to 1.5 %. Besides carbon, small percentage of Sulphur, phosphorus, manganese and silicon are also present.

Properties:

1. It has granular structure.
2. It is very hard.
3. Its specific gravity is 7.9.
4. It cannot easily forge and welded.
5. It can absorb shocks and vibrations in better way.
6. It is more elastic than mild steel.
7. It is brittle and less ductile than mild steel.
8. It rusts readily.
9. It can form permanent magnets.
10. It cannot take much of compression.

Uses:

1. It is used for parts of structures and machinery where hard, tough, elastic, shock- proof and durable material is required.
2. It is used in pre stressed concrete.
3. It is used for making knives, needles, bolts and surgical instruments.

Factors affecting physical properties of steel

1. Carbon content
 - a. The strength and hardness of steel increases as a percentage of carbon increases up to 1.5 %.
 - b. The elongation decreases as the carbon content increases and the metal becomes less resistance to impact.
 - c. The elastic range remains nearly on the same linearity, indicating that the modulus of elasticity is nearly the same and can be considered constant for various types of steel.

d. The plastic region decreases as the carbon content increases and appears to be nil for hard steel (high carbon steel).

e. The area under stress – strain curve varies with carbon content; it decreases as the percentage of carbon increases. This area represents the amount of work stored in specimen.

2. The percentage of impurities

The impurities present in steel are:

a. Silicon: If percentage of silicon is less than 0.2%, it has no appreciable effect on physical properties of steel, but when silicon content is between 0.3-0.4 %, the strength and modulus of elasticity are increased without decreasing ductility.

b. Sulphur: If Sulphur content is between 0.02-0.1 %, it has no effect on ductility and strength, but when the percentage of Sulphur is higher than 0.1%, the strength and ductility decreases.

c. Phosphorus: If the percentage of phosphorus exceed 0.12%, the strength, ductility and resistance to impact are decreased.

d. Manganese: When the manganese content is between 0.3-1 %, it helps to improving the strength of mild steel, but when it's content exceeds 1.5%, the steel becomes brittle and losses it's structural value.

3. Heat treatment: It is possible to alter the properties of steel by heating and cooling steel under controlled conditions. The term heat treatment is used to indicate the process in which the heating the heating and cooling of solid steel is involved to change the structural and physical properties of steel. The purpose of heat treatment are:

a. To alter magnetic properties of steel.

b. To change the structure of steel.

c. To increase resistance to heat and corrosion.

d. To increase surface hardness.

e. To make steel easily workable.

f. To vary strength and hardness.

Tensile requirements – ASTM – A615 – 86

Tensile requirements	Grade	
	Grade 300	Grade 400
Tensile strength, min., MPa	500	600
Yield strength, min., MPa	300	400
Elongation in 200mm, min., % For bar diameter(mm):		
10	11	9
15,20	12	9
25	-	8
30	-	7
35	-	7
45,55	-	7

Bar for grade 300 fabricated with diameter 10-20 mm only

Tensile properties – B.S. 4449-1988

Grade	Nominal size of bar mm	Specified Characteristic strength, N/mm ²	Minimum elongation of gauge length*, %
250	All sizes	250	22
460/425	6 up to and including 16 over 16	460	12
		425	14

* Gauge length is five times the diameter of the bar