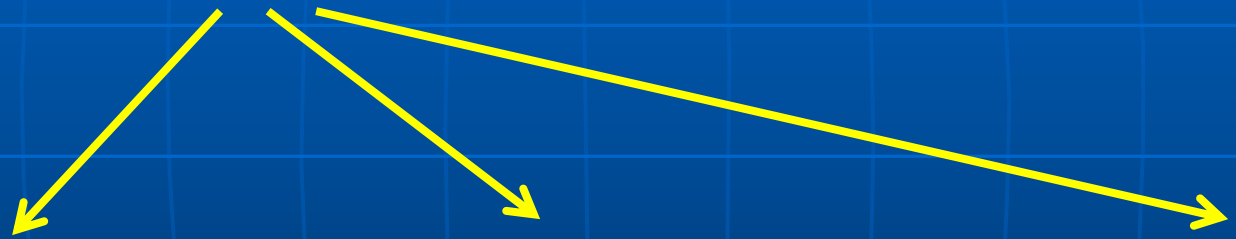
Tool Steel

Steel used as a tool, it is a high quality special tool used for cutting & forming purposes.

Classification of Tool Steel:

They are classified according to:



Quenching Medium	Alloy Content	Application of T. S
1 – Water quenching Steel	1 – Carbon Tool Steel	1 – Hot work Steel
2 – Oil quenching Steel	2 – Low Alloy Tool Steel	2 – Shock resisting Steel
3 – Air hardening Steel	3 – Medium Alloy Tool Steel	3 – High speed Steel
		4 – Cold work Steel

Tool Steel

AISI Classified Tool Steel according to:

1 – Method of Quench (water hardening).

2 – Applications (Shock resistance, C. W, H. W Steels).

3 – Special characteristic (High speed).

4 – Special industries (Mold special purpose).

Heat Treatment of Tool Steel:

- Tool Steel should not be heated so rapidly → Slow heating.
  → Preheating.
- To avoid overheating Tool Steel should not be:
  - a – heated to too high temperature.
  - b – kept at heat too long.
- Overheating causes → excessive grain growth.
  → loss in toughness.

Tool Steel

Heat Treatment of Tool Steel:

- Some means should be used to protect the surface of the Tool Steel from → scaling.
  → decarburizing.

Such as:

1 – Cu plating.

2 – Protective atmosphere.

3 – Liquid salt pots.

4 – Cast Iron chips.

- Carbon + Low Carbon Tool Steel are quenched in brine or water.
- High Alloy Tool Steel are quenched in Oil, Air, Molten salt.
- Tool Steel is quenched in a liquid bath of salt or lead between (900 – 1200) °f then cooled in Air to 150 °f.
- It is recommended to temper Tool Steel immediately after quenching and before they have cooled to minimize → Cracking.
  → Relieve stress.
  → Provide more toughness.

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Heat Treatment of Tool Steel:

- Carbon + low Alloy Steel is temper at (300 – 500) ^{o}f

  a – high Alloy Steel must tempered at (900 – 1200) ^{o}f for toughness.

  b – high Speed Tool is tempered between (950 – 1100) ^{o}f.

- Tools should be properly handled during and after Quench to avoid faulty Heat Treatment. They should be removed from the Quench while still warm and transferred immediately to tempering Furnace.

Selection of Tool Steel:

Factors that limited the selection of Tool Steel are:

a – Hardness.

b – Toughness.

c – Wear resistance.

d – Red hardness.

e – Resistance to decarburization.

f – Hardenability.

Tool Steel

Special Cutting Materials:

1. **Stellites (Co – Cr – W alloys):**

   a – Co Balance.

   b – Cr (25 – 35)%.

   c – W (4 – 25)%.

   d – C (1 – 3)%.

- Rc (40 – 60) + high resistance to wear + corrosion resistance + red hardness.
- They are consist of Tungstides + Carbides.
- They are used for machining Steel, Cast Iron, Stainless Steel.

  (They are used as a single point lathe Tools, spot facer reamer).
- They are usually cast to the desired shapes.
- They are Weaker & Brittle than High Speed Tool Steel.

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Special Cutting Materials:

2. Cemented Carbides:

- (W, Ti, Ta) Carbides mixing with a binder (Co powder & or W Carbide used for machining Cast Iron, γ Steel, non – Ferrous, Ti, Ta, for α Steel).
- Pressing the blended Powder into compacts of the desired shapes.
- Sintering the pressed shapes to achieve consolidation.
- Pressure used (5 – 30) ton/in^2.
- Sintering Temperature (2500 - 2700) ^{o}f for (30 – 60) min.

(Co + Carbide) → eutectic → cementing material.

3. Cermets:

- Usually contains (Ti + Cr) Carbides + Ni or Ni base Alloy as a binder.
- It has high hardness + high resistance to Oxidation + high resistance to thermal shock + low density + low ductility & toughness.

Tool Steel

Ceramic Tools:

- It is manufactured from Al_2O_3.
- It is produced either in → Cold Pressing.
  → Hot Pressing.

In Cold Pressing:

Fine Al_2O_3 Powder is compressed + Sintered in a furnace (1600 – 1700) ^oC.

Ti Oxide or Mg Oxide is added to retard growth.

In Hot Pressing:

(Forming + Sintering), pressure + heat being applied simultaneously.

Tool Steel

Ceramic Tools:

Advantages:

1. Machine time is reduced.
2. High stock- removal rates (Increased productivety).
3. (3 – 10) times longer life than Carbide Tools.
4. Retain their tensile strength & Hardness at high ^{o}T (2000) ^{o}f.
5. More accurate control size.
6. Rc 66, material can be readily machined.
7. Better surface finishes.

Disadvantages:

1. They are brittle.
2. Cost.
3. Needs more rigid machine.
4. Needs more horse power machine.