



Steels



- Steels are alloys of iron and carbon .
- However steels contain other elements like silicon, manganese, sulphur, phosphorus, nickel etc.

• *Classification of steels:*

- 1. Plain carbon steels.
 - (i) Low carbon steels
 - (ii) Medium carbon steels
 - (iii) High Carbon steels
- 2. Alloy Steels
 - (i) Low alloy steels
 - (ii) High alloy steels



Plain carbon Steels



Composition:

Carbon upto 1.5%

Copper upto 0.6%

Manganese upto 1.65%

Silicon upto 0.6%

Types

1. Low Carbon steels (Carbon- Less than 0.25%)
2. Medium Carbon steels (Carbon- 0.25% to 0.60%)
3. High Carbon steels (Carbon- more than 0.60%)

Low carbon Steels (Carbon- Less than 0.25%)



Characteristics:

- ✓ Its Relatively soft and weak
- ✓ They possess formability and Weldability
- ✓ They have outstanding ductility and toughness
- ✓ the microstructure of low-carbon steel consists of ferrite & pearlite
- ✓ Of all the steels, the low –carbon steels are least expensive to produce

Applications:

- ✓ Automobile body components
- ✓ Sheets that are used in pipelines, buildings, bridges and tin cans



Medium carbon Steels (Carbon- 0.25% to 0.60%)



Characteristics:

- ✓ Low hardenabilities
- ✓ High strength and hardness properties are achieved at the sacrifice of ductility and toughness

Applications:

- ✓ Railway wheels
- ✓ Railway tracks
- ✓ Gears
- ✓ Cranks shafts



High carbon Steels (Carbon- More than 0.60%)



Characteristics:

- ✓ Hardest and strongest of carbon steels
- ✓ They are the least ductile
- ✓ They have more wear resistant
- ✓ They are capable of holding a sharp cutting edge

Applications:

- ✓ Cutting tools and dies
- ✓ Razors
- ✓ Hacksaw blades
- ✓ High strength wire



Alloy Steels



- Any steels other than carbon steels
- The steels products manual defines alloy steels as steels that exceed one or more of the following limits
 - ✓ Manganese – 1.65%
 - ✓ Silicon- 0.60%
 - ✓ Copper- 0.60%
- **Other alloying elements of steels :-** Chromium, nickel, tungsten , boron and others



Alloy Steels



- **Classifications of alloy steels**
- Low alloy steels- 3 to 4 % of alloying elements
- High alloy steels – more than 5% of alloying elements



Low Alloy Steels



- 1) AISI Steels
 - 2) HSLA Steels
- **AISI Steels (American Iron and Steel Institute steels)**
 - Its an addition of elements Cr, Ni, Cu, Mn etc
 - Generally used for Machine construction
 - Also called **Construction steels or structural steels**
 - **HSLA Steels (High strength low alloy steels)**
 - They have different microstructure and require different heat treatments than that of plain carbon steels



High Alloy Steels



- 1) Tool and die Steels
 - 2) Stainless Steels
- **Tool and die steels**
 - It's used for making tools and dies
 - Special characteristics of hardenability, wear resistance,
 - **Stainless steels**
 - Its used for improving corrosion resistance



Important alloy steels



- Stainless steels
- Tools steels
- HSLA steels
- Maraging steels



Stainless steels



- Stainless steels are alloys of iron, chromium and other elements that resist corrosion from many environments
- It is also called as **Corrosion – resistant steels or chromium – behavior steels**
- All true stainless steel contain minimum of about **12%Cr**.
- This 12%Cr permits thin protective surface layer of chromium oxide to form when the steel is exposed to oxygen

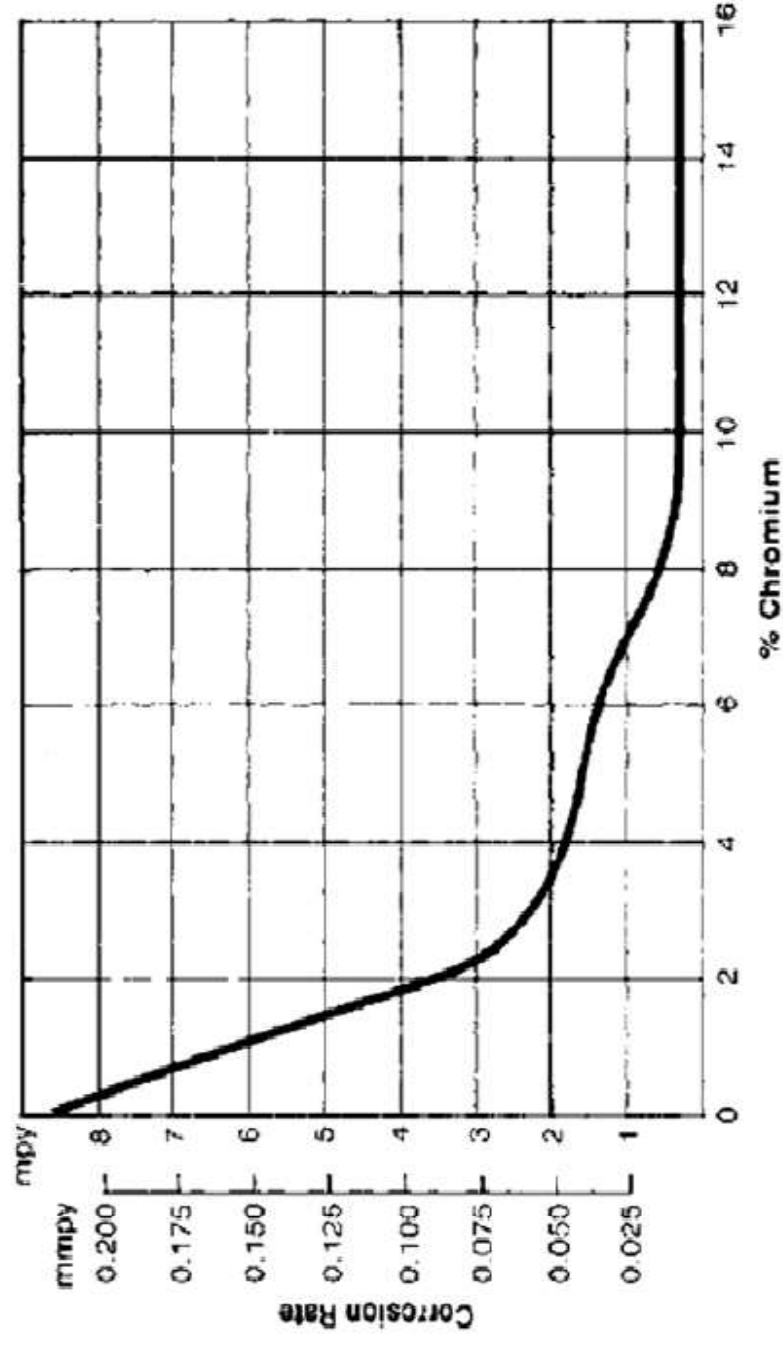




Effect of Chromium on Stainless steels



Effect of Chromium Content on Corrosion Rate (2)





Stainless steels



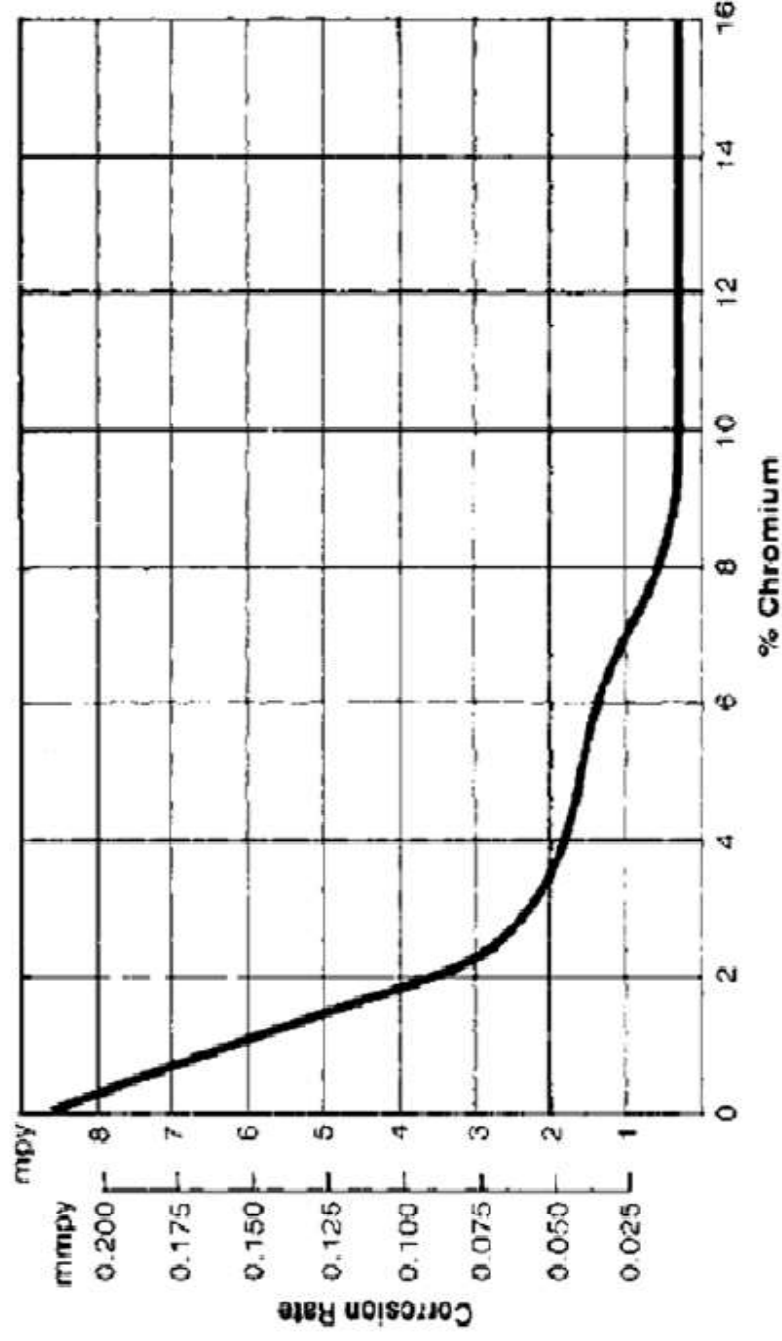
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Effect of Chromium on Stainless steels

Effect of Chromium Content on Corrosion Rate (2)





Types of Stainless steels



- It is classified basis of the predominant phase constituent of the microstructure.
- 1) Austenitic stainless steels
- 2) Ferritic stainless steels
- 3) Martensitic stainless steels





Austenitic Stainless steels



- **Composition**
 - C- 0.03 to 0.15%
 - Mn- 2 to 10%
 - Si- 1 to 2%
 - Cr- 16 to 26%
 - Ni- 3.5 to 22%
- **Properties**
 - Highest corrosion resistance
 - Good strength
 - Non magnetic
 - Very tough and can be welded , forged or rolled





Austenitic Stainless steels



● Applications

- ❑ Engine Parts (Aircraft industry)
- ❑ Chemical processing (Heat Exchanger)
- ❑ Food processing (Tanks)
- ❑ Household (Cooking tools)
- ❑ Transport industry (Trailers and railway cars) Etc.





Ferritic Stainless steels



Composition

- C- 0.08 to 0.10%
- Mn- 1 to 1.5%
- Si- 1 %
- Cr- 12 to 25%

Properties

- Good ductility
- Magnetic
- It can be welded , forged , rolled and , machined





Ferritic Stainless steels

● Applications

- Lining for petroleum industry
- Heating elements for furnaces
- Interior decorative work
- Screws and fittings, Etc.





Martensitic Stainless steels



- **Composition**
 - ❑ C- 0.1 to 1.5%
 - ❑ Mn- 1 %
 - ❑ Si- 1 %
 - ❑ Cr- 12 to 25%

- **Properties**
 - ❑ Good ductility , hardness and thermal conductivity
 - ❑ Good toughness and corrosion resistance





Martensitic Stainless steels

Applications

- Pumps and Valve parts
- Turbine buckets
- Surgical instruments





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