Metallic Materials for Gears

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WENLIO GEAR
Bevel Gear Manufacturing

Catalog

Carbon Steel

Carbon Steel with a carbon content greater than 0.0218% and less than 2.11%, without intentionally added alloying elements, are called carbon steel (also known as plain carbon steel).

1. Effects of Common Residual Elements on Steel Properties

Beneficial elements (mainly originating from deoxidizers)

1) Silicon (Si)

•Source: Silicon remains in steel as a result of ferrosilicon (FeSi) deoxidation during steelmaking.

•Effect on properties: Increases strength and hardness.

•Conclusion: A beneficial element in steel.

2) Manganese (Mn)

•Source: Manganese remains in steel as a result of ferromanganese (FeMn) deoxidation during steelmaking.

•Effect on properties: Increases strength and hardness.

•Conclusion: A beneficial element in steel.

Harmful elements (mainly originating from the iron ore itself)

3) Sulfur (S)

•Source: Introduced into steel during steelmaking from raw materials (ore) and fuels.

•Effect on properties: Causes hot shortness (reduced hot ductility / cracking tendency during hot working).

•Conclusion: A harmful element in steel.

4) Phosphorus (P)

•Source: Introduced into steel during steelmaking mainly from the iron ore/raw materials.

•Effect on properties: Causes cold shortness (increased brittleness / reduced toughness at lower temperatures).

•Conclusion: A harmful element in steel.

2. Classification of Carbon Steel

1) Classification by Carbon Content

① Low-carbon steel:C ≤ 0.25%

② Medium-carbon steel:0.25% < C < 0.60%

③ High-carbon steel:C ≥ 0.60%

2) Classification by Steel Quality (Impurity Limits)

① Ordinary-quality steel:S ≤ 0.050%, P ≤ 0.045%

② Quality steel:S ≤ 0.035%, P ≤ 0.035%

③ High-quality steel (premium):S ≤ 0.025%, P ≤ 0.025%

3) Classification by Application

① Structural steel: Mainly used for manufacturing machine parts and engineering/structural components; typically C < 0.70%.

② Tool steel: Mainly used for manufacturing cutting tools, dies/molds, and measuring tools; carbon content typically C > 0.70%.

4) Classification by Degree of Deoxidation During Steelmaking

① Rimmed steel

② Killed steel

③ Semi-killed steel

3. Designations and Applications of Carbon Steel Grades

1) Carbon Structural Steel (GB “Q” series)

① Designation rule: The grade consists of “Q” + yield strength value + quality grade symbol + deoxidation method symbol.

② Properties:General / medium-level mechanical properties.

③ Applications: Used for industrial buildings, bridges, ships, and fasteners such as rivets, bolts/screws, and nuts, etc.

④ Example:Q235-AF means an A-grade rimmed steel with a minimum yield strength of 235 MPa.

2) Quality Carbon Structural Steel

① Designation rule: Uses two digits to indicate the average carbon content, expressed as ten-thousandths of the steel (i.e., the digits represent C × 10,000).

② Classification:

A. 08–25 steels — Low-carbon steels

•Properties: Low strength and hardness; good plasticity, toughness, and weldability.

•Applications:Stamped parts, welded structural parts, and carburizing parts; e.g., deep-drawn components, pressure vessels, etc.

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A. 30–55 steels — Medium-carbon steels

•Properties: Relatively higher strength and hardness; plasticity and toughness gradually decrease as carbon content increases.

•Applications: Mechanical parts subjected to higher loads; e.g., connecting rods, crankshafts, gears, etc.

B. 60 and above — High-carbon steels

•Properties: High strength, hardness, and elasticity.

•Applications: Parts requiring higher strength, wear resistance, and elasticity; e.g., valve springs, spring washers, etc.

Limitations of carbon steel:

1. Poor hardenability.
2. Poor tempering stability.
3. Limited overall mechanical properties.
4. May not meet requirements for certain special applications.

Alloy Steel

Alloy steel is a type of steel developed from carbon steel, in which one or more alloying elements are intentionally added during steelmaking to improve the steel's properties.

1. Main Roles of Alloying Elements in Steel

1) Strengthen ferrite (ferrite strengthening)

2) Form alloy carbides

① Alloyed cementite
② Special carbides
③ Refine grain size
④ Improve hardenability.
⑤ Improve tempering stability

2. Classification of Alloy Steels

1) Classification by Application

•Alloy structural steels: Mainly used for engineering structures and machine parts.

•Alloy tool steels: Mainly used for cutting tools, dies/molds, and measuring tools (gauges).

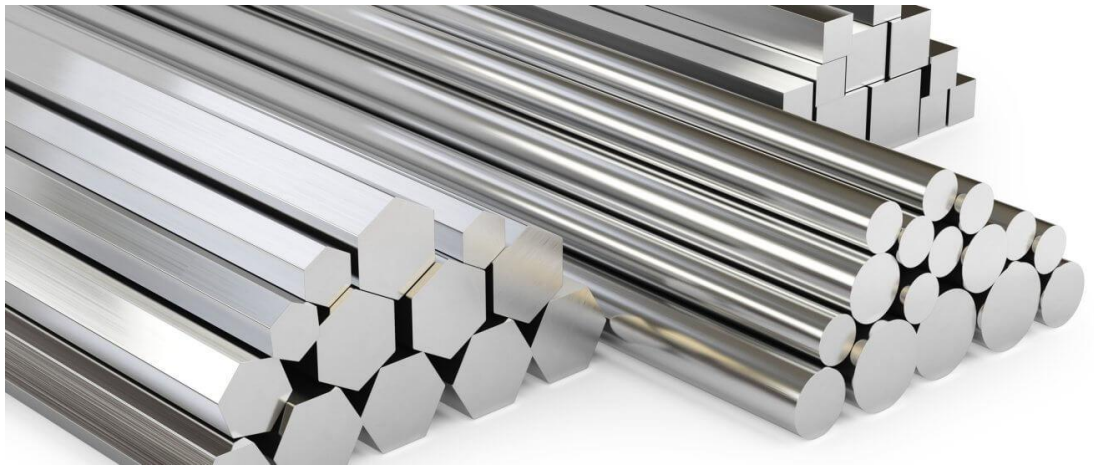
•Special-purpose (special property) steels: Steels with special physical and/or chemical properties.

2) Classification by Total Alloying Content

•Low-alloy steel

•Medium-alloy steel

•High-alloy steel



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