



Knowledge source on Materials Engineering

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## Classification of steels and cast irons

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Classification of steels by composition

### **Carbon steels**

- Low carbon steels ( $C < 0.25\%$ );
- Medium carbon steels ( $C = 0.25\%$  to  $0.55\%$ );
- High carbon steels ( $C > 0.55\%$ ).

Designation system:

American Iron and Steel Institute (AISI) together with Society of Automotive Engineers (SAE) have established four-digit (with additional letter prefixes) designation system:

### **SAE 1XXX**

**First digit** 1 indicates carbon steel (2-9 are used for alloy steels);

**Second digit** indicates modification of the steel.

0 - Plain carbon, non-modified

1 - Resulfurized

2 - Resulfurized and rephosphorized

5 - Non-resulfurized, Mn over 1.0%

**Last two digits** indicate carbon concentration in 0.01%.

*Example:* SAE 1030 means non modified carbon steel, containing 0.30% of carbon.

A letter prefix before the four-digit number indicates the steel making technology:

A - Alloy, basic open hearth

B - Carbon, acid Bessemer

C - Carbon, basic open hearth

D - Carbon, acid open hearth

E - Electric furnace

*Example:* AISI B1020 means non modified carbon steel, produced in acid Bessemer and containing 0.20% of carbon.

### **Alloy steels**

- Low alloy steels (alloying elements  $\leq$  8%);
- High alloy steels (alloying elements  $>$  8%).

According to the four-digit classification SAE-AISI system:

**First digit** indicates the class of the alloy steel:

2- Nickel steels;

3- Nickel-chromium steels;

4- Molybdenum steels;

5- Chromium steels;

6- Chromium-vanadium steels;

7- Tungsten-chromium steels;

9- Silicon-manganese steels.

**Second digit** indicates concentration of the major element in percents (1 means 1%).

**Last two digits** indicate carbon concentration in 0,01%.

*Example:* SAE 5130 means alloy chromium steel, containing 1% of chromium and 0.30% of carbon.

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## Classification of steels by application

### **Stainless steels:**

AISI has established three-digit system for the stainless steels:

2XX series – chromium-nickel-manganese austenitic stainless steels;

3XX series – chromium-nickel austenitic stainless steels;

4XX series – chromium martensitic stainless steels or ferritic stainless steels;

5XX series – low chromium [martensitic stainless steels](#);

### **Tool and die steels:**

Designation system of one-letter in combination with a number is accepted for tool steels.

The letter means:

- [W - Water hardened plain carbon tool steels](#);
- [O - Oil hardening cold work alloy steels](#);
- [A - Air hardening cold work alloy steels](#);
- [D - Diffused hardening cold work alloy steels](#);
- [S - Shock resistant low carbon tool steels](#);
- [T - High speed tungsten tool steels](#);
- [M - High speed molybdenum tool steels](#);
- [H - Hot work tool steels](#);
- [P - Plastic mold tool steels](#).

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### Classification of cast irons

- [White cast irons](#) - hard and brittle wear resistant cast irons consisting of [pearlite](#) and [cementite](#).
- [Grey cast irons](#) - cast irons at slow cooling and consisting of [ferrite](#) and dispersed graphite flakes.
- [Malleable cast irons](#) - cast irons, produced by heat treatment of white cast irons and consisting of ferrite and particles of free graphite.
- [Nodular \(ductile\) cast irons](#) - grey cast iron in which [Graphite](#) particles are modified by magnesium added to the melt before [casting](#). Nodular cast iron consists of spheroid nodular graphite particles in ferrite or pearlite matrix.

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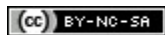
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