

SAE Steel Properties Designation System

The SAE system uses a basic four-digit system to designate the chemical composition of carbon and alloy steels. The first digit of this designation indicates a carbon steel; i.e., carbon steels comprise 1xxx groups in the SAE system and are subdivided into four categories due to the variance in certain fundamental properties among them.

For many years, certain grades of carbon and alloy steels have been designated by a four-digit AISE/SAE numerical index system that identified the grades according to standard chemical compositions. Since the American Iron and Steel Institute (AISI) ceased writing material specifications, the relationship between AISI and grade designations has been discontinued. From point of edition of the 1995 Iron and Steel Society (ISS) Strip Steel Manual, the four-digit designations are referred to solely as SAE Designations.

The SAE system uses a basic four-digit system to designate the chemical composition of carbon and alloy steels. The simplest system for designation of steel is schematically shown in Figure 1.



Figure 1: Schematic Representation of AISI/SAE Steel Designation System

Figure 1 demonstrates that the SAE-AISI system uses a four-digit number to designate a carbon and alloy steel and refers to its specific chemical composition. It is worth noting however, that there are also certain types of alloy steels that are designated by five digits (51XXX; 52XXX).

The first digit (**1**), of this designation indicates a carbon steel; i.e., carbon steels comprise 1xxx groups in the SAE-AISI system and are subdivided into four categories due to the variance in certain fundamental properties among them. Thus the plain carbon steels are comprised within the 10xx series (containing 1.00% Mn maximum); resulturized carbon steels within the 11xx series; resulturized and rephosphorized carbon steels within the 12xx series; and non-resulturized high-manganese (up-to 1.65%) carbon steels which are produced for applications requiring good machinability are comprised within the 15xx series.

The SAE-AISI system then classifies all other alloy steels using the same four digit index as follows:

- 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.

The second digit of the series indicates the concentration of the major element in percentiles (1 equals 1%). The last two digits of the series indicate the carbon concentration to 0.01%.

Example:

SAE 5130 indicates a chromium steel alloy, containing 1% of chromium and 0.30% of carbon.

Table 1 shows the SAE/AISI steel Numbering designation system

Additional letters added between the second and third digits include **B** when boron is added (between 0.0005 and 0.003%) for enhanced hardenability, and **L** when lead is added (between 0.15 and 0.35%) for enhanced machinability. The prefix **M** is used to designate merchant quality steel (the least restrictive quality descriptor for hot-rolled steel bars used in noncritical parts of structures and machinery). The prefix **E** (electric-furnace steel) and the suffix **H** (hardenability requirements) are mainly applicable to alloy steels. The full series of classification groups is shown in Table 2-4.

Table 1: The SAE/AISI steel numbering designation system

Carbon steels	10XX	Plain carbon, Mn 1.00% max
	11XX	Resulfurized free machining
	12XX	Resulfurized/rephosphorized free machining
	15XX	Plain carbon, Mn 1.00-1.65%
Manganese steels	13XX	Mn 1.75%
Nickel steels	23XX	Ni 3.50%
	25XX	Ni 5.00%
Nickel-chromium steels	31XX	Ni 1.25%, Cr 0.65-0.80%
	32XX	Ni 1.75%, Cr 1.07%
	33XX	Ni 3.50%, Cr 1.50-1.57%
	34XX	Ni 3.00%, Cr 0.77%
Molybdenum steels	40XX	Mo 0.20-0.25%
	44XX	Mo 0.40-0.52%
Chromium-molybdenum steels	41XX	Cr 0.50-0.95%, Mo 0.12-0.30%
Nickel-chromium-molybdenum steels	43XX	Ni 1.82%, Cr 0.50-0.80%, Mo 0.25%
	47XX	Ni 1.05%, Cr 0.45%, Mo 0.20-0.35%
Nickel-molybdenum steels	46XX	Ni 0.85-1.82%, Mo 0.20-0.25%
	48XX	Ni 3.50%, Mo 0.25%
Chromium steels	50XX	Cr 0.27-0.65%
	51XX	Cr 0.80-1.05%
	50XXX	Cr 0.50%, C 1.00% min
	51XXX	Cr 1.02%, C 1.00% min
	52XXX	Cr 1.45%, C 1.00% min
Chromium-vanadium steels	61XX	Cr 0.60-0.95%, V 0.10-0.015%
Tungsten-chromium steels	72XX	W 1.75%, Cr 0.75%
Nickel-chromium-molybdenum steels	81XX	Ni 0.30%, Cr 0.40%, Mo 0.12%
	86XX	Ni 0.55%, Cr 0.50%, Mo 0.20%
	87XX	Ni 0.55%, Cr 0.50%, Mo 0.25%
	88XX	Ni 0.55%, Cr 0.50%, Mo 0.35%
Silicon-manganese steels	92XX	Si 1.40-2.00%, Mn 0.65-0.85%, Cr 0-0.65%
Nickel-chromium-molybdenum steels	93XX	Ni 3.25%, Cr 1.20%, Mo 0.12%
	94XX	Ni 0.45%, Cr 0.40%, Mo 0.12%
	97XX	Ni 0.55%, Cr 0.20%, Mo 0.20%
	98XX	Ni 1.00%, Cr 0.80%, Mo 0.25%