

भारतीय मानक
इस्पातों का वर्गीकरण
(पहला पुनरीक्षण)

Indian Standard
CLASSIFICATION OF STEELS
(*First Revision*)

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards on 22 January 1990, after the draft finalized by the General Metallurgical Standards Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1974. This revision has been done keeping in view the manufacturing and trade practices followed in this field.

In the preparation of this standard assistance has been derived from:

ISO 4948/1 : 1982 Steels — Classification — Part 1 : Classification of steels into unalloyed and alloy steels based on chemical composition

ISO 4948/2 : 1981 Steels — Classification — Part 2 : Classification of unalloyed and alloy steels according to main quality classes and main property or application characteristics.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CLASSIFICATION OF STEELS

(First Revision)

1 SCOPE

1.1 This standard covers the classification of steels on the basis of chemical composition but provision is also made for subdivision according to specific characteristics or use.

2 DEFINITION OF STEEL

2.1 For the purpose of classification, steel is an iron base alloy generally suitable for working to the required shape in the solid state having a carbon content generally less than 1.5 percent and containing varying amounts of other elements. A limited number of high alloyed steels may have more than 2 percent carbon but 2 percent is the usual dividing line between steel and cast iron.

3 CLASSIFICATION ON THE BASIS OF CHEMICAL COMPOSITION

3.1 Steel shall be classified as follows:

- a) Unalloyed steels, and
- b) Alloy steels.

3.2 Unalloyed Steels

Unalloyed steels are those steels in which specified content of any element is less than that indicated below:

Constituent	Percentage
Aluminium	0.10
Boron	0.000 8
Bismuth	0.10
Chromium	0.30
Cobalt	0.10
Copper	0.40
Manganese	1.65*
Molybdenum	0.08
Nickel	0.30
Niobium	0.06
Lead	0.40
Selenium	0.10
Silicon	0.50
Tellurium	0.10
Titanium	0.05
Tungsten	0.10
Vanadium	0.10
Zirconium	0.05
Lanthanides (each)	0.05
Other specified elements (except S, P, C and N)	0.05

*If only a maximum is specified for the manganese content of the steel the boundary shall be at 1.80 percent.

NOTE — Limits specified in the table for the following elements shall not be considered for custom tariff purposes for demarcating unalloyed and alloy steels, unless otherwise agreed to:

- a) bismuth;
- b) lead;
- c) selenium;
- d) tellurium; and
- e) lanthanides and other specified elements (except S, P, C and N).

3.2.1 For determining whether the steel is unalloyed or alloyed, the composition given in the standard or specification or order shall be considered. This usually refers to ladle analysis. In the absence of a standard or specification or ordered composition, the classification shall be based on the ladle analysis reported by the manufacturer.

It may be necessary to certify the chemical composition of the material being supplied by analysis of the product. In such cases, the number of samples taken, the location of such samples, the methods of analysis used and the permissible deviation from the specified range of chemical composition shall be in accordance with the product specification to which material is being supplied.

Where the elements are defined by a range or by a minimum value, the minimum value of that range or the minimum specified shall determine the class of the steel.

Where the elements are defined only by maximum values, 70 percent of these maximum values shall determine the class of the steel.

3.3 Alloy Steels

Alloy steels are those steels where specified content of any element is equal to or greater than that indicated in 3.1.

Depending on the alloy content (exclusive of S, P, C and N), alloy steels shall be subdivided as follows:

Subdivision	Total Alloying Elements, Percent
Low alloy steels	Up to and including 5
Medium alloy steels	More than 5 but up to and including 10
High alloy steels	More than 10

4 MAIN CLASSES OF UNALLOYED STEELS

4.1 The main classes of unalloyed steels are characterized by:

- a) the main quality class (see 4.2), and
- b) the main characteristic (see 4.3) of the steel.

4.2 Main Quality Classes

4.2.1 Subdivision

Unalloyed steels are subdivided into the following main quality classes:

- a) Base steel (see 4.2.2),
- b) Unalloyed quality steel (see 4.2.3), and
- c) Unalloyed special steel (see 4.2.4).

4.2.2 Base* Steel

4.2.2.1 General description

The term 'base steel' applies to all steels for which no quality requirement, which would necessitate special care during steel production, is specified.

4.2.2.2 Definition

Base steels are steels which simultaneously meet the following four conditions:

- a) The steel is unalloyed.
- b) No heat treatment† is specified.
- c) The characteristics, if specified in product standards or specifications, are as follows:

Minimum tensile strength	< 690 N/mm ²
Minimum yield strength	< 360 N/mm ²
Minimum elongation on (L ₀ = 5 d ₀)	< 26 percent
Minimum diameter of bending mandrel	> 1 × thickness of test piece
Minimum energy absorbed at 20°C (on V- notch test piece taken longitudinally)	< 27 J
Maximum Rockwell Hardness HRB	> 60
Maximum carbon content	> 0.10 percent
Maximum phosphorus content	> 0.050 percent
Maximum sulphur content	> 0.050 percent
Maximum nitrogen content	> 0.007 percent

NOTE — The indicated mechanical characteristics correspond to the range of thicknesses from 3 to 16 mm and apply to test pieces taken in the longitudinal or transverse direction in accordance with the requirements of the relevant standard or specification.

- d) No other quality requirement is specified.

*Other terms used until now are regular steels, commercial or merchant steel.

†Annealing (for example, stress-relieving treatment, softening, annealing or normalizing) is not to be considered as heat treatment.

4.2.3 Unalloyed Quality Steel

4.2.3.1 General description

The term 'unalloyed quality steel', applies to those unalloyed steels which require special care during production (for example, by grain size control, decrease of sulphur and phosphorus content, improvement of surface finish or increased production control, etc) to achieve, in comparison with base steels, special quality characteristics such as improved resistance against brittle fracture, improved cold-forming properties, etc. However, requirements concerning careful production of these steels are less stringent than those for classical unalloyed special steels, that is, steels with controlled hardenability.

4.2.3.2 Definition

Unalloyed quality steels are those steels which are covered neither by the definition given in 4.2.2 for base steels nor by that given in 4.2.4 for unalloyed special steels.

4.2.4 Unalloyed Special Steel

4.2.4.1 General description

The term 'unalloyed special steel' applies to those steels the production of which requires special care comparable in extent with the care necessary for the production of the classical special steels, that is, unalloyed steels with controlled (special) hardenability requirements.

In view of their special manufacturing conditions, special steels are generally cleaner—especially from the point of view of inclusions—than quality steels.

4.2.4.2 Definition

The following unalloyed steels are special steels:

- a) All unalloyed steels (including unalloyed free-cutting steels and tool steels) destined for heat treatment for which specific requirements for at least one of the following characteristics are to be observed:
 - 1) Requirements concerning the impact properties in the quenched and tempered or simulated case-hardened condition.
 - 2) Requirements concerning the hardening depth or surface hardness after hardening or hardening and tempering.
 - 3) Requirements concerning limitation of surface discontinuities.
 - 4) Requirements concerning limitation of the non-metallic inclusion content and/or the internal homogeneity.
- b) All unalloyed steels not destined for heat treatment for which at least one of the following requirements is to be observed:
 - 1) Requirements concerning limitation of the non-metallic inclusion content and/or the internal homogeneity, for example, plates resistant to lamellar tearing.

- 2) The maximum phosphorus and/or sulphur content is limited as follows:
- For ladle analysis : <0.020 percent
 - For product analysis : <0.025 percent

Examples:

Certain steels for welding wire, steel for wire for tyres.

- 3) The contents of the following residual elements are simultaneously restricted as follows:

Cu *Max*, cast <0.10 percent

Co *Max*, cast <0.05 percent

V *Max*, cast <0.05 percent

- 4) The requirements for the surface quality are more stringent than those specified in ISO 4954 for cold-heading and cold-extruding steels.

Examples:

Certain cold-forging, cold-drawing and plating qualities.

- c) Steels with a specified electrical conductivity >9 S/m or with specified magnetic properties, excepting magnetic sheet and strip for which only the maximum magnetic losses and the minimum magnetic induction, and not, for example, the permeability, is specified.

4.3 Main Characteristics

For the purpose of this standard, main characteristics are considered to be those characteristics which are applied with a certain priority, for example, in designation systems or for classification of steels.

4.3.1 For unalloyed steels, the classification according to main characteristics used is as follows:

- Unalloyed steels with R_e maximum, R_m maximum, or HB maximum (or maximum diameter of bending mandrel, etc) as the main characteristic. (Example : Soft sheet for cold-forming).
- Unalloyed steels with R_e minimum or R_m minimum, as the main characteristic. (Examples : Structural steels including steels for ships, pipelines, pressure purposes and unalloyed steels with improved weather resistance).
- Unalloyed steels with the carbon content as the main characteristic, with the exception of the steels indicated under (d) and (e). (Examples: Steels for wire rod, steel for quenching and tempering, etc.).

- Unalloyed free cutting steels (percent sulphur minimum, cast > 0.070 percent and/or additions of Pb, Bi, Te, Se or P).
- Unalloyed tool steels.
- Unalloyed steels with particular specifications for magnetic or electrical properties (Examples: Magnetic sheet and strip, steel with permeability requirements for transmitters, telephone wire, etc.).
- Other unalloyed steels.

5 MAIN CLASSES OF ALLOY STEELS

5.1 The main classes of alloy steels are characterized by:

- the main quality class (see 5.2), and
- the main characteristic (see 5.3) of the steel.

5.2 Main Quality Classes

5.2.1 Alloyed Quality Steel

5.2.1.1 General description

The term 'alloyed quality steel' applies to steels with low alloy contents which are manufactured in relatively large quantities and according to quality requirements which are, in comparison with those for alloyed special steels, relatively easy to fulfil.

5.2.1.2 Definition

The following alloy steels are quality steels.

5.2.1.2.1 Structural weldable fine grain steels with high yield strength, which simultaneously meet the following conditions:

- The specified minimum yield strength is less than 420 N/mm² (for thicknesses <16 mm).
- The alloy contents, defined by a minimum value or the lower value of a range, are less than the values given in Table 1.

If the alloying elements is defined by a maximum value only the class to which it belongs is given by the value corresponding to 70 percent of this maximum value.

5.2.1.2.2 Steels which are only alloyed with copper and having a specified minimum copper content greater than or equal to 0.40 percent but less than 0.50 percent, or, if no minimum value is specified, a specified maximum copper content greater than or equal to 0.57 percent but less than 0.70 percent.

Table 1 High Yield Strength Alloyed Steels — Limiting Contents of Alloying Elements for Alloyed Quality Steels
[Clause 5.2.1.2.1 (b)]

Alloying Element	Limiting Contents, Percent
Chromium*	0.50
Copper*	0.50
Lanthanides	0.06
Manganese	1.80
Molybdenum*	0.10
Nickel*	0.50
Niobium†	0.08
Titanium†	0.12
Vanadium†	0.12
Zirconium†	0.12
Other elements not mentioned	—

*When two, three or four of these elements are specified together in the steel under consideration, it is necessary to consider simultaneously:

- the limiting contents for each one of these elements;
- the limiting content for all these elements which should be taken as equal to 70 percent of the sum of the limiting contents indicated for each one of the two, three or four elements in question.

†The rule in for (*) is also applicable in these elements.

5.2.1.2.3 Alloy steels for rails

5.2.1.2.4 Silico-manganese steels for springs or parts resistant to abrasion with P and S > 0.035 percent.

5.2.1.2.5 Steels for sheets and strips containing only Si and/or Al as alloying element and with requirements for magnetic losses and for the minimum values for magnetic induction only (which means, for example, no requirements for permeability).

5.2.2 Alloyed Special Steel

All alloy steels, excluding those indicated in 5.2.1 are special steels.

5.3 Main Characteristics

The general description given in 4.3.1, for the main characteristics of unalloyed steels applies also for alloy steels.

5.3.1 The criteria used for the main characteristics of alloy steels are characteristic applications, properties and/or alloy contents.

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