
**Structural steels with improved
atmospheric corrosion resistance**

*Aciers de construction à résistance améliorée à la corrosion
atmosphérique*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4952 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 3, *Steels for structural purposes*.

This second edition cancels and replaces the first edition (ISO 4952:1981), which has been technically revised.

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Structural steels with improved atmospheric corrosion resistance

1 Scope

1.1 This International Standard specifies the chemical and mechanical characteristics, methods of manufacture, the acceptance conditions and the marking of structural steel products possessing improved atmospheric corrosion resistance.

This International Standard applies to plates having a thickness of 4 mm and over, hot-rolled on reversing mills, wide flats, bars and hot-rolled sections generally used in the delivery condition and which, as a rule, form part of the bolted, riveted or welded structures in metal constructions¹⁾ and which have improved atmospheric corrosion resistance.

1.2 This International Standard does not include the following steels, certain of which are covered by other International Standards:

- general purpose structural steels (ISO 630);
- steels for boilers and pressure purposes (ISO 9328-2);
- steels for heat treatment; [ISO 4952:2003](https://standards.iteh.ai/catalog/standards/sist/0a570b3b-4502-4f86-8d29-114afe671338/iso-4952-2003)
- continuously hot-rolled structural steel sheet with improved atmospheric corrosion resistance (ISO 5952);
- steel plates for forming and deep drawing.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 148, *Steel — Charpy impact test (V-notch)*

ISO 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing*

ISO 404:1992, *Steel and steel products — General technical delivery requirements*

ISO 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels*

1) For precautions to be taken when welding, the guide for the welding and weldability of C-Mn and C-Mn micro-alloy steels, published by Sub-commission IX-G of the International Welding Institute, may be helpful (document IIS/IW 843-87) see also the notes given in annex A of this International Standard.

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ISO 4948-1, *Steels — Classification — Part 1: Classification of steels into unalloyed and alloy steels based on chemical composition*

ISO 6892, *Metallic materials — Tensile testing at ambient temperature*

ISO 7788, *Steel — Surface finish of hot-rolled plates and wide flats — Delivery requirements*

ISO/TR 9769, *Steel and iron — Review of available methods of analysis*

ISO 10474, *Steel and steel products — Inspection documents*

ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 steel with improved atmospheric corrosion resistance
steel in which a certain number of alloying elements, such as P, Cu, Cr, Ni have intentionally been added in order to increase its resistance to atmospheric corrosion, by forming an auto-protective oxide layer of the base metal

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4 General requirements

4.1 Steelmaking process

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Unless otherwise agreed at the time of order, the steelmaking method is left to the discretion of the manufacturer; however, at the time of delivery it shall be stated to the purchaser if he so requests.

4.2 Method of deoxidation

With the exception of qualities 1A, B and 2B, the steels shall be from casts containing addition of elements capable of producing fine grain.

Steel of quality 1A, B and 2B shall be supplied as non-rimming steel.

4.3 Delivery conditions

4.3.1 The products are usually delivered as-rolled. Other delivery conditions may be agreed at the time of the order.

4.3.2 Flat quality D products are delivered as-rolled, normalized or in an equivalent condition (normalizing rolling).

4.4 Surface condition

4.4.1 General

The products shall have a smooth surface corresponding to the rolling process used; they shall not have any imperfections that are prejudicial to their subsequent processing or appropriate use.

4.4.2 Flat products

The requirements of ISO 7788 shall be complied with.

4.4.3 Long products

4.4.3.1 Small defects may be removed by the manufacturer by means of grinding, provided the thickness remain within the minimum tolerance limits defined in the relevant ISO standards (see list in Annex B) or, in the absence of any ISO standards, is not reduced locally by more than 6 % in relation to the nominal value.

4.4.3.2 Unless otherwise agreed at the time of order, defects that are larger than those stipulated above may be removed and built up by welding under the following conditions:

- a) the thickness of the material taken off in order to remove the defect shall not, before welding, exceed 20 % of the nominal thickness at the location of the defect;
- b) all welding operations shall be carried out by qualified welders using electrodes appropriate to the grade of the item following procedures approved by the purchaser.

5 Technical requirements

5.1 Chemical composition

5.1.1 General

The steels specified in this International Standard are alloyed steels in accordance with ISO 4948-1.

5.1.2 Ladle analysis

The composition limits for the ladle analysis are given in Table 1.

If agreed upon at the time of enquiry and order, rare earth elements may be added to a maximum of 0,15 %.

5.1.3 Product analysis

Table 2 gives the limits of permissible deviations in the product analysis relative to the limits for the ladle analysis given in Table 1.

5.2 Mechanical properties

Steels in the delivery conditions defined in 4.3 shall comply with the mechanical properties specified in Table 3 when these are determined on test pieces selected in accordance with the specifications of Clause 7.

For products greater than 63 mm in thickness, the mechanical properties shall be subject to an agreement between the parties involved.

Table 1 — Chemical composition of improved atmospheric corrosion resistance steels (ladle analysis)

Grade	Quality	C	Mn	Si	P	S	Cr	Cu	Ni	Mo	Zr
		% max.	%	%	%	%	%	%	%	% max.	% max.
Fe 235W	B	0,13	0,20 to 0,60	0,10 to 0,40	≤ 0,040	0,035	0,40 to 0,80	0,25 to 0,55	0,65	—	—
	C ^a	0,13	0,20 to 0,60	0,10 to 0,40	≤ 0,040	0,035	0,40 to 0,80	0,25 to 0,55	0,65	—	—
	D ^a	0,13	0,20 to 0,60	0,10 to 0,40	≤ 0,040	0,035	0,40 to 0,80	0,25 to 0,55	0,65	—	—
Fe 355W	1A	0,12	≤ 1,00	0,20 to 0,75	0,06 to 0,15	0,035	0,30 to 1,25	0,25 to 0,55	0,65	—	—
	1D ^a	0,12	≤ 1,00	0,20 to 0,75	0,06 to 0,15	0,035	0,30 to 1,25	0,25 to 0,55	0,65	—	—
	2B	0,19	0,50 to 1,50	≤ 0,50	≤ 0,040	0,035	0,40 to 0,80	0,25 to 0,55	0,65	0,30	0,15
	2C ^a	0,19	0,50 to 1,50	≤ 0,50	≤ 0,040	0,035	0,40 to 0,80	0,25 to 0,55	0,65	0,30	0,15
	2D ^a	0,19	0,50 to 1,50	≤ 0,50	≤ 0,040	0,035	0,40 to 0,80	0,25 to 0,55	0,65	0,30	0,15

Other than those listed in this table, any element added intentionally shall be indicated to the purchaser.

^a These steels shall contain at least one of the following grain refining elements in the proportions indicated below:

- Al_{total} ≥ 0,020 %;
- Nb = 0,015 % to 0,060 %;
- V = 0,02 % to 0,15 %;
- Ti = 0,02 % to 0,10 %.

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If these elements are used in combination, at least one of them shall be present in the steel in the minimum specified quantity.

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Table 2 — Permissible deviations for the product analysis relative to the specified ladle analysis

Element	Specified limits %	Permissible deviation ^a
C	≤ 0,19	+ 0,03
Mn	≥ 0,20 but ≤ 1,50	+ 0,10 – 0,05
Si	≥ 0,10 but ≤ 0,75	+ 0,10 – 0,05
P	≤ 0,040 ≥ 0,06 but ≤ 0,15	+ 0,005 ± 0,01
S	≤ 0,035	+ 0,005
Cr	≥ 0,30 but ≤ 0,80 > 0,80 but ≤ 1,25	± 0,05 ± 0,10
Ni	≤ 0,65	+ 0,05
Cu	≥ 0,20 but ≤ 0,55	± 0,05
Nb	≥ 0,015 but ≤ 0,060	± 0,005
V	≥ 0,02 but ≤ 0,15	– 0,01 + 0,02
Ti	≥ 0,02 but ≤ 0,10	– 0,01 + 0,02
Al	≥ 0,020	– 0,005
Mo	≤ 0,30	+ 0,05
Zr	≤ 0,15	+ 0,02

^a The deviations apply either above or below the specified limits of the range, but not simultaneously for one element from different samples taken from different products originating from the same cast.

When maxima only are specified, the deviations are positive only.

The values only apply to samples prepared under the conditions laid down in 7.3.1

Table 3 — Mechanical characteristics

Grade	Quality	Specified yield strength			Tensile strength	Percentage elongation at fracture			Impact energy		
		R_{eH}^a			R_m^a	$A^{a, b}$			KV^c		
		N/mm ²			N/mm ²	%			J		
min.			min.	min.			min.				
			$L_0 = 5,65\sqrt{S_0}$								
		$t \leq 16$	$16 < t \leq 40$	$40 < t \leq 63$		$t \leq 16$	$16 < t \leq 40$	$40 < t \leq 63$	+ 20 °C	0 °C	- 20 °C
Fe 235W	B	235	225	215	340 to 470	26	26	25	27	—	—
	C	235	225	215	340 to 470	26	26	25	—	27	—
	D	235	225	215	340 to 470	26	26	25	—	—	27
F2 355W	1A	355 ^c	—	—	470 to 630	21 ^d	—	—	—	—	—
	1D	355 ^c	—	—	470 to 630	21 ^d	—	—	—	—	27
	2B	355	345	335	470 to 630	22	22	21	27	—	—
	2C	355	345	335	470 to 630	22	22	21	—	27	—
	2D	355	345	335	470 to 630	22	22	21	—	—	27

^a For transverse test pieces (plate and wide flats not less than 600 mm wide), these values are reduced by 2 points.

^b Non-proportional test pieces may be used (see 7.1).

^c Average of three tests; no individual result shall be less than 70 % of the specified minimum average value.

^d This quality is only delivered as a product not more than 12 mm thick.

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6 Inspection and testing

6.1 General

The product covered by this International Standard may be the subject of inspection and testing in accordance with the conditions specified in Clause 8 of ISO 404:1992 relating to the chemical composition and mechanical properties of the product. Verification of the chemical composition of the product is also carried out if this is agreed upon and stated in the order.

If inspection and testing are specified in the order, these shall be carried out in accordance with Clauses 6 and 7, unless otherwise agreed at the time of order.

6.2 Test unit

6.2.1 General

The verification of product analysis and mechanical properties shall be per cast (heat).

6.2.2 Tensile tests

A test unit shall contain products of the same form, grade and delivery condition and be taken from the same thickness range in accordance with Table 3 for the specified yield strength.

For a test unit not exceeding 50 t, one tensile test shall be carried out.

For a test unit exceeding 50 t, two tensile tests shall be carried out.

6.2.3 Impact tests

A test unit shall contain products of the same form, grade and delivery condition.

For a test unit not exceeding 50 t, one set of three impact tests shall be carried out at 0 °C for quality C or at – 20 °C for quality D or, if specified in the order, at + 20 °C for quality B.

For a test unit exceeding 50 t, two sets of three impact tests shall be carried out at 0 °C for quality C or at – 20 °C for quality D or, if specified in the order, at + 20 °C for quality B.

6.2.4 Product analysis

6.2.4.1 General

If specified on the order, one product analysis shall be carried out per cast. Unless otherwise stated by the purchaser, the procedure shall be as follows.

6.2.4.2 Tensile test

A sample shall be taken for each thickness range specified in Table 3 with the additional requirement that for $t \leq 16$ mm, the maximum thickness of the products of the batch shall be no greater than twice the minimum thickness.

6.2.4.3 Impact test

A sample shall be taken from the thickest product in each thickness range given in Table 3.

For flat products of quality D, if agreed upon at the time of enquiry and order, a test sample shall be taken from each rolled product (parent plate).

6.3 Position and orientation of sample

6.3.1 General

For product thicknesses between 6 mm and 40 mm, sub-surface specimens shall be used.

For product thicknesses exceeding 40 mm, samples shall be taken from the 1/4 thickness position.

See annex C and ISO 377.

6.3.2 Plates, wide strip (coils) and wide flats of width equal to or greater than 600 mm

The test samples shall be taken midway between the axis in the direction of rolling and the edge of the rolled product.

The longitudinal axes of tensile test pieces shall be perpendicular to the direction of rolling.

The longitudinal axes of impact test pieces shall always be parallel to the direction of rolling.

6.3.3 Sections, girders and wide flats of width less than 600 mm

The longitudinal axes of the test pieces shall be parallel to the direction of rolling. However, if agreed upon, a transverse test piece may be used for widths between 450 mm and 600 mm.

For sections, the test samples shall be taken such that the axis of the test piece is 1/3 from the outer edge of the half-flange (for I sections) or of the flange (for other sections) or, for small sections, as near as possible to