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ISO 5952

Fifth edition
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Steel sheet, hot-rolled, of structural quality with improved atmospheric corrosion resistance

Tôles en acier de construction laminées à chaud en continu à résistance améliorée à la corrosion atmosphérique

Reference number
ISO 5952:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This fifth edition cancels and replaces the fourth edition (ISO 5952:2011), which has been technically revised.

The main changes compared to the previous edition are as follows:

— tables have been updated throughout for clarity;

— additional editorial changes for clarity.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Steel sheet, hot-rolled, of structural quality with improved atmospheric corrosion resistance

1 Scope

This document specifies requirements for steel sheet hot-rolled of structural quality with improved atmospheric corrosion resistance, also known as weather-resistant structural steel. It is produced in the grades and classes listed in Table 1. The product is intended for applications where requirements are for mechanical properties and increased resistance to atmospheric corrosion. It is generally used in the delivered condition and is intended for bolted, riveted or welded structures.

This document does not apply to the following steel qualities:

— steels intended for boilers and pressure vessels, and steels designated as commercial quality and drawing qualities (see ISO 3573);

— steels produced on reversing mills and designated with improved atmospheric corrosion resistance (see ISO 630-5);

— steels designated with structural quality (see ISO 4995), and high yield strength structural quality (see ISO 4996);

— steels designated with higher yield strength with improved formability (see ISO 5951).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 16160, *Hot-rolled steel sheet products — Dimensional and shape tolerances*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
improved atmospheric corrosion resistance
characteristic achieved by intentional addition of a certain number of alloying elements, such as P, Cu, Cr, Ni, etc., providing a chemical composition which promotes the formation of a protective oxide layer on the product

Note 1 to entry: The degree of corrosion resistance is based on data acceptable to the purchaser.

3.2
hot-rolled steel sheet
product obtained by rolling heated steel through a continuous-type wide strip mill to the required sheet thickness

Note 1 to entry: The product has a surface covered with oxide or scale resulting from the hot-rolling operation.

3.3
hot-rolled, descaled steel sheet
hot-rolled steel sheet (3.2) from which oxide or scale has been removed by pickling in an acid solution or by mechanical means such as grit blasting

Note 1 to entry: Some change in properties can result from mechanical descaling.

3.4
lot
up to a specified quantity of steel sheet of the same designation rolled to the same thickness and coating condition

4 Dimensions

4.1 This product is commonly produced in the range of thicknesses 1,6 mm up to and including 12,5 mm and widths of 600 mm and over, in coils and cut lengths.

4.2 Hot-rolled sheet less than 600 mm wide can be slit from wide sheet and will be considered as not strip.

NOTE Hot-rolled sheet up to but not including 3 mm in thickness is commonly known as sheet. Hot-rolled sheet 3 mm and over in thickness is commonly known as either "sheet" or "plate".

5 Conditions of manufacture

5.1 Steelmaking

Unless otherwise agreed upon, the processes used in making the steel and in manufacturing hot-rolled sheet are left to the discretion of the manufacturer. On request, the purchaser shall be informed of the steelmaking process being used.

5.2 Chemical composition

5.2.1 The chemical composition (heat analysis) shall conform to the requirements given in Table 1.

5.2.2 When selecting the grade or chemical composition to be used, attention should be directed to the appropriate welding procedure to be followed (see 5.6).

5.3 Chemical analysis

5.3.1 Heat analysis

An analysis of each heat shall be made by the manufacturer in order to determine conformity with the requirements given in Table 1. On request, a report of the heat analysis shall be made available to the purchaser or the purchaser's representative. Each of the elements listed in Table 1 shall be included in the report of the heat analysis.

Table 1 — Chemical composition (heat analysis)

Mass fractions in percent

Grade	Class[a]	Method of deoxidation[b]	C max.	Mn	Si	P	S max.	Cu	Ni	Cr	Mo	Zr
HSA 235W	B D	NE CS	0,13	0,20 to 0,60	0,10 to 0,40	0,040 max.	0,035	0,25 to 0,55	0,65 max.	0,40 to 0,80	[c]	[c]
HSA 245W	B D	NE CS	0,18	1,25 max.	0,15 to 0,65	0,035 max.	0,035	0,30 to 0,50	0,05 to 0,30	0,45 to 0,75	[c]	[c]
HSA 355W1	A D	NE CS	0,12	1,00 max.	0,20 to 0,75	0,06 to 0,15	0,035	0,25 to 0,55	0,65 max.	0,30 to 1,25	[c]	[c]
HSA 355W2	C D	NE CS	0,16	0,50 to 1,50	0,50 max.	0,035 max.	0,035	0,25 to 0,55	0,65 max.	0,40 to 0,80	0,30 max.	0,15 max.
HSA 365W	B D	NE CS	0,18	1,40 max.	0,15 to 0,65	0,035 max.	0,035	0,30 to 0,50	0,05 to 0,30	0,45 to 0,75	[c]	[c]

NOTE Each grade can contain one or more microalloying elements, such as vanadium, titanium, niobium, etc.

[a] Class A steels satisfy only moderate loading conditions.

Class B steels are intended for use in welded structures or structural parts, subjected to normal loading conditions.

Class C steels are to be used in cases where, owing to loading conditions and the general design of the structure, some resistance to brittle fracture is necessary.

Class D steels are to be used for structures or structural parts where, owing to loading conditions and the general design of the structure, a high resistance to brittle fracture is necessary.

[b] NE — non-rimming.

CS — aluminium killed (0,020 % minimum total aluminium).

[c] The total content of Mo, Nb, Ti, V and Zr is not to exceed 0,15 %.

5.3.2 Product analysis

A product analysis may be made by the purchaser in order to verify the specified analysis of the product and shall take into consideration any normal heterogeneity. The product analysis tolerances shall be in accordance with Table 2.

Table 2 — Product analysis tolerances for Table 1

Mass fractions in percent

Element	Maximum or range of specified element	Tolerance over maximum specified
C	< 0,15	0,03
	0,15 ≤ C ≤ 0,18	0,04
Mn	< 0,60	0,03
	≥ 0,60 < Mn ≤ 1,50	0,05
Si	0,10 to 0,40	0,02
	0,15 to 0,75	0,03
	0,50	0,05
P	0,15	0,01
S	0,035	0,010
Cu	0,55	0,03

Table 2 *(continued)*

Element	Maximum or range of specified element	Tolerance over maximum specified
Ni	0,65	0,03
Cr	1,25	0,04
Mo	0,30	0,01

5.4 Mechanical properties

At the time that the steel is made available for shipment, the mechanical properties shall be as stated in Table 3 when they are determined on test pieces obtained according to the requirements of Clause 7. Any additional property requirements specified or required are subject to agreement before ordering.

5.5 Application

It is desirable that the specified product be identified for fabrication by name of the part or by intended application. Proper identification of the part may include visual examination, prints or description, or a combination of these.

5.6 Weldability

This product is suitable for welding if appropriate welding conditions are selected.

NOTE See the recommendations given in Reference [11] as an example.

5.7 Surface condition

Oxide or scale in hot-rolled steel sheet is subject to variations in thickness, adherence and colour. Removal of the oxide or scale by pickling or blast cleaning may disclose surface imperfections not readily visible prior to this operation.

5.8 Oiling

As a deterrent to rusting, a coating of oil is usually applied to hot-rolled, descaled steel sheet, but sheet may be furnished unoiled, if required. The oil is not intended as a forming lubricant and shall be easily removable with degreasing chemicals. When requested, the manufacturer shall advise the purchaser which type of oil has been used.

5.9 Corrosion resistance

The resistance of these steels to atmospheric corrosion is due to the formation of a protective oxide layer. The formation of this protective layer depends not only on chemical composition, such as the distinctive differences between the analyses of the various grades, but also on a number of factors such as surrounding atmosphere, design, etc., over which the steel producer has no control. See Annexes A and B for information on estimating the corrosion resistance and cautions concerning the use of these steels.

5.10 Dimensional and shape tolerances

Dimensional and shape tolerances applicable to hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance shall be as given in ISO 16160.

6 Tensile test sampling

One representative sample from each lot of 50 t or less for shipment shall be taken for the tensile test to verify conformity with the requirements of Table 3.

7 Tensile test method

The tensile test shall be carried out in accordance with ISO 6892-1. Transverse test pieces shall be taken mid-way between the centre and edge of the sheet as rolled.

Table 3 — Mechanical properties

Grade	Class[a]	R_e[b] min. MPa	R_m MPa		A[c] min. %					
					$e < 3$ mm		$3 \le e \le 6$ mm		$e > 6$ mm	
			$e < 3$ mm	$e \ge 3$ mm	$L_o = 80$ mm	$L_o = 50$ mm	$L_o = 5{,}65\sqrt{S_o}$ mm	$L_o = 50$ mm	$L_o = 5{,}65\sqrt{S_o}$ mm	$L_o = 200$ mm
HSA 235W	B and D	235	360 to 510	340 to 470	18	20	24	22	24	17
HSA 245W	B and D	245	400 to 540		18	20	24	22	24	17
HSA 355W1	A and D	355	510 to 680	490 to 630	15	15	20	19	24	18
HSA 355W2	C and D	355	510 to 680	490 to 630	15	18	20	22	24	18
HSA 365W	B and D	365	490 to 610		12	15	17	19	21	15

R_e = yield strength.

R_m = tensile strength.

A = percentage elongation after fracture.

L_o = gauge length on test piece.

e = thickness of steel sheet, in millimetres.

S_o = original cross-sectional area of gauge length.

1 MPa = 1 N/mm^2.

[a] Class A steels satisfy only moderate loading conditions.

Class B steels are intended for use in welded structures or structural parts, subjected to normal loading conditions.

Class C steels are to be used in cases where, owing to loading conditions and the general design of the structure, some resistance to brittle fracture is necessary.

Class D steels are to be used for structures or structural parts where, owing to loading conditions and the general design of the structure, a high resistance to brittle fracture is necessary.

While not usually specified, if so agreed at the time of ordering, impact tests may be specified for material of Class C or D, 6 mm and over in thickness.

The test pieces shall be in the longitudinal direction and the test shall be carried out in accordance with ISO 148-1 for the Charpy V-notch test.

[b] The yield strength can be measured either by 0,5 % total elongation proof stress $R_{t0,5}$ (proof stress under load) or by 0,2 % offset $R_{p0,2}$ when a definite yield phenomenon is not present.

[c] For thicknesses up to 3 mm, use either $L_o = 50$ mm or $L_o = 80$ mm. For thicknesses of 3 mm inclusive to 6 mm inclusive, use $L_o = 5{,}65\sqrt{S_o}$ or $L_o = 50$ mm. For thickness over 6 mm, use $L_o = 5{,}65\sqrt{S_o}$ or $L_o = 200$ mm. In case of dispute, however, only the results obtained on a proportional test piece will be valid for material 3 mm and over in thickness.

8 Retests

8.1 Machining and flaws

If any test piece shows defective machining or develops flaws, it shall be discarded and another test piece shall be substituted.

8.2 Elongation

On any tensile test, if any part of the fracture is outside the middle half of the gauge length as scribed before the test, the test shall be discarded and a retest carried out.

8.3 Additional tests

If a test does not give the specified results, two additional tests shall be taken at random from the same lot. Both retests shall conform to the requirements of this document; otherwise, the lot shall be rejected.

9 Resubmission

9.1 The manufacturer has the right to resubmit for acceptance the products that have been rejected during earlier inspection because of unsatisfactory properties, after the rejected products have been subjected to a suitable treatment (e.g. selection, heat treatment), which on request, will be indicated to the purchaser. In this case, tests shall be carried out as if they applied to a new lot.

9.2 The manufacturer has the right to present the rejected products to a new examination for conformity with the requirements for another grade.

10 Workmanship

10.1 The surface condition shall be that normally obtained in a hot-rolled product.

10.2 The steel sheet in cut lengths shall be free from any laminations, surface flaws and other imperfections that are detrimental to the final product or to subsequent appropriate processing.

10.3 Processing for shipment in coils does not afford the manufacturer the opportunity to observe readily or to remove non-conforming portions, as can be carried out on the cut length product. However, this does not relieve the manufacture of responsibility to provide a product that meets the requirement for surface condition that is normally obtained on a hot-rolled product.

11 Inspection and acceptance

11.1 Although not usually required for products covered by this document, when the purchaser specifies that inspection and tests for acceptance shall be observed prior to shipment from the manufacturer's works, the manufacturer shall afford the purchaser's inspector all reasonable facilities to determine that the steel is being furnished in accordance with this document.

11.2 Steel that is reported to be nonconforming after arrival at the user's works shall be set aside, properly and correctly identified and adequately protected. The manufacturer shall be notified in order that the reported nonconforming material may be properly investigated.

12 Coil size

When steel sheet in accordance with this document is ordered in coils, a minimum or range of acceptable inside diameters (ID) shall be specified. In addition, the maximum outside diameter (OD) and maximum acceptable coil mass shall be specified.

13 Marking

Unless otherwise stated, the following minimum requirements for identifying the steel sheet shall be legibly stencilled on the top of each lift or shown on a tag attached to each coil or shipping unit:

a) manufacturer's name or identifying brand;

b) a reference to this document, i.e. ISO 5952:2019;

c) the grade and class designation;

d) the order number;

e) the product dimensions;

f) the lot number;

g) the mass;

h) the bundle or coil number.

14 Information to be supplied by the purchaser

To adequately specify requirements in this document, enquiries and orders shall include the following information:

a) a reference to this document, i.e. ISO 5952:2019;

b) name, quality, grade and class of material (for example, hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance, grade HSA 355W1, Class A);

c) dimensions of product and quantity required;

d) application (name of part) if possible (see 5.5);

e) pickling (or descaling by blast cleaning), if required (material so specified will be oiled unless it is ordered unoiled) (see 5.8);

f) ends cropped, if required;

g) if required, report of heat analysis (see 5.3.1);

h) if necessary, additional mechanical property requirements (see 5.4);

i) limitations on mass and dimensions of individual coils and bundles, if applicable (see Clause 12);

j) inspection and tests for acceptance prior to shipment from the manufacturer's works, if required (see Clause 11).

EXAMPLE A typical ordering description is as follows:

ISO 5952:2019 hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance, grade HSA 355W1, Class A, 3 mm × 1 200 mm × 2 440 mm restricted thickness tolerance, 40 000 kg, for Part No. 32154, formed channels for outdoor parking garage.

Annex A
(informative)

Guidelines for estimating the atmospheric corrosion resistanceof low-alloy steels

A.1 General

This annex presents a method for estimating the atmospheric corrosion resistance of low-alloy weather-resistant steels from chemical composition data.

The method utilizes predictive formulae based on the steel composition to calculate indices of atmospheric corrosion resistance.

As many indices have been used around the world, it is necessary to consider the different environments and the chemical composition of the steel when choosing an index. As any index may be inappropriate based on the above, it is necessary for the purchaser and supplier to decide on the type of index to use and the requirement levels of that index for the expected environment.

A.2 Terminology

Low-alloy steels means iron-carbon alloys containing greater than 1 % but less than 5 %, by mass, of total alloying elements.

NOTE Most "low-alloy weather-resistant steels" contain additions of both chromium and copper, and can also contain additions of silicon, nickel, phosphorus, or other alloying elements which enhance atmospheric corrosion resistance.

A.3 Procedure

A.3.1 Formulae for predicting the corrosion penetration of low-alloy steels after 15,5 years of exposure to various atmospheres, based on the chemical composition of the steel, were published by Legault and Leckie[9]. The formulae are based on extensive data published by Larrabee and Coburn[10].

A.3.2 For use with these guidelines, the Legault-Leckie formula for an industrial atmosphere (Kearny, N.J., USA) was modified to allow calculation of an atmospheric corrosion resistance index based on chemical composition. The modification consisted of deletion of the constant and changing the signs of all the terms in the formula. The modified formula for calculation of the atmospheric corrosion resistance index (I) is given below. The higher the index, the more corrosion resistant is the steel.

$$I = 26{,}01\ (\%\ \mathrm{Cu}) + 3{,}88\ (\%\ \mathrm{Ni}) + 1{,}20\ (\%\ \mathrm{Cr}) + 1{,}49\ (\%\ \mathrm{Si}) + 17{,}28\ (\%\ \mathrm{P}) - 7{,}29\ (\%\ \mathrm{Cu})\ (\%\ \mathrm{Ni}) - 9{,}10\ (\%\ \mathrm{Ni})\ (\%\ \mathrm{P}) - 33{,}39\ (\%\ \mathrm{Cu})^2$$

A.3.3 The predictive formula should be used only for steel compositions within the range of the original test materials in the Larrabee-Coburn data set. These limits are as follows:

— $0{,}012 \leq \mathrm{Cu} \leq 0{,}51$

— $0{,}05 \leq \mathrm{Ni} \leq 1{,}1$

— $0{,}10 \leq \mathrm{Cr} \leq 1{,}3$