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Steel sheet, twin-roll cast, zinc-coated by the continuous hot-dip process, of structural quality and high strength

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
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).

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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 second edition cancels and replaces the first edition (ISO 15211:2012), which has been technically revised.

The main changes are as follows:

— Clause 3 update.

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, twin-roll cast, zinc-coated by the continuous hot-dip process, of structural quality and high strength

1 Scope

This document specifies the requirements for steel sheet, in coils and cut length, metallic-coated by the continuous hot-dip zinc-coated twin-roll cast process, of structural and high strength quality.

The product is intended for applications requiring corrosion resistance, and paintability.

The steel sheet is produced in a number of grades, coating masses, surface treatments and ordering conditions.

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 1460, *Metallic coatings — Hot dip galvanized coatings on ferrous materials — Gravimetric determination of the mass per unit area*

ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

ISO 3497, *Metallic coatings — Measurement of coating thickness — X-ray spectrometric methods*

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

ISO 7438, *Metallic materials — Bend test*

ISO 16163, *Continuously hot-dipped coated 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 terminology databases for use in standardization at the following addresses:

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

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

3.1
continuous hot-dip zinc-coated steel sheet
product obtained by hot-dip coating of cold-reduced sheet coils or hot-rolled descaled sheet coils on a continuous zinc-coating line

3.2
normal spangle
finish obtained as a result of unrestricted growth of zinc crystals during normal solidification

Note 1 to entry: This coating has a metallic lustre and is the type normally furnished for a wide variety of applications. It can be furnished S (normal spangle with skin pass) or N (normal spangle, no skin pass), however, it can be variable in appearance and not suitable for decorative paintings.

3.3
minimized spangle
finish obtained by restricting normal spangle formation during the solidification of the zinc

Note 1 to entry: This product can have some lack of uniformity in surface appearance within a coil or from coil to coil.

3.4
differential coating
coating deliberately produced to have a different coating mass on each surface

3.5
skin pass
light cold rolling of the product

Note 1 to entry: The purpose of skin passing is one or more of the following: to minimize the appearance of coil breaks, stretcher strains and fluting; to control the shape or to obtain the required surface finish.

Note 2 to entry: Some increase in hardness and some loss in ductility will result from skin passing.

3.6
twin-roll cast steel sheet
steel sheet produced by casting to near final thickness directly from the liquid metal with minimal hot rolling to achieve the final thickness

3.7
lot
up to a specified quantity of steel sheet of the same designation rolled to the same thickness and coating condition

3.8
coating mass
total amount of zinc on both surfaces of the sheet, expressed in grams per square meter (g/m^2) of sheet

4 Dimensions

Zinc-coated structural and high strength quality twin-roll cast steel sheet is produced in thicknesses up to 2,0 mm, inclusive, after zinc coating, and in widths up to 2 000 mm in coils and cut lengths. Zinc-coated twin-roll cast steel sheet less than 600 mm wide, slit from wide sheet, is considered as sheet.

The thickness of zinc-coated twin-roll cast steel sheet may be specified as a combination of the base-metal and metallic coating or base-metal alone. The purchaser shall indicate on the order which method of specifying thickness is required. If the purchaser does not indicate any preference, the thickness as a combination of the base-metal and coating shall be provided. Annex A describes the requirements for specifying the thickness as base-metal alone.

5 Conditions of manufacture

5.1 Steelmaking

Unless otherwise agreed by the interested parties, the processes used in making the steel and in manufacturing zinc-coated steel sheet are left to the discretion of the manufacturer. Upon request, the purchaser shall be informed of the steelmaking process being used.

5.2 Chemical composition

The chemical composition (heat analysis) shall conform to the requirements given in Tables 1, 2 and 3.

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 Tables 1, 2 and 3. 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 Tables 1, 2 and 3 shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium or molybdenum present is less than 0,02 %, the analysis may be reported as "<0,02 %".

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 Tables 3 and 4.

Table 1 — Chemical composition (heat analysis) for structural quality steel sheet

Mass fractions in percent

Base-metal grade designation	C max.	Mn max.	P max.	S max.	Si[a]
HR275	0,25	1,35	0,040	0,035	–
HR340					
HR380					
HR410					
HR480					
HR550					

[a] "–" indicates that there is no requirement, but the analysis shall be reported.

Table 2 — Chemical composition (heat analysis) for high strength steel sheet

Mass fractions in percent

Base-metal grade designation	Class	C max.	Mn max.	P max.	S max.	Si[a]	V[d] min.	Ti[d] min.	Nb[d] min.	N[a]
HSS 310	1[b]	0,22	1,35	0,04	0,04	–	0,008	0,008	0,008	–
	2	0,15	1,35	0,04	0,04	–	0,008	0,008	0,008	–
HSS 340	1[b]	0,23	1,35	0,04	0,04	–	0,008	0,008	0,008	–
	2	0,15	1,35	0,04	0,04	–	0,008	0,008	0,008	–
HSS 380	1[b]	0.25	1,35	0,04	0,04	–	0,008	0,00	0,008	–
	2	0,15	1,35	0,04	0,04	–	0,008	0,008	0,008	–
HSS 410	1	0,26	1,50	0,04	0,04	–	0,008	0,008	0,008	–
	2	0,15	1,50	0,04	0,04	–	0,008	0,008	0,008	–

[a] "–" indicates that there is no requirement, but the analysis shall be reported.

[b] For each reduction of 0,01 % below the specified carbon maximum, an increase of 0,06 % manganese above the specified maximum shall be permitted up to a maximum of 1,50 %.

[c] The purchaser has the option of restricting the nitrogen content. It should be noted that, depending on the microalloying scheme (for example use of vanadium) of the producer, nitrogen is permitted as a deliberate addition. Consideration should be given to the use of nitrogen-binding elements (for example vanadium and titanium).

[d] The producer shall add at least one or more of the elements V, Ti or Nb.

Table 2 *(continued)*

Base-metal grade designation	Class	C max.	Mn max.	P max.	S max.	Si[a]	V[d] min.	Ti[d] min.	Nb[d] min.	N[a]
HSS 450	1	0,26	1,50	0,04	0,04	–	0,008	0,008	0,008	–[c]
	2	0,15	1,50	0,04	0,04	–	0,008	0,008	0,008	–[c]
HSS 480	1	0,26	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]
	2	0,15	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]
HSS 550	1	0,26	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]
	2	0,15	1,65	0,04	0,04	–	0,008	0,008	0,008	–[c]

[a] "–" indicates that there is no requirement, but the analysis shall be reported.

[b] For each reduction of 0,01 % below the specified carbon maximum, an increase of 0,06 % manganese above the specified maximum shall be permitted up to a maximum of 1,50 %.

[c] The purchaser has the option of restricting the nitrogen content. It should be noted that, depending on the microalloying scheme (for example use of vanadium) of the producer, nitrogen is permitted as a deliberate addition. Consideration should be given to the use of nitrogen-binding elements (for example vanadium and titanium).

[d] The producer shall add at least one or more of the elements V, Ti or Nb.

Table 3 — Limits on additional chemical elements for structural quality steel sheet

Mass fractions in percent

Element	Cu max.	Ni max.	Cr max.	Mo max.	Nb max.	V max.	Ti max.
Heat analysis	0,50	0,30	0,30	0,15	0,008	0,008	0,008
Product analysis	0,53	0,33	0,34	0,16	0,018	0,018	0,018

Table 4 — Product analysis tolerances

Mass fractions in percent

Element	Maximum of specified element	Tolerance over the maximum specified
C	0,26	0,04
Mn	1,65	0,05
P	0,04	0,01
S	0,04	0,01

NOTE The above maximum tolerance is the allowable excess over the requirements of the heat analysis specified in Tables 1 and 2.

5.4 Mechanical properties

The mechanical properties for structural quality steel sheet and high strength steel sheet shall be as shown in Tables 5 and 6.

Table 5 — Mechanical properties for structural quality steel sheet

Base-metal grade designation	R_{eL} [a] min. MPa	R_m min. MPa	A [b] min. %	
			$e \leq 2$ mm	
			$L_o = 50$ mm	$L_o = 80$ mm
HR275	275	380	15	14
HR340	340	340	9	8
HR380	380	380	8	7
HR410	410	410	7	6
HR480	480	480	6	5
HR550	550	550	5	4

Key

R_{eL}: lower yield strength

R_m: tensile strength

A: percentage elongation after fracture

L_o: gauge length on original test piece

e: thickness of steel sheet, in millimetre(s)

NOTE 1 MPa = 1 N/mm^2

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

[b] Use either $L_o = 50$ mm or $L_o = 80$ mm to measure elongation. For materials up to and including 0,6 mm in thickness, the elongation values in this table shall be reduced by 2.

Table 6 — Mechanical properties for high strength steel sheet

Base-metal grade designation	Class	R_{eL} [a] min. MPa	R_m min. MPa	A [b] min. %	
				$e \leq 2$ mm	
				$L_o = 50$ mm	$L_o = 80$ mm
HSS 310	1	310	410	18	17
	2	310	380	18	17
HSS 340	1	340	450	15	14
	2	340	410	15	14

Key

R_{eL}: lower yield strength

R_m: tensile strength

A: percentage elongation after fracture

L_o: gauge length on original test piece

e: thickness of steel sheet, in millimetre(s)

NOTE 1 MPa = 1 N/mm^2

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

[b] For thicknesses up to 2 mm, use either $L_o = 50$ mm or $L_o = 80$ mm. In cases of dispute, however, only the results obtained on a 50 mm test piece shall be valid.