INTERNATIONAL STANDARD

ISO 9364

Third edition
2006-09-15

Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities

Tôles en acier revêtues en continu par immersion à chaud d'une couche d'alliage aluminium-zinc de qualité commerciale, pour emboutissage ou destinées à la construction

Reference number
ISO 9364:2006(E)

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Published in Switzerland

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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 9364 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This third edition cancels and replaces the second edition (ISO 9364:2001), which has been technically revised.

Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities

1 Scope

This International Standard applies to the characteristics of steel sheet of commercial, drawing and structural qualities coated by a continuous hot-dip aluminium/zinc alloy coating process. The aluminium/zinc alloy composition by mass is nominally 55 % aluminium, 1,6 % silicon, and the balance zinc. The product is intended for applications where the corrosion characteristics of aluminium coupled with those of zinc are desired.

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 1460:1992, *Metallic coatings — Hot dip galvanized coatings on ferrous materials — Gravimetric determination of the mass per unit area*

ISO 2178:1982, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

ISO 3497:2000, *Metallic coatings — Measurement of coating thickness — X-ray spectrometric methods*

ISO 6892:1998, *Metallic materials — Tensile testing at ambient temperature*

ISO 7438:2005, *Metallic materials — Bend test*

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

ISO 16162, *Continuously cold-rolled steel sheet products — Dimensional and shape tolerances*

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.

3.1
normal spangle
coating formed as a result of unrestricted growth of aluminium/zinc crystals during normal solidification

3.2
smooth finish
smooth coating produced by skinpassing the coated material in order to achieve an improved surface condition compared with the normal as-coated product

3.3
ageing
susceptibility to changes in properties with the passage of time

NOTE Ageing may result in a change in yield strength and a corresponding decrease in ductility during storage. Ageing always has a negative effect on formability. The redevelopment of an upper yield point as a result of ageing can result in a renewed susceptibility to surface imperfections, such as stretcher strain marks (Luder's Lines) and fluting when the steel is formed. To avoid these adverse outcomes, it is essential that the period between final processing at the producing mill and fabrication be kept to a minimum. Rotation of stock, by using the oldest material first, is important. Effective roller leveling immediately prior to fabrication can achieve reasonable freedom from stretcher strain marks.

3.4
skin pass
a light cold rolling of the coated steel sheet

NOTE The purpose of the skin pass is to produce a higher degree of surface smoothness and thereby improve the surface appearance. The skin pass also temporarily minimizes the occurrence of a surface condition known as stretcher strain (Luder's Lines) or fluting during the fabrication of finished parts. The skin pass also controls and improves flatness. Some increase in hardness and some loss in ductility will result from skin passing.

3.5
differential coating
coating having a coating mass on one surface that is significantly different from the coating mass on the other surface

4 Thickness, ordering conditions and fabrication qualities

4.1 Aluminum/zinc-coated steel sheet is produced in thicknesses up to and including 5,0 mm after coating, and in widths of 600 mm and over in coils and cut lengths. Aluminium/zinc-coated steel sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

4.2 The thickness of hot-dip aluminum/zinc-coated steel sheet may be specified as a combination of the base metal and metallic coating, or as base metal alone. The purchaser shall indicate on the order which method of specifying thickness is required. In the event that the purchaser does not indicate any preference, the thickness as a combination of the base metal and coating will be provided. Annex B describes the requirements for specifying the thickness as base metal alone.

4.3 Aluminium/zinc-coated steel sheet may be ordered in one of two ordering conditions.

— Ordering condition A): Steel ordered to satisfy mechanical properties.

— Ordering condition B): Steel ordered to make an identified part.

4.4 Aluminium/zinc-alloy-coated steel sheet is available in several fabrication qualities.

a) Commercial: intended for general fabricating purposes, where sheet is used in the flat, or for bending or moderate forming.

b) Drawing: intended for applications where drawing or severe forming may be involved.

c) Deep drawing: intended for applications where severe drawing or severe forming may be involved.

d) Structural: aluminium/zinc-coated steel sheet is produced in six grades as defined by minimum yield stress.

e) Interstitial free steel (IF Steel) may be applied on orders specifying 02 drawing [see item b)] or 03 deep drawing [see item c)] provided that the customer be informed of the substitution and related shipping documents that reflect the actual material shipped.

5 Requirements

5.1 Chemical composition

The chemical composition (heat analysis) shall not exceed the values given in Tables 1 and 2.

Table 1 — Chemical composition (heat analysis)

Mass fractions in percent

Base-metal quality		C	Mn	P	S
Name	Designation	max.	max.	max.	max.
Commercial	01	0,10	0,60	0,030	0,035
Drawing and deep drawing [a]	02 and 03	0,06	0,50	0,020	0,025
Structural	220 to 550	0,25 [b]	1,15	0,20 [c]	0,040

[a] If interstitial free steel (IF Steel) is to be applied on drawing 02 or deep drawing 03 orders [see 4.4, item e)], the values of 0,15 % maximum for titanium and 0,10 % maximum for niobium and vanadium are acceptable to ensure that the carbon and nitrogen are fully stabilized.

[b] Grade 350 may exceed the limits in Table 3 or conform to all the requirements of Table 3 and have 0,40 % max. carbon.

[c] Grades 250 and 280: phosphorus - 0,10 % max. Grade 350: phosphorus - 0,20 % max.

Table 2 — Limits on additional chemical elements [a]

Elements	Heat analysis max. %	Product analysis max. %
Cu [b]	0,20	0,23
Ni [b]	0,20	0,23
Cr [b, c]	0,15	0,19
Mo [b, c]	0,06	0,07
Nb [e]	0,008	0,018
V [d, e]	0,008	0,018
Ti [e]	0,008	0,018

[a] Each of the elements listed in this table 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 %".

[b] The sum of copper, nickel, chromium and molybdenum shall not exceed 0,50 % on heat analysis. When one or more of these elements are specified, the sum does not apply; in which case, only the individual limits on the remaining elements will apply.

[c] The sum of chromium and molybdenum shall not exceed 0,16 % on heat analysis. When one or more of these elements are specified, the sum does not apply; in which case, only the individual limits on the remaining elements will apply.

[d] Heat analysis greater than 0,008 may be supplied after agreement between the producer and consumer.

[e] For interstitial free steel (IF Steel), only the value of 0,15 % maximum for titanium, and 0,10 % maximum for niobium and vanadium, are acceptable to ensure that the carbon and nitrogen are fully stabilized.

A verification analysis may be made by the purchaser to verify the specified analysis of the product and shall take into consideration any normal heterogeneity. Non-killed steels (such as rimmed or capped) are not technologically suited to product analysis. The product analysis tolerances are shown in Table 3.

Table 3 — Product analysis tolerances %

Element	Maximum of specified element	Tolerance over maximum specified
C	0,25	0,04
Mn	1,15	0,05
P	0,05	0,01
S	0,35	0,01
NOTE The above maximum tolerance is the allowable excess over the specified requirement and not the heat analysis.		

The processes used in making the steel and in manufacturing aluminium/zinc alloy sheet are left to the discretion of the manufacturer. When requested, the purchaser shall be informed of the steel-making process used. On request, a report of the heat analysis shall be made to the purchaser.

5.2 Mechanical properties

5.2.1 Commercial and drawing quality

Aluminium/zinc-alloy-coated sheet of designations 01, 02 and 03 are supplied under the following two ordering conditions.

Ordering condition A): Steel, when ordered according to its mechanical properties, at the time the steel is made available for shipment, shall satisfy the applicable requirements of Table 4.

Ordering condition B): Steel, when ordered to make an identified part, shall be supplied with a commitment for satisfactory manufacturing performance within a properly established breakage allowance, which shall be previously agreed upon between the interested parties. In these cases, the part name, the details of fabrication, and special requirements (such as freedom from stretcher strain or fluting) shall be specified.

Table 4 — Mechanical properties

Base metal quality		R_e max. [a]	R_m max. [b]	A min. [c] %		
Name	Designation	N/mm [d]	N/mm [d]	L_o = 50 mm	L_o = 80 mm	$L_o = 5{,}65\sqrt{S_o}$ [e]
Commercial	01	—	—	—	—	—
Drawing	02	300 [f]	430	24	23	22
Deep drawing	03	260	410	26	25	24

R_e = yield stress

R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

S_o = original cross-sectional area of gauge length

NOTE 1 Time period for which values stated in this table are applicable.

Quality	Time period
Commercial	—
Drawing	8 days
Deep drawing	1 month

NOTE 2 For products produced according to performance criteria (5.2.1) ordering condition B, the typical mechanical properties presented here are non-mandatory. They are intended solely to provide the purchaser with as much information as possible to make an intelligent ordering decision. Values outside these ranges are to be expected. The purchaser may negotiate with the supplier if a specific range, or a more restrictive range, is required for the application.

NOTE 3 These typical mechanical properties apply to the full range of steel sheet thicknesses. The yield stress tends to increase and some of the formability aspects tend to decrease as the sheet thickness decreases.

[a] The yield values apply to 0,2 % proof stress if the yield point is not pronounced, otherwise to the lower yield point (R_{eL}).

[b] The minimum tensile strength for drawing qualities would normally be expected to be 270 N/mm^2. All tensile strength values are determined to the nearest 10 N/mm^2.

[c] For material up to and including 0,6 mm in thickness, the elongation values in the table shall be reduced by 2.

[d] 1 N/mm^2 = 1 MPa.

[e] May be used for material over 3 mm in thickness.

[f] This value applies to skin-passed products only.

5.2.2 Structural quality

The mechanical properties, at the time the steel is made available for shipment, shall satisfy the requirements of Table 5.

Table 5 — Mechanical properties of structural-quality steels and coating bend test

Grade	R_e min. N/mm^2	R_m min. N/mm^2	A min. [a] %		Coated metal 180° bend mandrel diameter mm	
			L_o = 50 mm	L_o = 80 mm	$e < 3$	$e \geqslant 3$
220	220	320	20	18	1a	2a
250	250	350	18	16	1a	2a
280	280	390	16	14	2a	3a
320	320	430	14	12	3a	3a
350	350	450	12	10	—	—
550 [b]	550	560	—	—	—	—

R_e = yield stress — can be either R_{eL} or R_{eH}, but not both
R_{eL} = lower yield stress
R_{eH} = higher yield stress
R_m = tensile strength
A = percentage elongation after fracture
L_o = gauge length on test piece
a = thickness of bend test piece
1 N/mm^2 = 1 MPa

NOTE 1 R_{eL} is measured by 0,5 % total elongation proof stress (proof stress under load) or by 0,2 % offset when a definite yield phenomenon is not present.

NOTE 2 In determining the base-metal mechanical properties, base-metal thickness is measured after stripping the coating from the end of the specimen contacting the grips of the tension-testing machine before testing.

[a] Use either L_o = 50 mm or L_o = 80 mm to measure elongation. For material up to and including 0,6 mm in thickness, the elongation values in the table are reduced by 2.

[b] Grade 550 is in the unannealed condition and therefore has limited ductility. If the hardness is HRB 85 or higher, no tension test is required.

5.3 Coating

5.3.1 Coating mass

The coating-mass limits shall conform to the limits for the designations shown in Table 6. The coating mass is the total amount of coating on both sides of the sheet, expressed in grams per square metre.

Table 6 — Coating-mass test limits for aluminium/zinc-coated steel sheet

Coating designation	Triple-spot test, total both sides min. g/m^2	Single-spot test, total both sides min. g/m^2
AZ090	090	75
AZ100	100	85
AZ150	150	130
AZ165	165	140
AZ185	185	160
AZ200	200	170

NOTE 1 The coating mass, in grams per square metre, refers to the total coating on both surfaces. Because of the many variables and changing conditions that are characteristic of continuous hot-dip coating, the coating mass is not always evenly divided between the two surfaces of a sheet, neither is the coating evenly distributed from edge to edge. However, it can normally be expected that no less than 40 % of the single-spot test limit will be found on either surface.

NOTE 2 Values of total theoretical thickness for coating mass are given in Annex A.

NOTE 3 The coating thickness can be estimated from the coating mass by using the following relationship:

100g/m^2 total both sides ≅ 0,002 6 mm total both sides

5.3.2 Coating adherence

For commercial and drawing qualities, the coated sheet shall be capable of being bent 180° flat on itself in any direction, without flaking of the coating on the outside of the bend. For structural-quality grades, the sheet shall be capable of being bent 180°, in accordance with the mandrel requirements of Table 5, without flaking of the coating on the outside of the bend. Flaking of the coating within 7 mm from the edge shall not be a cause for rejection.

5.4 Weldability

This product is suitable for welding if appropriate welding conditions are selected with special attention to the heavier coatings. When the carbon content increases above 0,15 %, spot welding becomes increasingly difficult. Because the heat of welding might have a significant effect on lowering the strength of grade 550, this grade is not recommended for welding.

5.5 Surface treatments

5.5.1 Mill passivation

A chemical treatment may be applied to aluminium/zinc-coated steel sheet to minimize the hazard of wet storage stain during shipment and storage. However, the inhibiting characteristics of the treatment are limited and, if a shipment is received wet, the material shall be used immediately or dried.