
**Continuous hot-dip zinc-5 % aluminium
alloy coated steel sheet**

Tôles en acier revêtues à chaud en continu d'alliage zinc-aluminium 5 %

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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 14788 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 14788:2005), which has been technically revised.

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Continuous hot-dip zinc-5 % aluminium alloy coated steel sheet

1 Scope

This International Standard is applicable to the minimum requirements for steel sheet, in coils and cut lengths, metallic-coated by the continuous hot-dip process, with zinc-5 % aluminium alloy coating.

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

The steel sheet is produced in a number of qualities and grades, coating mass, surface treatments and coating conditions designed to be compatible with differing application requirements.

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

[ISO 14788:2011](#)

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 16163:2011, *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 Quality applications

3.1.1

commercial

intended for general fabricating purposes where sheet is used in the flat condition, or for bending or moderate forming

3.1.2

drawing

intended for parts where drawing or severe forming may be involved

3.1.3

deep drawing

intended for parts where severe forming or severe drawing may be involved

3.1.4

deep drawing aluminium killed (non-ageing)

intended for fabricating parts where particularly severe drawing or forming may be involved or essential freedom from ageing is required

3.1.5

extra-deep drawing (stabilized)

intended for applications requiring interstitial-free steel (IF) which is non-ageing and has maximum formability

3.2

aluminium killed

steel which has been deoxidized with aluminium that is sufficient to prevent the evolution of gas during solidification

3.3

stabilized interstitial-free steel

extra-low-carbon steel in which all interstitial elements are combined with titanium and/or equivalent elements

NOTE Stabilized steel is sometimes referred to as interstitial-free steel.

3.4

continuous hot-dip zinc-5 % aluminium-coated steel sheet

product obtained by hot-dip coating of steel sheet coils on a continuous coating line to produce either coated coils or cut lengths

3.5

normal spangle

coating formed as a result of the unrestricted growth of zinc-5 % aluminium alloy crystals during normal solidification

3.6

smooth finish

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

3.7

skin pass

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 (Lüders' lines) or fluting during the fabrication of finished parts. The skin pass also controls and improves flatness.

3.8

ageing

susceptibility of zinc-5 % aluminium alloy coated steel sheet to changes in properties with the passage of time

NOTE Ageing may result in a change in yield strength and 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 renewed susceptibility to surface imperfections, such as stretcher-strain marks (Lüders' 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 levelling immediately prior to fabrication can achieve reasonable freedom from stretcher-strain marks.

4 Thickness

4.1 Zinc-5 % aluminium alloy coated steel sheet is produced in thicknesses up to 5 mm after coating, and in widths of 600 mm and over in coils and cut lengths. Zinc-5 % aluminium alloy 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 zinc-5 % aluminium alloy coated sheet steel may be specified as a combination of the base metal and metallic coating, or as the 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 A describes the requirements for specifying the thickness of the base metal alone.

5 Requirements

5.1 Chemical composition

The chemical composition (heat analysis) shall not exceed the values given in Tables 1 and 2. On request, a report of the heat analysis shall be made to the purchaser.

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

The processes used in making the steel and in manufacturing zinc-5 % aluminium alloy coated sheet are left to the discretion of the manufacturer. When requested, the purchaser shall be informed of the steel-making process being used.

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Table 1 — Chemical composition (heat analysis), % (mass fraction)

Quality		C % max.	Mn % max.	P % max.	S % max.	Ti % max.
Designation	Name					
01	Commercial	0,15	0,60	0,05	0,035	—
02	Drawing	0,10	0,50	0,04	0,035	—
03	Deep drawing	0,08	0,45	0,03	0,03	—
04	Deep drawing aluminium killed	0,06	0,45	0,03	0,03	—
05	Extra-deep drawing (stabilized interstitial-free)	0,02	0,25	0,02	0,02	0,15
06	Structural	0,25	1,70	0,05	0,05	—

For interstitial-free steels only, 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.

By agreement, the levels of manganese, phosphorus, sulfur and titanium may be adjusted.

Table 2 — Limits on additional chemical elements, % (mass fraction)

Element	Cu ^a max.	Ni ^a max.	Cr ^{ab} max.	Mo ^{ab} max.	Nb ^c max.	V ^{cd} max.	Ti ^d max.
Heat analysis	0,20	0,20	0,15	0,06	0,008	0,008	0,008
Product analysis	0,23	0,23	0,19	0,07	0,018	0,018	0,018

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 %.

^a 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.

^b 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.

^c For interstitial-free steels only, the value of 0,15 % titanium, and 0,10 % maximum for niobium and vanadium are acceptable to ensure that the carbon and nitrogen are fully stabilized.

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

Table 3 — Product analysis tolerances, % (mass fraction)

Element	Maximum of specified element	Tolerance over maximum specified
C	0,15	0,03
	0,25	0,04
Mn	0,60	0,03
	1,70	0,05
P	0,05	0,01
S	0,05	0,01
Ti	0,15	0,01

NOTE The above maximum tolerance is the allowable excess over the specified requirement and not the heat analysis.

5.2 Mechanical properties

5.2.1 Commercial and drawing qualities

Zinc-5 % aluminium alloy coated steel sheet of designations 01, 02, 03, 04 and 05 is supplied under the following two ordering conditions.

- a) Ordering condition A): steel when ordered to mechanical properties shall, at the time the steel is made available for shipment, satisfy the applicable requirements of Table 4.
- b) Ordering condition B): steel when ordered to make an identified part shall be supplied with a commitment to 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.

Prolonged storage of the sheet can cause a change in mechanical properties (increase in hardness and decrease in elongation), leading to a decrease in drawability. To minimize this effect, quality 04 or 05 should be specified.

5.2.2 Structural quality

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

5.2.3 Fabrication qualities

Zinc-5 % aluminium alloy coated steel sheet is available in several fabrication qualities.

- Commercial: intended for general fabrication purposes, where sheet is used in the flat condition or for bending or moderate forming.
- Drawing: intended for fabricating parts where drawing or severe forming may be involved.
- Deep drawing: intended for fabricating parts where severe drawing or severe forming may be involved.
- Deep drawing/aluminium killed (non-ageing): intended for fabricating parts where particularly severe drawing or forming may be involved or essential freedom from ageing is required.
- Extra-deep drawing (stabilized interstitial-free): intended for applications requiring interstitial-free steel (IF) which is non-ageing and has maximum formability.

Structural: zinc-5 % aluminium alloy coated steel sheet is produced in six grades as defined by a minimum yield stress and is intended for structural applications.

Table 4 — Mechanical properties

Base-metal quality ^a		R_{eL} ^b MPa ^g max.	R_m ^c MPa max.	A , % ^d min.		\bar{r} e ^{fh} min.	\bar{n} e ^{fh} min.												
Designation	Name			$L_0 = 80$ mm	$L_0 = 50$ mm														
01	Commercial	—	—	—	—	—	—												
02	Drawing	340	430	30	31	—	—												
03	Deep drawing	300	410	34	35	—	—												
04	Deep drawing aluminium killed	270	410	36	37	—	—												
05	Extra-deep drawing (stabilized interstitial-free)	250	380	38	38	1,4	0,17												
R_{eL} yield stress R_m tensile stress A percentage elongation after fracture L_0 gauge length of test piece \bar{r} index of drawability of the product \bar{n} index of the stretchability of the product																			
NOTE 1 Duration of applicability of values stated in this table: <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Designation</th> <th>Time period</th> </tr> </thead> <tbody> <tr> <td>01</td> <td>—</td> </tr> <tr> <td>02</td> <td>8 days</td> </tr> <tr> <td>03</td> <td>30 days</td> </tr> <tr> <td>04</td> <td>6 months</td> </tr> <tr> <td>05</td> <td>6 months</td> </tr> </tbody> </table>								Designation	Time period	01	—	02	8 days	03	30 days	04	6 months	05	6 months
Designation	Time period																		
01	—																		
02	8 days																		
03	30 days																		
04	6 months																		
05	6 months																		
NOTE 2 For products produced according to performance criteria (ordering condition B), the typical mechanical properties presented here are not mandatory. For products ordered according to specific mechanical properties (ordering condition A), the purchaser can negotiate with the supplier if a specific range of values or a more restrictive range is required for the application. Therefore, these values can be specified by agreement.																			
NOTE 3 These typical mechanical properties apply to the full range of steel sheet thickness. The yield stress tends to increase and some of the formability tends to decrease as the sheet thickness decreases.																			
^a All qualities are available with a normal spangle or smooth finish. ^b The yield values apply to 0,2 % proof stress if the yield point is not pronounced, otherwise to the lower yield point (σ_{e1}). ^c The minimum tensile strength for qualities 02, 03 and 04 would normally be expected to be 270 MPa. For design purposes, the lower limit for R_{eL} may be assumed to be 140 MPa for grades 01, 02, 03, and 04, and 120 MPa for grade 05. ^d For materials of thickness up to and including 0,6 mm, the elongation percentages in this table shall be reduced by 2. ^e \bar{r} and \bar{n} values are only applicable to thickness $\geq 0,5$ mm. For thickness $> 2,0$ mm, the \bar{r} value is reduced by 0,2. ^f \bar{r} can also be written as r-bar and \bar{n} can also be written as n-bar. ^g 1 MPa = 1 N/mm ² . ^h \bar{r} and \bar{n} values may be modified or excluded from this specification, by agreement between the producer and the purchaser.																			

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.

5.3.2 Coating adherence

The coated sheet shall be capable of being bent in any direction, in accordance with the mandrel diameter requirements of Table 7, without flaking of the coating on the outside of the bend. Flaking of the coating within 7 mm from the edge of the test piece shall not be a cause for rejection.

Table 5 — Mechanical properties of structural-quality steels

Grade	R_e min. ^a MPa	R_m min. MPa	A min. ^b , %	
			$L_0 = 50$ mm	$L_0 = 80$ mm
220	220	310	20	18
250	250	360	18	16
280	280	380	16	14
320	320	430	14	12
350	350	450	12	10
380	380	540	12	10
550 ^c	550	570	—	—

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

^a The yield stress specified in this table shall be the lower yield stress (R_{e1}). The values can also be 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. When the upper yield stress (R_{eH}) is specified, the values shall be 20 MPa above the R_{e1} values for each grade.

^b The elongation values in the table shall be reduced by 2 for material up to and including 0,6 mm in thickness.

^c 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. Bend testing for coating adherence is not applicable to Grade 550.

Table 6 — Coating mass (total both sides) test limits for zinc-5 % aluminium alloy coated steel sheet

Coating designation	Triple-spot test total for both sides min. g/m ²	Single-spot test total for both sides min. g/m ²
ZA001	no minimum	no minimum
ZA080	80	70
ZA090	90	75
ZA095	95	80
ZA100	100	85
ZA120	120	100
ZA130	130	110
ZA135	135	115
ZA140	140	120
ZA150	150	130
ZA160	160	135
ZA180	180	155
ZA185	185	155
ZA200	200	170
ZA225	225	190
ZA250	250	210
ZA255	255	215
ZA275	275	235
ZA300	300	255
ZA350	350	300
ZA450	450	385
ZA600	600	510
ZA700	700	595

NOTE 1 Not all coating designations are available from all producers.

NOTE 2 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 characteristics of continuous hot-dip coating, the coating mass is not always evenly divided between the two surfaces of a sheet, nor 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 3 The coating thickness can be estimated from the coating mass by using the following relationship:

— 100 g/m² total for both sides \cong 0,015 mm total for both sides.