
**Steel sheet, 55 % aluminium-zinc
alloy-coated by the continuous hot-dip
process, of commercial, drawing and
structural qualities**

*Tôles en acier revêtues en continu par immersion à chaud d'une
couche d'alliage aluminium-zinc 55 % de qualité commerciale, pour
emboutissage ou destinées à la construction*

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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 on 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 the following URL: 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 9364:2011), which has been technically revised.

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Steel sheet, 55 % aluminium-zinc alloy-coated by the continuous hot-dip process, of commercial, drawing and structural qualities

1 Scope

This document is applicable to the requirements for steel sheet, in coils and cut lengths, metallic-coated by the continuous hot-dip process with 55 % aluminium-zinc alloy coating.

The product is intended for applications requiring the corrosion characteristics of aluminium coupled with those of zinc, or heat resistance, or both.

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

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 terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

commercial

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

3.2

drawing

base-metal quality intended for parts where drawing or severe forming may be involved

3.3

deep drawing

base-metal quality intended for parts where severe forming or severe *drawing* (3.2) may be involved

3.4

interstitial-free steel

IF steel

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

Note 1 to entry: Interstitial-free steel is sometimes referred to as “stabilized steel”.

3.5

breakage allowance

agreed upon level of acceptable die breakage not subject to claim

3.6

normal spangle

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

3.7

smooth finish

smoothness produced by *skin passing* (3.8) the coated material in order to achieve an improved surface condition as compared with the normal as-coated product

3.8

skin pass

light cold rolling of the product

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

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

3.9

differential coating

coating deliberately produced to have a different *coating mass* (3.11) on each surface

3.10

lot

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

3.11

coating mass

total amount of coating on both sides of the sheet

Note 1 to entry: Coating mass is expressed in grams per square metre.

4 Dimensions

4.1 55 % aluminium-zinc alloy-coated steel sheet is produced in thicknesses from 0,25 mm to 5 mm inclusive after coating, and in widths of 600 mm and over in coils and cut lengths. 55 % aluminium-zinc alloy-coated steel sheet less than 600 mm wide, slit from wide sheet, is considered as sheet.

4.2 The thickness of 55 % aluminium-zinc alloy-coated steel sheet 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 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 55 % aluminium-zinc alloy-coated steel 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

The chemical composition (heat analysis) shall conform to the requirements given in [Tables 1](#) and [2](#).

5.3 Chemical analysis

5.3.1 Heat analysis

An analysis of each heat shall be made by the manufacturer in order to determine compliance with the requirements given in [Tables 1](#) and [2](#). 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](#) and [2](#) 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 shall be in accordance with [Tables 2](#) and [3](#).

Table 1 — Chemical composition (heat analysis)

Mass fractions in percent

Base-metal quality		C	Mn	P	S
Designation	Name	max.	max.	max.	max.
01	Commercial	0,10	0,60	0,030	0,035
02 and 03 ^a	Drawing and deep drawing	0,06	0,50	0,020	0,025
220 to 550	Structural	0,25	1,15	0,05 ^b	0,035

^a Interstitial-free steel may be applied (see [5.4.1.3](#)).

^b Grades 250 and 280: phosphorus – 0,10 % max. Grade 350: phosphorus – 0,20 % max.

Table 2 — Limits on additional chemical elements

Mass fractions in percent

Element	Cu ^a max.	Ni ^a max.	Cr ^{a,b} max.	Mo ^{a,b} max.	Nb ^c max.	V ^{c,d} max.	Ti ^c 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

^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 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 apply.

^c For interstitial-free steels 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.

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

Table 3 — Product analysis tolerances for Table 1

Mass fractions in percent

Element	Maximum of specified element	Tolerance over maximum specified
C	0,15	0,03
	0,25	0,04
Mn	1,15	0,05
P	0,20	0,01
S	0,035	0,01

NOTE The maximum tolerance is the allowable excess over the requirement of heat analysis shown in Table 1.

5.4 Mechanical properties

5.4.1 Commercial and drawing quality

5.4.1.1 Ordering conditions

55 % aluminium-zinc alloy-coated steel sheet of designations 02 and 03 are supplied under either of the following two ordering conditions.

- Ordering condition A: steel sheet mechanical properties shall, at the time the steel is made available for shipment, satisfy the applicable requirements of Table 4, when they are determined on test pieces obtained in accordance with the requirements in Clause 7. The values specified in Table 4 are applicable for the periods indicated in Table 5 from the time that the steel is available for shipment.
- Ordering condition B: steel sheet, ordered to make an identified part, shall be supplied with a commitment for satisfactory manufacturing performance within an established breakage allowance, which shall be previously agreed upon by the interested parties. In the agreement, the part name, the details of fabrication, and special requirements (such as freedom from stretcher strain or fluting) shall be specified.

In the case of ordering condition B, mechanical properties of the steel sheet may also be agreed upon by the interested parties and such properties may not necessarily satisfy the requirements of Table 4.

5.4.1.2 Fabrication qualities

55 % aluminium-zinc alloy-coated steel sheet is available in three fabrication qualities as given in 3.1 to 3.3.

5.4.1.3 Interstitial-free steel

Stabilized interstitial-free (IF) steel is applicable to orders for designations 02 and 03, provided that the purchaser is informed of the substitution and that related shipping documents reflect the actual material shipped.

Table 4 — Mechanical properties of commercial and drawing quality grades

Base-metal quality		R_{eL} max. ^a MPa	R_m max. ^b MPa	A min. ^c %		
Designation	Name			$L_0 = 80$ mm	$L_0 = 50$ mm	$L_0 = 5,65 \sqrt{S_0}$ ^d
01	Commercial	—	—	—	—	—
02	Drawing	300 ^e	430	23	24	22
03	Deep drawing	260	410	25	26	24

R_{eL} = lower yield strength
 R_m = tensile strength
A = percentage elongation after fracture
 L_0 = gauge length of original test piece
 S_0 = original cross-sectional area of gauge length
1 MPa = 1 N/mm²

For products produced according to the performance criteria (ordering condition B), the typical mechanical properties presented here are non-mandatory. For products specified according to mechanical properties (ordering condition A), the purchaser may negotiate with the manufacturer if a specific range, or a more restrictive range, is required for the application. When agreed to, such values may be specified.

NOTE With the exception of footnote e, these typical mechanical properties apply to the full range of steel sheet thicknesses. The yield strength tends to increase and some of the formability aspects tend to decrease as the sheet thickness decreases.

^a The values apply to 0,2 % proof strength when a definite yield phenomenon is not present, otherwise to the lower yield strength (R_{eL}).

^b The minimum tensile strength for qualities, 02 and 03, would normally be expected to be 270 MPa. All tensile strength values are determined to the nearest 10 MPa.

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

^d This may be used for material over 3 mm in thickness.

^e This value applies to skin-passed products only.

Table 5 — Applicable period for values specified in Table 4

Designation	Period
01	Not applicable
02	8 d
03	30 d

5.4.2 Structural quality

The mechanical properties, at the time the steel is made available for shipment, shall satisfy the requirements of Table 6.

Table 6 — Mechanical properties of structural quality grades and coating bend test

Grade designation	R_{eL} min.	R_m min.	A min. ^a %		Coated metal 180° bend mandrel diameter mm ^b	
	MPa	MPa	$L_0 = 80 \text{ mm}$	$L_0 = 50 \text{ mm}$	$e < 3$	$e \geq 3$
220	220	320	18	20	1a	2a
250	250	350	16	18	1a	2a
280	280	390	14	16	2a	3a
320	320	430	12	14	3a	3a
350	350	450	10	12	—	—
550 ^c	550	560	—	—	—	—

R_{eL} = lower yield strength

R_m = tensile strength

A = percentage elongation after fracture

L_0 = gauge length of original test piece

e = thickness of steel sheet in mm

a = thickness of bend test piece in mm

1 MPa = 1 N/mm²

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

NOTE 2 In determining the base-metal mechanical properties, the 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 The elongation values in the table shall be reduced by 2 and the yield strength increased by 20 MPa for material up to and including 0,6 mm in thickness.

^b Bend testing for coating adherence is not applicable to grade 550.

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

5.5 Coating

5.5.1 Coating mass

The coating mass limits shall conform to the limits for the designations shown in [Table 7](#). The coating mass is the total amount of coating on both sides of the sheet, expressed in grams per square metre. The interested parties shall agree upon the coating mass of differentially coated products. If a maximum coating mass is required, the manufacturer shall be notified at the time of ordering.

Table 7 — Coating mass (total both sides)

Coating mass designation	Minimum check limit	
	Triple-spot test g/m ²	Single-spot test g/m ²
AZ070 ^a	70	60
AZ090	90	75
AZ100	100	85
AZ120	120	102
AZ150	150	130
AZ165	165	140
AZ185	185	160
AZ200	200	170

NOTE 1 Because of the many variables and changing conditions that are characteristic of continuous aluminium-zinc 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 check limit will be found on either surface.

NOTE 2 The coating thickness can be estimated from the coating mass by using the following relationship: 100 g/m² total mass both sides \cong 0,026 mm total thickness both sides.

^a AZ070 is available only upon agreement between the purchaser and the manufacturer.

5.5.2 Coating adherence

For commercial, drawing and deep drawing qualities, 55 % aluminium-zinc alloy-coated steel 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 6, 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.

5.6 Weldability

This product is normally suitable for welding when appropriate welding methods and procedures are used 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.

5.7 Painting

55 % aluminium-zinc alloy-coated steel sheet is a suitable base for paint, but the first treatment may be different from those used on uncoated steel. Pre-treatment primers, chemical conversion coatings (chromate, phosphate or oxide type), and some paints specially formulated for direct application to coated surfaces, are all appropriate first treatments for 55 % aluminium-zinc alloy-coated sheet. In drawing up a painting schedule, consideration shall be given to whether the 55 % aluminium-zinc alloy-coated sheet shall be ordered in the passivated or not passivated state.

NOTE Surfaces with certain passivation treatments (e.g. chromated) are not suitable for the application of a pre-treatment (etch) primer.

5.8 Coating finish condition

The coating finish of 55 % aluminium-zinc alloy-coated steel sheet is either a normal, as-coated surface with unrestricted spangle growth (see 3.6), or a skin passed surface that has improved smoothness compared to an as-coated surface (see 3.7 and 3.8).

5.9 Surface treatment

5.9.1 Mill passivation

A chemical treatment is normally applied to 55 % aluminium-zinc alloy-coated steel sheet to minimize the hazard of wet storage staining (white rust) 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.

5.9.2 Oiling

When specified, 55 % aluminium-zinc alloy-coated steel sheet as produced shall be oiled to prevent marring and scratching of the soft surface during handling or shipping and to minimize wet storage stain.

NOTE When 55 % aluminium-zinc alloy-coated steel sheet has received a passivating treatment, oiling will further minimize the hazard of wet storage stain.

5.10 Coated coil joining

Continuous coil coating lines use various methods to join coil ends. These methods include lap welding, butt welding and stitching. The shipment of coils containing the joined coil ends may be permitted, if agreed upon between the purchaser and the manufacturer.

5.11 Dimensional and shape tolerances

5.11.1 Dimensional and shape tolerances applicable to 55 % aluminium-zinc alloy-coated steel sheet shall be as specified in ISO 16163. The tolerances for thickness apply to products whose thickness is a combination of base metal and coating thickness.

5.11.2 When the base-metal thickness is specified, the thickness tolerances of ISO 16163 shall apply to the product thickness calculated in accordance with [Annex A](#).

6 Sampling

6.1 Tensile test

When required, one representative transverse sample from each lot of 50 t or less for shipment shall be taken for the tensile test to verify conformance with the requirements of [Tables 4](#) and [6](#).

6.2 Coating tests

6.2.1 Coating mass

6.2.1.1 The manufacturer shall develop a testing plan with a frequency sufficient to adequately characterize the lot of material and ensure conformance with specification requirements.

6.2.1.2 The purchaser may conduct verification tests by securing a sample piece approximately 300 mm in length by the as-coated width and cutting three test specimens: one from the mid-width position and one from each side, not closer than 25 mm to the side edge. The minimum area of each of the three specimens shall be 1 200 mm².

6.2.2 Triple-spot test

The triple-spot test result shall be the average coating mass found on three test specimens taken in accordance with [6.2.1](#).

6.2.3 Single-spot test

The single-spot test result shall be the minimum coating mass found on any one of the three specimens used for the triple-spot test. Material, which has been slit from wide coil, shall be subject to a single-spot test only.

6.2.4 Coating adherence

One representative sample for the coating-adherence bend test shall be taken from each lot of 50 t or less for shipment. The specimens for the coating-adherence bend test shall be taken not closer than 25 mm from the side edge. The minimum width of the test specimen shall be 50 mm.

7 Test methods

7.1 Tensile test

The tests shall be conducted in accordance with the methods specified in ISO 6892-1. Transverse test pieces shall be taken midway between the centre and the edge of the as-coated sheet. Base-metal thickness shall be used to calculate the cross-sectional area needed for the tensile test; however, for orders specifying thickness as “base metal only”, there are two permissible methods for determining the base-metal thickness.

- a) Option A — Determine the actual base-metal thickness through direct measurement of the substrate of a specimen from which the coating has been removed.
- b) Option B — Calculation of the base-metal thickness, through subtraction of the equivalent coating thickness for the appropriate coating designation included in [Annex A](#) from the actual coated thickness of the test specimen.

7.2 Coating properties

7.2.1 Coating mass

The manufacturer shall conduct tests using methods deemed necessary to ensure that the material complies with the requirements shown in [Table 7](#). Test methods to be used include ISO 1460, ISO 3497 or ISO 2178. The coating mass is determined by converting coating-thickness measurements made with magnetic gauges (ISO 2178) or by X-ray spectrometry (ISO 3497), using the relationship given in [Table 7](#). Either the test method in ISO 2178 or ISO 3497 shall be used as a basis for acceptance, but not for rejection. In cases of dispute, ISO 1460 shall be used as the referee method.

7.2.2 Coating adherence

Bend tests shall be conducted in accordance with the methods specified in ISO 7438.

8 Designation system

8.1 General

The designation system includes the coating name, coating-mass, coating finish condition, surface treatment and base-metal quality or grade of structural steel.

8.2 Coating designation

The letters AZ are used to indicate 55 % aluminium-zinc coating.

8.3 Coating mass

8.3.1 The coating-mass designations are AZ070, AZ090, AZ100, AZ120, AZ150, AZ165, AZ185 and AZ200, as indicated in [Table 7](#).

8.3.2 The coating mass is expressed as the total mass on both surfaces, in grams per square metre. The coating mass specified should be compatible with the desired service life, the thickness of the base metal, and with the forming requirements involved.

NOTE For differential coatings, the coating mass of each surface, which is based on the agreement of the interested parties, is shown in the order of top surface and bottom surface. An example of a differential coating designation is AZ165090NC01 (see [8.7.3](#))

8.4 Coating finish condition

The coating finish condition designations are as follows:

- N: as coated finish, no skin pass;
- S: smooth finish with skin pass.

NOTE 1 The normal spangle is the “as-coated” condition and the smooth finish is achieved with a skin pass.

NOTE 2 End-use applications might require negotiation between the manufacturer and the purchaser to establish specific surface requirements.

8.5 Surface treatment

The surface treatment designations are as follows:

- C: mill passivation;
- O: oiling;
- CO: mill passivation and oiling.

8.6 Base-metal quality

The base-metal quality designations are as follows:

- 01: commercial quality;
- 02: drawing quality;
- 03: deep drawing quality.

Structural quality grades are indicated by three digits according to [Table 6](#).

8.7 Examples

8.7.1 An example of a complete designation is AZ150NC02. This designation is obtained by combining the following components:

- AZ: aluminium-zinc alloy coating;
- 150: coating mass;
- N: as coated finish, no skin pass;
- C: mill passivation;

- 02: drawing quality.

8.7.2 An example of a complete designation for a structural-quality product is AZ150C0350. This designation is obtained by combining the following components:

- AZ: aluminium-zinc alloy coating;
- 150: coating-mass;
- S: smooth finish with skin pass;
- C0: mill passivation and oiling;
- 350: structural quality grade.

8.7.3 An example for differential coatings is AZ165090NC01. The standard designation would give the top surface before the bottom surface. This designation is obtained by combining the following components:

- AZ: aluminium-zinc alloy coating;
- 165: coating-mass top surface;
- 090: coating-mass bottom surface;
- N: as coated finish, no skin pass;
- C: mill passivation;
- 01: commercial quality;

9 Retests

9.1 Machining and flaws

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

9.2 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.

9.3 Additional tests

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

10 Resubmission

10.1 The manufacturer may 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.