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**Hot-rolled and cold-reduced electrolytic  
zinc-coated carbon steel sheet of  
commercial and drawing qualities**

*Tôles en acier au carbone laminées à chaud et à froid, revêtues par  
zingage électrolytique (tôles électro-zinguées) de qualité commerciale  
et pour emboutissage*

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ISO 5002:1999

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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 3.

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.

International Standard ISO 5002 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 5002:1982) which has been technically revised.

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# Hot-rolled and cold-reduced electrolytic zinc-coated carbon steel sheet of commercial and drawing qualities

## 1 Scope

1.1 This International Standard specifies the characteristics of carbon steel sheet of commercial and drawing qualities in cut length or coil form, zinc coated by electrolytic deposition. Electrolytic zinc-coated sheet is intended for the manufacture of formed or of miscellaneous parts, and can be supplied chemically treated to render it more suitable for painting. The zinc coating is expressed in micrometres of thickness per side for either equally coated, differentially coated or one-side coated sheets. These sheets are generally produced with coatings which are not intended to withstand outdoor exposure without chemical treatment and painting. Electrolytic zinc-coated sheet may be produced in thicknesses of 0,36 mm and thicker (normally up to 4,0 mm) and in widths of 600 mm and over in coils or cut lengths. It is recognized that materials thinner than 0,36 mm or heavier than 4,0 mm may be suitable for electrolytic zinc coating, and if required should be the subject of agreement between the interested parties.

1.2 Electrolytic zinc-coated sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

1.3 Commercial quality electrolytic zinc-coated sheet (HR1 or CR1) is intended for general fabricating purposes where sheet is used in the flat, or for bending or moderate forming.

1.4 Drawing quality electrolytic zinc-coated sheet (HR2, HR3, HR4, or CR2, CR3, CR4, CR5) is intended for drawing or severe forming. It is furnished to all requirements of this International Standard or, by agreement when ordered, to fabricate an identified part, in which case the mechanical properties of Table 3 (for hot rolled) and Table 4 (for cold reduced) do not apply.

Drawing qualities are identified as follows:

- HR2/CR2 – Drawing quality
- HR3/CR3 – Deep drawing quality
- HR4/CR4 – Deep drawing quality aluminum killed (non-ageing)
- CR5 – Extra deep drawing quality (stabilized interstitial free)

## 2 Normative Reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, this publication do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

### 3 Terms and definitions

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

#### 3.1

##### **electrolytic zinc-coated steel sheet**

product obtained by electrolytic deposition of a zinc coating on steel sheet on a zinc coating line to produce either electrolytic zinc-coated coils or electrolytic zinc-coated cut lengths

#### 3.2

##### **skin pass**

light cold rolling of hot-rolled descaled sheet or of the cold-reduced and annealed steel sheet prior to electrolytic zinc coating the purposes which are one or more of the following:

- a) to temporarily minimize the appearance of coil breaks, stretcher strains (Lüders lines) or fluting during fabrication of finished parts;
- b) to minimize the appearance of coil breaks;
- c) to control shape.

NOTE Some increase in hardness and some loss in ductility will result from skin passing.

#### 3.3

##### **camber**

greatest deviation of a side edge from a straight line, the measurement being taken on the concave with a straightedge

#### 3.4

##### **out-of-square**

greatest deviation of an end edge from a straight line at right angles to a side and touching one corner, the measurement being taken as shown in Figure 2, also measurable as one-half the difference between the diagonals of the cut length sheet

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### 4 Conditions of manufacture

#### 4.1 Steelmaking

The processes used in making the steel and in manufacturing electrolytic zinc-coated cold-reduced sheet and hot-rolled sheet are left to the discretion of the manufacturer. When requested, the purchaser shall be informed of the steelmaking process being used.

## 4.2 Chemical Composition

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

**Table 1 — Chemical composition (heat analysis)**

Content in percent by mass

Quality		C	Mn	P	S	Ti <sup>a</sup>
		max.	max.	max.	max.	max.
Designation	Name					
HR1/CR1	Commercial	0,15	0,60	0,05	0,05	
HR2/CR2	Drawing	0,12	0,50	0,04	0,04	
HR3/CR3	Deep drawing	0,10	0,45	0,03	0,03	
HR4/CR4	Deep drawing special killed (non-ageing)	0,08	0,45	0,03	0,03	
CR5	Extra deep drawing <sup>b</sup> (stabilized interstitial free)	0,02	0,25	0,02	0,02	0,3

<sup>a</sup> Titanium may be replaced totally or partially by niobium or vanadium. Carbon and nitrogen shall be completely stabilized.

<sup>b</sup> By agreement, the manganese, phosphorus and sulfur maxima may be adjusted.

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## 4.3 Chemical analysis

### 4.3.1 Heat analysis

An analysis of each heat of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus and sulfur. When requested, this analysis will be reported to the purchaser or to his representative.

### 4.3.2 Verification analysis

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) are not technologically suited to verification analysis.

For killed steels, the sampling method and deviation limits shall be agreed upon between manufacturer and purchaser at the time of ordering.

## 4.4 Zinc coating

The amount of coating is expressed in micrometres of thickness per surface of sheet and shall conform to the requirements given in Table 2.

## 4.5 Weldability

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

## 4.6 Application

It is desirable that electrolytic zinc-coated steel sheet be identified for fabrication by name of the part or by the intended application. Steel sheet of drawing qualities (HR2, HR3, HR4, and CR2, CR3, CR4, CR5) may be produced to make an identified part within a properly established breakage allowance, which shall be previously agreed upon between the interested parties. In this case, the part name, the details of fabrication, and special requirements (i.e. exposed or unexposed, freedom from stretcher strains, or fluting, coating performance requirements) shall be specified and the mechanical properties of Tables 3 or 4 do not apply.

## 4.7 Mechanical properties

Except when ordered to an identified part as explained in 4.6, at the time that the steel is made available for shipment the mechanical properties shall be as stated in Tables 3 or 4 when they are determined on test pieces obtained according to the requirements of clause 6. Prolonged storage of the sheet can cause a change in mechanical properties, leading to a decrease in drawability. To minimize this effect, quality HR4, CR4 or CR5 should be specified.

## 4.8 Strain ageing

Electrolytic zinc-coated steel sheet (except HR4, CR4 and CR5) tends to strain age and this may lead to the following:

- a) surface marking from stretcher strains or fluting when the steel is formed;
- b) deterioration in ductility.

Because of these factors, it is essential that the period between final processing at the mill and fabrication be kept to a minimum. Rotation of stock, by using the oldest material first, is important. Stocking of such steels for extended periods of time should be avoided and for optimum performance should not exceed 6 weeks.

For skin-passed sheet, reasonable freedom from stretcher strain can be achieved by effective roller levelling immediately prior to fabrication at the manufacturer's plant. Freedom from stretcher strain for a period of 6 months can be achieved by the supply of skin-passed non-ageing steel. Grades HR4, CR4 or CR5 should be specified in such cases where Lüders lines are not acceptable and where roller levelling is not possible.

## 4.9 Surface treatment of electrolytic zinc-coated products

The requirements for solutions used in surface treatments for paint preparation, surface passivation or both, should be agreed upon between the interested parties at the time of ordering, taking into consideration the user's paint schedule and paint systems.

### 4.9.1 Surface preparation for painting

Electrolytic zinc-coated steel sheet may be processed chemically (such as phosphating or other suitable methods) at the manufacturer's mill to prepare the sheet for painting without further treatment except normal cleaning, if required.

### 4.9.2 Surface passivation

A chemical treatment is normally applied to zinc to minimize the hazard of wet storage stain (white rust) during shipment and storage. However, the inhibiting characteristics of the treatment are limited and if the material becomes wet during shipment or storage, the material should be used immediately or dried.

## 4.10 Oiling

The electrolytic zinc coated steel sheet as produced may be oiled to minimize wet storage stain. When the zinc coated sheet has received a passivating treatment, oiling will minimize further the hazard of wet storage stain. Removal of the oil may create difficulties (such as staining) if an unsuitable cleaning solution is used.

#### 4.11 Painting

Electrolytic zinc-coated steel sheet is a suitable base for paint but the first treatments may be different from those used on mild steel. Pre-treatment primers, chemical conversion coatings and some paint specially formulated for direct application to zinc surfaces are all appropriate first treatments for electrolytic zinc-coated sheet (see 4.9).

### 5 Dimensional tolerances

Applicable tolerance limits for electrolytic zinc-coated sheets are shown in Tables 5 to 19 inclusive.

Restricted thickness tolerances are given in Tables 6 and 8.

### 6 Sampling

#### 6.1 Tensile sampling

When ordered to mechanical properties, one representative sample for the tensile property test required in Tables 3 and 4 shall be taken from each lot of sheet for shipment. A lot consists of 50 t or less of sheet of the same designation rolled to the same thickness and condition.

#### 6.2 Coating tests

The manufacturer shall make such tests and measurements as he deems necessary to ensure that the material produced complies with the values in Table 2. The purchaser may relate the thickness of coating to the mass by the use of the following sample method.

Three specimens shall be cut, one from the mid-width position and one from each side no closer than 50 mm from the side edge. The minimum specimen area shall be 2 000 mm<sup>2</sup>.

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### 7 Test methods

#### 7.1 Tensile test (base metal)

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

#### 7.2 Coating tests

When the purchaser wishes to relate the thickness of coating to the mass of coating, the spot test procedure may be used.

The spot test result shall be the lowest coating mass found in any of the three specimens taken in accordance with 6.2. The zinc coating mass may be determined by any of the recognized and acceptable analytical methods.

### 8 Retests

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

## 9 Resubmission

The manufacturer may resubmit for acceptance the products that have been rejected during earlier inspection because of unsatisfactory properties, after he has subjected them to a suitable treatment, which, on request, will be indicated to the purchaser. In this case, the tests should be carried out as if they applied to a new batch.

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

## 10 Workmanship

The electrolytic zinc-coated steel sheet in cut lengths shall be free from any laminations, surface flaws and other imperfections that are detrimental to subsequent appropriate processing. Processing for shipment in coils does not afford the manufacturer the opportunity to readily observe or to remove defective portions as can be carried out on the cut length product.

## 11 Inspection and acceptance

While not usually required for products covered by this International Standard, when the purchaser specifies that inspection and tests for acceptance 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 International Standard.

Steel that is reported to be defective after arrival at the user's works shall be set aside, properly and correctly identified and adequately protected. The supplier shall be notified in order that he may properly investigate.

## 12 Coil size

[ISO 5002:1999](https://standards.iteh.ai/catalog/standards/sist/44c11be0-c5ae-4ff-b36-cd1db6f520e7/iso-5002-1999)

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When zinc-coated steel 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

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

- a) the manufacturer's name or identifying brand;
- b) the number of this International Standard, i.e. ISO 5002;
- c) the quality designation number;
- d) the coating designation number;
- e) the order number;
- f) the product dimensions;
- g) the lot number;
- h) the mass.





- l) details of fabrication or special requirements (fluting or coating performance);
- m) inspection and tests for acceptance prior to shipment from the producer's works, if required (see clause 11).

EXAMPLE International Standard ISO 5002, cold-reduced electrolytic zinc-coated sheet, drawing quality CR2, coating designation ZE 25/25, normal thickness tolerance, 0,6 mm × 1 000 mm × 2 000 mm, 20 000 kg, roll-formed tracks.

**Table 2 — Zinc coatings for electrolytic zinc-coated hot-rolled and cold-reduced steel sheet**

Coating designation	Nominal thickness per surface	Nominal coating mass per surface (for information only)
	μm	g/m <sup>2</sup>
ZE 10/10	1,0	7
ZE 25/25	2,5	18
ZE 38/38	3,8	27
ZE 50/50	5,0	36
ZE 75/75	7,5	54
ZE 100/100	10,0	75
ZE 135/0	13,5	96
ZE 150/0	15,0	107

NOTE 1 a) Equally coated material should be designated as ZE 10/10.  
b) Differentially coated material should be designated as ZE 50/10.  
c) Single surface coated material should be designated as ZE 38/0.

NOTE 2 The minimum thickness should not be less than 90 % of the nominal thickness shown in this table.

NOTE 3 The density of zinc used is 7 100 kg/m<sup>3</sup>.

**Table 3 — Mechanical property requirements<sup>a</sup> for hot-rolled electrolytic zinc-coated carbon steel sheet**  
(see 4.11)

Base metal quality		$R_m^b$ max. N/mm <sup>2</sup>	$A^c$ min. %			
Designation	Name		$e < 3$		$3 \leq e \leq 6$	
			$L_0 = 80$ mm	$L_0 = 50$ mm	$L_0 = 5,65 \sqrt{S_0}$	$L_0 = 50$ mm
HR1	Commercial	410	22	23	25	26
HR2	Drawing	370	25	26	28	29
HR3	Deep drawing	350	28	29	32	33
HR4	Deep drawing aluminum killed	350	28	29	32	33

<sup>a</sup>  $R_m$  tensile strength  
 $A$  percentage elongation after fracture  
 $L_0$  gauge length on test piece  
 $S_0$  original cross sectional area of gauge length  
 $e$  thickness of steel sheet, in millimetres  
1 N/mm<sup>2</sup> = 1 MPa

<sup>b</sup> Minimum tensile strength for qualities HR2, HR3 and HR4 would normally be expected to be 270 N/mm<sup>2</sup>. All tensile strength values are determined to the nearest 10 N/mm<sup>2</sup>.

<sup>c</sup> The non-proportional test piece with a fixed original gauge length (50 mm), up to 6 mm thick sheet can be used in conjunction with a conversion table. 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.