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Electrolytically zinc coated cold rolled steel flat products for cold forming — Technical delivery conditions

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National foreword

This British Standard is the UK implementation of EN 10152:2017. It supersedes BS EN 10152:2009 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/109, Coated and Uncoated Flat Products to be Used for Cold Forming.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Electrolytically zinc coated cold rolled steel flat products for cold forming - Technical delivery conditions

Produits plats en acier, laminés à froid, revêtus de zinc par voie électrolytique pour formage à froid - Conditions techniques de livraison

Elektrolytisch verzinkte kaltgewalzte Flacherzeugnisse aus Stahl zum Kaltumformen - Technische Lieferbedingungen

This European Standard was approved by CEN on 21 November 2016.

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European foreword

This document (EN 10152:2017) has been prepared by Technical Committee ECISS/TC 109 “Coated and uncoated flat products to be used for cold forming”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2017, and conflicting national standards shall be withdrawn at the latest by July 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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1 Scope

This European Standard specifies requirements for continuously electrolytic (or produced with an alternative process on cold rolled finish substrate) zinc coated cold rolled flat products of low carbon steels suitable for cold forming according to Table 1 in rolled widths ≥ 600 mm and thicknesses from 0,35 mm up to below and including 3 mm, delivered as strip (in coil form), sheet, slit strip or cut lengths obtained from slit strip or sheet.

NOTE 1 This European Standard can also be applied to continuously electrolytic zinc coated flat products of:

a) steels according to EN 10139 (cold rolled strip in rolled widths < 600 mm),

b) steels normally characterized by minimum yield strength or minimum tensile strength values in addition to formability parameters, e.g.

1) steels with high yield strength and improved formability according to EN 10268 (cold rolled flat products),

2) multiphase steels (cold rolled or hot rolled) according to EN 10338,

3) steels for construction according to national or regional standards (see e.g. DIN 1623).

NOTE 2 By agreement at the time of enquiry and order this European Standard can be applied to continuously electrolytic zinc coated hot-rolled steel flat products (e.g. according to EN 10025–1 and –2, EN 10111, EN 10149–1 to EN 10149–3, etc.).

NOTE 3 As the mass of the zinc coating applied is relatively small, the material is not intended to withstand outside exposure without further chemical treatment and painting.

NOTE 4 The products covered by this European Standard can be used as substrates for organic coated flat products specified in EN 10169 for building and general engineering applications.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10020:2000, *Definition and classification of grades of steel*

EN 10021:2006, *General technical delivery conditions for steel products*

EN 10027-1, *Designation systems for steels - Part 1: Steel names*

EN 10027-2, *Designation systems for steels - Part 2: Numerical system*

EN 10051, *Continuously hot-rolled strip and plate/sheet cut from wide strip of non-alloy and alloy steels - Tolerances on dimensions and shape*

EN 10079:2007, *Definition of steel products*

EN 10131, *Cold rolled uncoated and zinc or zinc-nickel electrolytically coated low carbon and high yield strength steel flat products for cold forming - Tolerances on dimensions and shape*

EN 10204:2004, *Metallic products - Types of inspection documents*

ISO 10113, *Metallic materials — Sheet and strip — Determination of plastic strain ratio*

ISO 10275, *Metallic materials — Sheet and strip — Determination of tensile strain hardening exponent*

EN ISO 6892-1:2009, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature (ISO 6892-1:2009)*

3 Terms and definitions

For the purposes of this document the terms and definitions given in EN 10020:2000, EN 10021:2006, EN 10079:2007, EN 10204:2004 and the following apply.

3.1
electrolytic zinc coating (ZE)
application of a zinc coating by electrolysis on a suitably prepared steel surface from an aqueous zinc salt solution by the use of an electric current

Note 1 to entry Flat products can have a zinc coating on one or both surfaces. If both surfaces are zinc coated, a different coating thickness can be applied on each side (this process being referred to as differential zinc coating).

4 Classification and designation

4.1 Classification

The steel grades specified in this European Standard are classified in accordance with EN 10020:2000 as non-alloy quality steels (DC01, DC03, DC04, DC05) and alloy quality steels (DC06, DC07) and by their increasing suitability for cold forming as follows:

— DC01: drawing quality;

— DC03: deep drawing quality;

— DC04, DC05: special deep drawing quality;

— DC06: extra deep drawing quality;

— DC07: super deep drawing quality.

4.2 Designation

4.2.1 The steel names are allocated in accordance with EN 10027-1. The steel numbers are allocated in accordance with EN 10027-2.

4.2.2 The products covered by this document shall be designated as follows in the given order:

1) Type of product (e.g. strip, sheet, cut length);

2) Number of this European Standard (EN 10152);

3) Steel name or steel number and symbol for the type of electrolytic coating (see Table 1);

4) Numbers denoting the nominal coating thickness on each surface (e.g. 50/50 = nominal coating thickness of 5,0 µm on each side, see Table 2 and 6.9.2);

5) Letters A or B indicating the surface quality (see 6.10.2);

6) Letters denoting the surface treatment (see 6.11 and Table 3).

EXAMPLE 1 Designation of strip made of steel DC03+ZE (1.0347+ZE), electrolytically zinc coated with a nominal thickness of 5,0 µm on each surface (50/50), surface quality A, surface treatment phosphated (P):

Strip EN 10152 —+ZE50 DC03/50-A-P

or

Strip EN 10152–1.0347+ZE50/50-A-P

EXAMPLE 2 Designation of sheet made of steel DC05+ZE (1.0312+ZE), electrolytically zinc coated with a nominal thickness of 7,5 µm on one surface and of 2,5 µm on the other surface (75/25), surface quality B, surface treatment phosphated and oiled (PO):

Sheet EN 10152 —+ZE75 DC05/25-B-PO

or

Sheet EN 10152–1.0312+ZE75/25-B-PO

4.2.3 Where appropriate, additional information to the designation as specified in 4.2.2 shall be given to describe clearly the delivery requirements (see Clause 5).

5 Information to be supplied by the purchaser

5.1 Mandatory information

The following information shall be supplied by the purchaser at the time of enquiry and order:

a) complete designation (see 4.2.2);

b) nominal dimensions (thickness, width and, in the case of sheet and cut lengths, length);

c) quantity;

d) limiting mass and sizes of the coils and individual bundles of sheets;

e) surface quality and surface finish (see 6.10);

f) type of surface treatment (see 6.11 and Table 3).

5.2 Options

A number of options are specified in this document and listed below; if the purchaser does not indicate a wish to implement any of these options, the products shall be supplied in accordance with the basis specification of this document (see 5.1):

1) Delivery of hot rolled products (see NOTE 2 to Clause 1);

2) Use of substrates not specified in Table 1 (see 6.1);

3) Steelmaking and manufacturing processes (see 6.2);

4) Non-skin passed products (see 6.5);

5) Products supplied suitable for the manufacture of a specific part (see 6.6);

6) Delivery of several steel grades as alloy steels (see Table 1, footnote f);

7) Differential coatings (see 6.9.4);

8) One-side coated products (see 6.9.5);

9) Maximum coating mass per product surface (see 6.9.6);

10) Quality of the uncoated surface for one-side coated products and/or testing of both surfaces (see 6.10.2.1);

11) Range for surface roughness *Ra* (see 6.10.3);

12) Specification of dimensional tolerances different from those in EN 10131 or EN 10051, respectively (see 6.13.2);

13) Type of inspection and inspection document to be delivered (see 7.1.1 to 7.1.3);

14) Certificate of compliance with order (see 7.1.2);

15) determination of the tensile properties by calculation (see 7.1.2);

16) Marking by branding (see 8.2);

17) Requirements for packaging (see Clause 9).

6 Requirements

6.1 General

The requirements according to 6.2 to 6.5 and 6.13 apply to products made of the steel grades given in Table 1.

For other steels used as substrate for electrolytically deposited coatings of zinc the requirements shall be based on the appropriate quality standard for the non-coated steel product.

6.2 Steelmaking and manufacturing processes

Unless otherwise agreed at the time of enquiry and order, the steelmaking and manufacturing processes are left to the discretion of the manufacturer. The purchaser shall be informed of these processes, if required.

6.3 Deoxidation

The method of deoxidation shall be in accordance with that specified in Table 1.

6.4 Chemical composition

The chemical composition based on cast analysis shall be as given in Table 1.

6.5 Delivery condition

The steel substrates are normally supplied in the skin-passed condition. By agreement at the time of enquiry and order non skin-passed products may be supplied.

6.6 Choice of properties

The products covered by this document shall comply with the requirements of Table 1. By agreement at the time of enquiry and order, they can be supplied with suitability for manufacturing a specific part. In this case a specific proportion exceeding the reject tolerances may be agreed and acceptance on the basis of mechanical properties is not applicable.

6.7 Mechanical properties

6.7.1 The mechanical properties are given in Table 1; they apply only to skin-passed products.

NOTE 1 The properties in Table 1 are those specified for cold rolled non-coated low carbon steel flat products according to EN 10130 with the exception of the R_e, A_{80} and n_{90} values for the grades DC04+ZE, DC05+ZE, DC06+ZE and DC07+ZE which have been altered with respect to the influence of the electrolytical treatment on those properties.

The mechanical properties are valid for the period specified in Table 1 from the date on which the products are made available. The date of availability shall be notified to the purchaser with reasonable prior notice compatible with the validity of the mechanical properties.

NOTE 2 Prolonged storage of products of grade DC01+ZE could result in some change in the mechanical properties leading to a reduction in formability.

6.7.2 The tensile test values apply to transverse samples and relate to the test piece cross-section without zinc coating.

6.7.3 Strain ratio r_{90} (see Table 1) and the strain hardening exponent n_{90} shall be determined in the range of homogeneous deformation, within the strain range of 10 % to 20 %.

NOTE The uniform elongation of the material to be tested can be lower than 20 %. In this case an upper limit of the strain range of ≥ 15 % can be applied.

Table 1 — Chemical composition and mechanical properties of electrolytically zinc coated mild steel flat products [a]

Designation			Definition and classification according to EN 10020:2000	Deoxidation	Validity of mechanical properties	Surface appearance	Absence of stretcher strain marks	R_e MPa	R_m MPa	A_{80} % min.	r_{90} min.	n_{90} min.	Chemical composition (ladle analysis) % by mass max.				
Steel grade		Symbol for the type of coating															
Steel name	Steel number							a		b	c, d	c	C	P	S	Mn	Ti
DC01 [e]	1.0330	+ZE	Non alloy quality steel [f]	Manufacturer's discretion	–	A	–	– / 280 [g,h]	270 to 410	28	–	–	0,12	0,045	0,045	0,60	–
						B	3 months										
DC03	1.0347	+ZE	Non alloy quality steel [f]	Fully killed	6 months	A, B	6 months	– / 240 [g]	270 to 370	34	1,3	–	0,10	0,035	0,035	0,45	–
DC04	1.0338	+ZE	Non alloy quality steel [f]	Fully killed	6 months	A, B	6 months	– / 220 [g]	270 to 350	37	1,6	0,170	0,08	0,030	0,030	0,40	–
DC05	1.0312	+ZE	Non alloy quality steel [f]	Fully killed	6 months	A, B	6 months	– / 200 [g]	270 to 330	39	1,9	0,190	0,06	0,025	0,025	0,35	–
DC06	1.0873	+ZE	Alloy quality steel	Fully killed	6 months	A, B	no limit	– / 180 [i]	270 to 350	41	2,1	0,210	0,02	0,020	0,020	0,25	0,3 [j]
DC07	1.0898	+ZE	Alloy quality steel	Fully killed	6 months	A, B	no limit	– / 160 [i]	250 to 310	43	2,5	0,220	0,01	0,020	0,020	0,20	0,2 [j]

[a] The values of yield strength shall be the 0,2 % proof strength ($R_{p0,2}$) for products which do not present a definite yield point and the lower yield strength (R_{eL}) for the others.
When the thickness is less than or equal to 0,7 mm but greater than 0,5 mm the values for yield strength shall be increased by 20 MPa. For thicknesses less than or equal to 0,5 mm the values shall be increased by 40 MPa.

[b] When the thickness is less than or equal to 0,7 mm but greater than 0,5 mm the minimum values for elongation shall be reduced by 2 units. For thicknesses less than or equal to 0,5 mm the minimum values shall be reduced by 4 units.

[c] The values of r_{90} and n_{90} determined in accordance with 7.5.2 only apply to products of thickness equal to or greater than 0,5 mm.

[d] When the thickness is over 2 mm the value for r_{90} is reduced by 0,2.

[e] It is recommended that products in grade DC01+ZE should be formed within 6 weeks from the time of their availability.

[f] Unless otherwise agreed at the time of the enquiry and order DC01+ZE, DC03+ZE, DC04+ZE and DC05+ZE may be supplied as alloy steels (for example with boron or titanium).

[g] For design purposes, the lower limit of *R*e for grades DC01, DC03, DC04 and DC05 may be assumed to be 140 MPa.

[h] The upper limit of R_e of 280 MPa for the grade DC01+ZE is valid only for 8 days from the time of the availability of the product.

i For design purposes, the lower limit of R_e may be assumed to be 130 MPa for the grade DC06 and 110 MPa for the grade DC07.

j Titanium may be replaced by niobium. Carbon and nitrogen shall be completely bound.

6.8 Stretcher strain marks

All products are generally subjected to a light skin-pass after annealing and before coating at the manufacturer's works to avoid the formation of stretcher strain marks.

The tendency to form such marks reappears a certain time after the skin-pass. It is therefore in the purchaser's interest to form the products as soon as possible.

Products of grade DC06+ZE and DC07+ZE do not exhibit stretcher strain marks whether delivered skin passed or non-skin-passed.

For skin-passed products the manufacturer shall ensure the absence of stretcher strain marks:

— for 6 months after products of grades DC03+ZE, DC04+ZE and DC05+ZE are made available, for surface qualities A and B,

— for 3 months after products of DC01+ZE are made available, for surface quality B.

6.9 Coatings

6.9.1 Zinc coatings as given in Table 2 are applicable for equally coated products.

6.9.2 In the designation the coating is expressed as 10 times the nominal coating thickness in μm, indicated separately for either surface of the product (see 4.2.2 4).

6.9.3 The coatings shall be checked by determining the mass of zinc per square metre on each surface (see 7.4.3 and 7.5.3). Each result shall meet the requirements for the minimum coating mass according to Table 2.

6.9.4 Differential coatings based upon a combination of the coatings mentioned in Table 2 may be available, subject to agreement between manufacturer and purchaser. They shall be designated as follows: ZE75/25, etc.

When differential coatings are supplied the manufacturer shall indicate which surface has the greater coating thickness, i.e. the top or the bottom surface of the sheets, inside or outside of the coil.

6.9.5 Products may be supplied, subject to agreement between manufacturer and purchaser, with coating on one surface only. Such coatings shall be designated as follows: ZE25/00, etc.

Slight zinc coatings may appear at the edge areas of the uncoated surface.

6.9.6 A maximum value (single spot test) for the coating mass per surface of the product may be agreed upon for each coating designation.

Table 2 — Electrolytic zinc coatings (see also 6.9.4 and 6.9.5)

Coating Designation	Nominal zinc coating values for each surface [a]		Minimum zinc coating values for each surface [b]	
	Thickness µm	Mass g/m²	Thickness µm	Mass g/m²
ZE25/25	2,5	18	1,7	12
ZE50/50	5,0	36	4,1	29
ZE75/75	7,5	54	6,6	47
ZE100/100	10,0	72	9,1	65

[a] A coating mass of 50 g/m² corresponds to a coating thickness of approximately 7,1µm.

[b] See 7.4.3 and 7.5.3.

6.10 Surface characteristics

6.10.1 General

The surface characteristics consist of the surface quality and the surface finish.

The surface quality and finish shall be specified by the purchaser at the time of enquiry and order (see 4.2.2).

6.10.2 Surface quality

6.10.2.1 The products shall be supplied with either of the surface qualities A or B.

— Surface quality A:

  Defects such as pores, slight indentations, small marks, minor scratches and slight colouring which do not effect formability or the application of subsequent surface coatings are permitted.

— Surface quality B:

  The better of the two surfaces shall be virtually free from surface imperfections liable to impair the uniform appearance of a high-quality paint finish. For one-sided coating, this requirement shall apply for the uncoated surface unless otherwise agreed. The other surface shall at least conform to surface quality A.

Unless otherwise agreed, a single surface of the sheet shall be inspected and shall comply with the requirements.

The other surface shall be such that, during subsequent treatment, it does not have a deleterious effect on the surface inspected.

6.10.2.2 When supplying strip in coils, there is greater risk of surface defects than if sheet and cut lengths are supplied as it is not possible for the manufacturer to eliminate all the defects in a coil. This shall be taken into account by the purchaser when evaluating the products.

6.10.3 Surface finish

By agreement at the time of the enquiry and order, a range for surface roughness (*R*a values) may be specified for specific end uses.

6.11 Surface treatment (surface protection)

At the time of enquiry and order, one of the surface treatment conditions listed in Table 3 shall be agreed.

Surface treatment can reduce the risk of corrosion occurring during transport and storage, which is mainly due to humidity and gives rise to wet storage stain (white rust). The phosphated, chemically sealed and oiled treatment condition normally offers the best corrosion protection. Since this type of protection is, however, not permanent the transport and storage conditions shall be selected to suit the material concerned.

A surface treatment also improves the adherence and protective effect of a coating applied by the processor who shall ensure that pretreatment and coating systems are compatible with each other.

NOTE 1 Discoloration as a result of chemical treatment does not impair further processing.

Chemically sealed or passivated material is not recommended for products which will subsequently be phosphated.

Phosphating in conjunction with a suitable lubricating agent may improve workability.

The application of a sealed (S) surface treatment, with a transparent organic film of about 1g/m^2, will offer protection against corrosion and fingerprints. It may improve the sliding characteristics during forming and can be used as a priming coat for subsequent varnishing.

The products are only supplied without surface treatment (U) if expressively desired by the purchaser on his own responsibility.

NOTE 2 In such cases, corrosion damage to the product can occur even when stored for short periods or during transport. Untreated products are also susceptible to fretting corrosion and are easily scratched.

In the case of oiled surfaces, it shall be possible to remove the oil layer with suitable detergents not attacking the zinc coating. It is assumed that the processor has all the equipment necessary for degreasing the products.

Table 3 — Surface treatment

Symbol	Type of treatment
P	Phosphated
PC	Phosphated and chemically treated
C	Chemically passivated
PCO	Phosphated, chemically treated and oiled
CO	Chemically passivated and oiled
PO	Phosphated and oiled
O	Oiled
S	Sealed
U	As coated, i.e. untreated

6.12 Applications

6.12.1 Welding

The product is suitable for welding under conditions laid down for the base metal. However, precautions may be necessary to overcome the presence of the zinc and, where applied, the phosphate on the surface of the product.

6.12.2 Painting

Zinc coated steel is a suitable base for paint, but the first treatment may be different from those used for uncoated steel. Pre-treatment primers, chemical conversion coatings and primers specially formulated for direct application to zinc surfaces are all appropriate first treatments for electrolytically zinc coated steel.

In drawing up a surface preparation and painting schedule, consideration should be given by the purchaser as to whether the material should be supplied chemically passivated or phosphated and/or oiled (see also 6.11).

6.12.3 Forming

Electrolytic zinc coatings are usually tightly adherent even when used for difficult formings. However, powdering can occur if the product is overformed or "coined" during fabrication. Care should be taken to ensure that the speed of forming and the clearance of dies is carefully controlled.

6.13 Mass, tolerances on dimensions and shape

6.13.1 The product mass shall be calculated taking the density of the steel as 7,85 kg/dm^3 and the density of the zinc coating as 7,1 kg/dm^3.

6.13.2 For the tolerances on dimensions and shape EN 10131 applies.

When hot rolled products are supplied, the tolerances shall be in accordance with EN 10051.

The application of other dimensional standards shall be specially agreed at the time of enquiry and order.

7 Inspection

7.1 Types of inspection and inspection documents

7.1.1 Unless otherwise specified at the time of enquiry and order (see 7.1.2 and 7.1.3), the products shall be delivered with non-specific inspection without inspection document.

7.1.2 Specific testing in accordance with the requirements in 7.2 to 7.6 may be specified at the time of enquiry and order.

By agreement at the time of enquiry and order, the manufacturer may determine the tensile properties by calculation in accordance with an approved method.

Specific testing may not be specified either for the product analysis or for the surface finish. However, if so agreed at the time of enquiry and order, the manufacturer shall supply a certificate of compliance with the order.

7.1.3 The type of inspection document to be delivered in accordance with EN 10204, if requested for non-specific inspection (inspection document 2.1 or 2.2) or mandatory to be delivered for specific inspection (inspection document 3.1 or 3.2), shall be specified at the time of enquiry and order.

If an inspection certificate 3.2 is specified, the purchaser shall notify the manufacturer of the name and address of the organization or person who is to carry out the inspection and produce the inspection document. It shall also be agreed which party shall issue the certificate.

7.2 Test units

The test unit consists of a maximum of 20 t or a fraction of 20 t of electrolytically zinc coated flat products of the same grade and nominal thickness, coating type and surface characteristics. In the case of strip, a coil with a mass of more than 20 t is regarded as one test unit.

7.3 Tests to be carried out

One series of tests shall be carried out per test unit as specified in 7.2 to determine:

— the mechanical properties (see 7.5.1),

— the r_{90}- and n_{90}-values if specified in Table 1 (see 7.5.2),

— the coating mass (see 7.5.3).

7.4 Sampling

7.4.1 In the case of strip, the samples shall be taken from the beginning or end of the coil. In the case of sheet and cut lengths, the selection of the sample shall be left to the discretion of the inspector carrying out the inspection tests.

7.4.2 The sample for the tensile test (see 7.5.1) shall be taken transversely to the direction of rolling at a distance of at least 50 mm from the edges of the product.

7.4.3 One sample for testing the coating mass (see 7.5.3) with an area of at least 5 000 mm^2 shall be taken at a distance of at least 50 mm from the edges of the product.

7.4.4 All the samples shall be taken and machined, if necessary, in such a way that the results of the tests are not affected.

7.5 Test methods

7.5.1 Tensile test

The tensile test shall be carried out as specified in EN ISO 6892-1:2009 (see also 6.7).

The tensile test is carried out by using test pieces with or without coating at the discretion of the manufacturer.

7.5.2 Plastic strain ratio and hardening exponent

The determination of the plastic strain ratio r_{90} and the strain hardening exponent n_{90} shall be carried out in accordance with ISO 10113 and ISO 10275.

7.5.3 Coating mass

The coating mass shall be determined from the difference in mass of the sample before and after the coating has been removed chemically.

Other methods – e.g. non-destructive tests – may be used for continuous checks at the manufacturer's works.

In cases of dispute, the method described in Annex A shall be used.

7.6 Retests

The requirements of EN 10021:2006 shall apply. In the case of coils, the retest specimens shall be taken from a distance of at least one lap away, but with a maximum of 20 m from the end of the coil.

8 Marking

8.1 A label shall be attached to each coil or bundle containing at least the following information:

— name or mark of the manufacturer's works,

— full designation (see 4.2.2),

— nominal dimensions of the product,

— identification number,

— order number,

— mass of the lot, coil or bundle.

Bar coding according to EN 606 can supplement marking, when the abovementioned minimum information is also given in clear text.

8.2 Marking of the products by branding may be agreed upon at the time of enquiry and order.

9 Packing

The packing requirements for the product shall be agreed at the time of enquiry and order.

10 Storage and transportation

10.1 Moisture, in particular condensation between the sheets, laps of the coil or other adjacent parts made of electrolytically zinc coated flat products may lead to the formation of matt grey to white deposits (white rust). The possible types of surface protection are given in 6.12. However, if there is lengthy contact with moisture, the corrosion protection may be reduced locally. As a precaution, the product should be transported and stored dry and protected from moisture.

10.2 During transportation, dark spots may appear on the zinc coated surfaces as a result of friction. Generally, they only impair the appearance. Friction is reduced by oiling the products. However, the following precautionary measures should be taken: secure packing, laid flat, no local pressure spots.

Annex A
(normative)

Reference method for determination of the zinc coating mass

A.1 Principle

The sample shall be at least 5 000 mm^2 in area. Using a sample with a surface area of 5 000 mm^2, the loss of mass in grams when the coating is dissolved, multiplied by 200, will represent the zinc mass in grams per square metre on each surface of the product.

A.2 Reagent and preparation of the solution

A.2.1 Reagent

A.2.1.1 Hydrochloric acid (HCl ρ_{20} = 1,19 g/ml)

A.2.1.2 Hexamethylenetetramine ($C_6H_{12}N_4$)

A.2.2 Preparation of the solution

The hydrochloric acid is diluted with deionized or distilled water in the ratio one part pure HCl to one part water (50 % dilution). Hexamethylenetetramine is then added, stirring, in the ratio of 3,5 g per litre of dilute hydrochloric acid solution.

This prepared solution permits the execution of numerous successive dissolutions under satisfactory conditions of attack of the coating, with regard to both speed and accuracy.

A.3 Apparatus

Balance capable of weighing samples to an accuracy of 0,001 g. For the test, use a take-off device.

A.4 Procedure

The following operations are applied to the sample:

1) if necessary, degrease the sample with an organic solvent which will not attack the zinc, then dry the sample;

2) protect one surface of the sample against the attack of the solution by coating with a suitable lacquer;

3) weigh the sample to an accuracy of 0,001 g;

4) place the sample in the hydrochloric acid solution with hexamethylenetetramine inhibitor at ambient temperature (20 °C to 25 °C); leave the sample immersed in the solution until the release of hydrogen ceases or only a few bubbles are released;

5) after the attack, the tested surface of the sample is washed and brushed under running water, dried with a cloth and then by heating to around 100 °C and cooled and dried by blowing with warm air;

6) weigh the sample again to an accuracy of 0,001 g;

7) determine the difference between the mass of the coated sample and that of the sample without its coating; this difference, calculated in grams, represents the mass of the coating on the tested surface;

8) remove the lacquer from the other surface (see A.4 2)) and continue as mentioned above under A.4 3) to A.4 7).

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