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Zinc-coated steel for the reinforcement of concrete

Aciers pour béton armé galvanisés

ICS 77.140.99 ; 91.080.40

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Foreword

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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.

Attention is drawn to the possibility that some of the elements of ISO 14657 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14657 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 16, *Steels for the reinforcement and prestressing of concrete*.

Annex A forms a normative part of this International Standard. Annex B and Annex C are for information only.

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Zinc-coated steel for the reinforcement of concrete

1 Scope

This International Standard specifies requirements for hot-dip zinc (galvanized) coating on steel reinforcing bars, wire, and welded fabric for the reinforcement of concrete.

It specifies two classes, class A and class B coatings which differ in coating mass (see 6.5.3).

This standard does not apply to hot-dip zinc-coated reinforcement for prestressing or components of these reinforcements.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision. Parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 752:1981, *Zinc ingots*.

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

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

ISO 6935-1:1991, *Steel for the reinforcement of concrete – Part 1: Plain bars*.

ISO 6935-2:1991, *Steel for the reinforcement of concrete – Part 2: Ribbed bars*.

ISO 6935-3:1992, *Steel for the reinforcement of concrete – Part 3: Welded fabric*.

ISO 10544:1992, *Cold-reduced steel wire for the reinforcement of concrete and the manufacture of welded fabric*.

ISO 10606:1995, *Steel for the reinforcement of concrete – Determination of percentage total elongation at maximum force*.

ISO/DIS 15630:1999, *Steel for the reinforcement and prestressing of concrete – Test methods*.

3 Definitions

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

3.1

hot-dip galvanizing

any process in which the product is immersed in a molten zinc bath

3.2

bundle

two or more bars properly bound together

3.3

coated bar

steel reinforcing bar which has been coated with zinc and/or zinc-iron alloys

3.4

coated wire

straightened steel wire which has been coated with zinc

3.5

coated welded fabric

sheet of steel welded fabric which has been coated with zinc

3.6

fabricator

any organization which cuts and/or bends coated steel reinforcing bar, wire or welded fabric

3.7

longitudinal rib

uniform continuous rib parallel to the axis of the steel reinforcing bar

3.8

lot

the quantity of coated reinforcing steel that is represented by the sample which has been tested

3.9

manufacturer

any organization which produces coated steel reinforcing bar, wire or welded fabric

3.10

transverse rib

any rib on the surface of the steel reinforcing bar or wire other than a longitudinal rib

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4 Materials

4.1 Steel reinforcing bars

Steel reinforcing bars to be coated with zinc shall comply with the product standard as specified by the purchaser. If a product standard is not specified by the purchaser, the steel reinforcing bars shall comply with ISO 6935-1 or ISO 6935-2.

4.2 Steel wire or welded fabric

Steel wire or welded fabric to be coated shall comply with the product standard as specified by the purchaser. If a product standard is not specified by the purchaser, the steel wire or welded fabric shall comply with ISO 10544 or ISO 6935-3.

4.3 Zinc for coating

The zinc used for coating shall conform to ISO 752.

4.4 Repair material

Material for repairing damaged coating and renovating uncoated areas shall be an appropriate zinc-rich formulation (paint).

5 Manufacture (galvanizing)

It is at the discretion of the manufacturer to choose the galvanization method.

If specified by the purchaser, the galvanized coating shall be chromate treated (see Annex C).

NOTE The manufacturer should exercise due care: (1) to avoid distortion or cracking of the steel reinforcement occurring during galvanizing; and (2) in processing steel reinforcement that is susceptible to embrittlement.

6 Requirements for zinc-coated steel reinforcing bars, wire and welded fabric

6.1 General

The requirements of 6.2 to 6.4 shall be satisfied for geometrical and mechanical properties.

6.2 Geometrical properties

Geometrical properties are the nominal diameter, nominal cross-section and shape parameters.

The nominal diameter of a zinc-coated bar or wire shall lie within the ranges defined in the appropriate clauses of the product standards referenced in clause 2 or the product standard taken as a reference. The referenced standard is either the product standard specified by the purchaser or ISO 6935-1 or ISO 6935-2 or ISO 10544.

The nominal cross-section of a zinc-coated bar or wire shall be taken as being equal to the area of the circle with the nominal diameter of the reinforcement.

The shape parameter for a zinc-coated bar or wire shall comply with the requirements defined in the product standard taken as a reference.

6.3 Form and dimensions of welded fabric

The form and dimensions of welded fabric shall comply with the appropriate clause of the product standard specified by the purchaser or clause 4 of ISO 6935-3:1992, whichever is applicable.

6.4 Mechanical properties

The mechanical properties of the zinc-coated reinforcements shall be equal to or greater than the values defined for the grade and/or product standard taken as a reference.

6.5 Zinc coating characteristics

6.5.1 General

The characteristics of the zinc coating are

- finish and appearance;
- adherence;
- mass of zinc deposited per area unit;
- coating continuity.

6.5.2 Finish and appearance

The zinc coating shall have no bare spots. The coating shall be free of blisters, flux spots or inclusions, dross, and acid or black spots. Reinforcement that sticks together after galvanizing shall be rejected. In addition, the presence of tears or sharp spikes which make the reinforcement hazardous to handle shall be cause for rejection. A matte gray finish appearance shall not be cause for rejection.

6.5.3 Adherence

The adherence of the zinc coating shall be evaluated by a bend test (see A.1). After the test, the coating shall not show cracking on the outside radius of the bent bar visible to a person with normal or corrected vision. In addition, the coating shall be adherent so it cannot be removed by any reasonable process of handling.

6.5.4 Mass of zinc deposited per area unit

The mass of zinc deposited per area unit shall not be less than: for class A coating, 600 g/m² for reinforcement with $d > 6$ mm; and 500 g/m² for $d \leq 6$ mm; where d is the nominal diameter of the bar or wire; and for class B coating, 300 g/m² for all nominal diameters.

If the coating thickness correspondence is requested in micrometres, it shall be calculated by the formula:

$$\{e\} = \{m\} / 7$$

where

$\{e\}$ is the numerical value of the thickness, expressed in micrometres (μm);

$\{m\}$ is the numerical value of the mass of zinc per area unit, expressed in grams per square metre (g/m²).

The mass shall be determined using the provisions in A.1.1.

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6.5.5 Coating continuity

The coating continuity shall be such that the characteristic value of the coating thickness determined in accordance with the method described in A.1.2 shall not be less than 25 μm .

NOTE The characteristic value is defined as the lower limit of the statistical dispersion interval for which there is a 95% confidence ($1 - \alpha = 0,95$) so that 95 % ($p = 0,95$) of values are equal to or greater than this lower limit.

7 Sampling and acceptance testing

Unless otherwise agreed, the following rules shall be applied.

7.1 Batching

The inspection can be done either by cast or by batch. The batching method shall be defined in the order.

7.2 Inspection unit

The inspection unit shall consist of zinc-coated products made using the same process starting from reinforcement of the same grade, nominal diameter and source; the mass of each inspection unit being

- for inspection by cast, 40 tonnes or the remaining fraction of less than 40 tonnes;
- for inspection by batch, 20 tonnes or the remaining fraction of less than 20 tonnes.

Twelve test series shall be carried out for each inspection unit, and each series shall include

- one tensile test;
- one bend test;
- one check of reinforcement shape parameters and mass per length unit.

A zinc coating check (thickness and continuity) shall be carried out on each inspection unit on at least three samples from different production units (bars or coils).

7.3 Interpretation of the results

No result shall be less than the limit; furthermore for R_{eH} and R_m , $m_{12} - 2,74s$ shall not be less than the specified value,

where

$$m_{12} = \frac{1}{12} \sum_{i=1}^{12} x_i$$

$$s = \sqrt{\frac{\sum_{i=1}^{12} (x_i - m_{12})^2}{11}}$$

x_i denotes individual values for R_{eH} or R_m .

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The batch shall be considered as non-conforming if these conditions are not met.

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8 Permissible amount of damaged coating and repair of damaged coating

Damaged coating discernible to a person with normal or corrected vision shall be repaired with an appropriate zinc-rich formulation (paint).

The total damaged surface area, prior to repair with a zinc-rich formulation (paint), shall not exceed 0,5 % of the surface area in any one metre length of the bar or wire. This limit on repaired damage does not include sheared or cut ends that are coated with a zinc-rich formulation (paint).

When coated steel reinforcing bars, wire and welded fabric are sheared, saw-cut, or cut by other means during the fabrication process, the cut ends shall be repaired with the same zinc-rich formulation (paint) that is used for the repair of damaged coating.

The coating at repaired areas shall have a minimum thickness of 80 μm for class A coating and 50 μm for class B coating.

NOTE 1 These requirements apply to the coated product before the coated steel is accepted from the supplier by the purchaser and are not site acceptance criteria. See Annex B "Guidelines for Site Practice."

NOTE 2 If the total damaged surface area in any one metre length of the bar or wire exceeds 0,5 % of the surface area, that section should be removed from the coated bar or wire and discarded.

9 Packing, handling, storage, transport

The product shall be delivered in the form of bars or coils, subject to agreement between supplier and purchaser.