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Zinc-coated steel for the reinforcement of concrete

Aciers revêtus de zinc pour l'armature du béton

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

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 used in the reinforcement of concrete.

It specifies three classes, class A, class B and class C coatings, which differ in coating mass (see 6.2.3).

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

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 752:2004, *Zinc ingots*

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

ISO 1461:1999, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*

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 10474, *Steel and steel products — Inspection documents*

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

ISO 15630-1:2002, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 1: Reinforcing bars, wire rod and wire*

ISO 15630-2:2002, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 2: Welded fabric*

ISO 16020:2004, *Steel for the reinforcement and prestressing of concrete — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16020 and the following 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 or sheets of welded fabric properly bound together

3.3
manufacturer
any organization that produces coated steel reinforcing bar, wire or welded fabric

4 Materials

4.1 Reinforcing steel

Reinforcing steel 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 reinforcing steel shall comply with ISO 6935-1, ISO 6935-2, ISO 6935-3 or ISO 10544.

4.2 Zinc for coating

The zinc used for coating shall conform to ISO 752.

4.3 Repair material

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

NOTE Appropriate types of materials, for repairing damaged coatings and renovating uncoated areas, are prescribed in e.g. ASTM A780.

5 Process of manufacture (galvanizing)

It shall be the responsibility of the manufacturer to maintain identity of the steel reinforcement throughout the galvanizing process and to the point of shipment.

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

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

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

6.1 Mechanical and geometrical properties

For the geometrical and mechanical properties of the steel, the requirements of the applicable product standard for uncoated steel also apply to the steel after zinc-coating.

6.2 Zinc coating characteristics

6.2.1 Finish and appearance

Finish and appearance shall conform to 6.1 in ISO 1461:1999.

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.

6.2.2 Adherence

For steel reinforcement that is galvanized as an integral phase of the steel-making process, the adherence of the zinc coating shall be evaluated by a bend test or rebend test depending on the specified product standard. After the test, the coating shall not show flaking 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.

For steel reinforcement that is produced, tested and complies with the applicable product standard, and is subsequently galvanized, the adherence of the coating shall be evaluated by a knife test (see B.1.2). In addition, the coating shall be adherent so it cannot be removed by any reasonable process of handling.

6.2.3 Mass of zinc deposited per unit area

The mass of zinc deposited per unit area shall not be less than:

— for class A coating: 600 g/m^2 for reinforcement with $d > 6$ mm, and 500 g/m^2 for $d \leqslant 6$ mm, where d is the nominal diameter of the bar or wire;

— for class B coating: 300 g/m^2 for all nominal diameters;

— for class C coating: 140 g/m^2 for all nominal diameters.

NOTE Coating masses greater than 600 g/m^2 may be mutually agreed upon by the manufacturer and purchaser.

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

$$\{e\} = \{m\} / 7{,}14$$

where

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

$\{m\}$ is the numerical value of the mass of zinc per unit area, expressed in grams per square metre (g/m^2).

The mass shall be determined using the provisions given in B.1.3.

7 Inspection of zinc-coated steel

7.1 Applicability

Unless otherwise agreed, this clause shall apply to the final inspection of the zinc-coated steel reinforcement before it is released. For steel reinforcement that is galvanized as an integral phase of the steel-making process, the provisions here shall take precedence over any conflicting provisions in the applicable product standard for the uncoated steel. For steel reinforcement that has been produced, tested and confirmed to be in accordance with the applicable product standard prior to zinc-coating, 7.4 shall not apply.

NOTE Some national or regional certification schemes have rules for the evaluation of conformity, which deviate from those in Clause 7.

7.2 Batching

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

7.3 Test unit

The test 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 test 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.

7.4 Inspection of mechanical and geometrical properties

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

— one tensile test;

— one bend or rebend test;

— one check of reinforcement shape parameters and mass per unit length;

— one determination of the weld shear force for welded fabric.

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

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

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

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

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

NOTE R_{eH} is the upper yield strength in N/mm^2 and R_m is the tensile strength in N/mm^2. (1 N/mm^2 = 1 MPa.)

7.5 Inspection of mass of zinc per unit area

A zinc coating check (thickness) shall be carried out for each test unit on at least three samples from different production units (bars or coils). For no sample, the result shall be less than the requirement, see 6.2.3.

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 using an appropriate zinc-rich formulation.

The total damaged surface area, prior to repair with the zinc-rich formulation, shall not exceed 0,5 % of the surface area in any 1 m length of the bar or wire. This limit on repaired damage does not include sheared or cut ends that are coated with the zinc-rich formulation.

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 using the same zinc-rich formulation 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, 50 μm for class B coating, and 25 μm for class C coating.

NOTE These requirements apply to the coated product before the coated steel reinforcement is accepted from the manufacturer by the purchaser and are not site acceptance criteria. See Annex C.

9 Packing, handling, storage, transport

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

Arrangements shall be made such that the coating is not significantly altered during handling, storage or transport.

10 Labelling

Labelling shall be sufficient to ensure product traceability. At least the following information shall be marked on each bundle of bars or sheets of welded fabric, or on each coil:

— name or address of manufacturer's factory;

— product identification (grade, diameter, length or configuration as appropriate);

— bundle or coil mass;

— batch number or equivalent information for cross reference to inspection documents.

11 Information to be provided by the purchaser

The purchaser shall provide the following information at the time of the enquiry and order:

— product designation;

— nominal dimensions;

— quantity ordered;

— class of coating (see 6.2.3);

— whether chromate treatment is required (see Clause 5);

— type of inspection document (see ISO 10474);

— the batching mode to be used by the inspection (see Clause 7).