FINAL
DRAFT

INTERNATIONAL
STANDARD

**ISO/FDIS
7989-2**

ISO/TC **17**/SC **17**

Secretariat: SAC

Voting begins on:
2020-11-30

Voting terminates on:
2021-01-25

Steel wire and wire products — Non-ferrous metallic coatings on steel wire —

Part 2:
Zinc or zinc-alloy coating

Fils et produits tréfilés en acier — Revêtements métalliques non ferreux sur fils d'acier —
Partie 2: Revêtements de zinc ou d'alliages de zinc

Reference number
ISO/FDIS 7989-2:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ..... **iv**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Coating requirements **2**
4.1 Requirements for the coating material 2
4.2 Requirements relating to coating on the wire 2
4.2.1 Coating mass per unit area 2
4.2.2 Coating requirements to salt-spray test 3
4.2.3 Appearance of coating 4
4.2.4 Dipping test 4
4.2.5 Special finishes 5
4.2.6 Adherence of coating 5

5 Test conditions **6**
5.1 Selection of samples 6
5.2 Determination of coating mass per unit area 7
5.2.1 General 7
5.2.2 Gravimetric method 7
5.2.3 Gaseous volumetric method 8
5.3 Dipping test 13
5.3.1 Principle 13
5.3.2 Reagents 13
5.3.3 Preparation of test piece 13
5.3.4 Test procedure 13
5.3.5 Interpretation of results 14

Bibliography **15**

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 of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 17, *Steel wire rod and wire products*.

This second edition cancels and replaces the first edition (ISO 7989-2:2007), which has been technically revised.

The main changes compared to the previous edition are as follows:

— reference is also made towards ASTM B997 for Zn-Al alloy coatings (4.1);

— coating mass Class E is introduced for zinc-aluminium coatings (Table 1);

— coating requirements to salt-spray test is added, see 4.2.2;

— dipping test better specified for Zinc-Alu alloy coatings (Table 3);

— correction of formulae in 5.2.3.6.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Steel wire and wire products — Non-ferrous metallic coatings on steel wire —

Part 2:
Zinc or zinc-alloy coating

1 Scope

This document specifies the requirements for the coating mass per unit area, for other properties and also for testing of zinc or zinc-alloy coatings on steel wire and steel wire products of circular or other section.

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 7802, *Metallic materials — Wire — Wrapping test*

ISO 7989-1:2006, *Steel wire and wire products — Non-ferrous metallic coatings on steel wire — Part 1: General principles*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

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:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
wire with zinc or zinc-alloy coating
wire where the coating has first been applied to protect it against corrosion

Note 1 to entry: Steel wire and steel wire products of circular or other sections are produced in a continuously hot dip coated/galvanized or continuously electro galvanized process. The coating method may be hot dipping in a bath of molten zinc, or by means of an aqueous solution of suitable electrolyte. In the hot dipping process, wiping media may be used to modify the coating mass per unit area.

3.2
zinc or zinc alloy coating
coating composed of zinc or zinc alloy, where the zinc alloy is zinc to which other elements have been deliberately added in order to obtain particular characteristics, and in which the quantity of zinc is at least 50 %

Note 1 to entry: The most common alloy elements are aluminium, tin and nickel, but other elements may also be considered.

3.3
coating mass per unit area
mass of zinc or zinc alloy per unit of surface area of bare wire.

Note 1 to entry: This is expressed in grams per square metre of surface.

3.4
zinc-alu alloy coating
Zn95Al5 or an advanced metallic coating

3.5
advanced metallic coating
metallic coating which reaches specific requirements

Note 1 to entry: Examples of advanced metallic coatings are Zn90 % + 10 % aluminium and Zn95 % + 5 % aluminium with 0,2 % to 0,5 % magnesium.

4 Coating requirements

4.1 Requirements for the coating material

The zinc or zinc alloy used for the coating shall be specified at the time of the enquiry and order. For zinc alloys not mentioned in this document, the alloy shall be specified at the enquiry and order.

NOTE For Zn-Al alloy coatings, reference is made to ASTM B997 or ASTM B750.

The ingot of the material used for the zinc coating shall be of minimum 99,9 % purity unless otherwise stated in the relevant product standard or other specification in the order. Coatings applied by electrolysis shall contain a minimum of 99 % zinc.

4.2 Requirements relating to coating on the wire

4.2.1 Coating mass per unit area

The minimum mass of zinc or zinc-aluminium alloy coatings, per unit of surface area of the wire, shall comply with the requirements of Table 1.

If no class of zinc coating or no coating mass per unit area is specified, the coating shall be called “regular coating”.

Zinc-coated wire produced as “regular coating” shall have the full surface covered with zinc, but there is no specified minimum weight of coating.

Coating mass different to Table 1 is possible in agreement between the manufacturer and the supplier.

Table 1 — Coating mass per unit area

Diameter *d* mm	Class					
	A g/m²	AB g/m²	B g/m²	C g/m²	D g/m²	E[ab]
0,15 ≤ *d*< 0,20	—	—	15	—	10	40
0,20 ≤ *d*< 0,25	30	20	20	20	15	
0,25 ≤ *d*< 0,32	45	30	30	25	15	
0,32 ≤ *d*< 0,40	60	30	30	25	15	
0,40 ≤ *d*< 0,50	85	55	40	30	15	
0,50 ≤ *d*< 0,60	100	70	50	35	20	
0,60 ≤ *d*< 0,70	115	80	60	40	20	
0,70 ≤ *d*< 0,80	130	90	60	45	20	
0,80 ≤ *d*< 0,90	145	100	70	50	20	
0,90 ≤ *d*< 1,00	155	110	70	55	25	
1,00 ≤ *d*< 1,20	165	115	80	60	25	
1,20 ≤ *d*< 1,40	180	125	90	65	25	60
1,40 ≤ *d*< 1,65	195	135	100	70	30	
1,65 ≤ *d*< 1,85	205	145	100	75	30	
1,85 ≤ *d*< 2,15	215	155	115	80	40	
2,15 ≤ *d*< 2,50	230	170	125	85	45	
2,50 ≤ *d*< 2,80	245	185	125	95	45	
2,80 ≤ *d*< 3,20	255	195	135	100	50	
3,20 ≤ *d*< 3,80	265	210	135	105	60	
3,80 ≤ *d*< 4,40	275	220	135	110	60	
4,40 ≤ *d*< 5,20	280	220	150	110	70	
5,20 ≤ *d*< 8,20	290			110	80	
8,20 ≤ *d* ≤ 10,00	300			110	80	

[a] The corrosion resistance in salt spray according ISO 9227 of this Class E shall be at least equivalent of these from a zinc coating according Class B.

[b] only for zinc-aluminium coatings.

4.2.2 Coating requirements to salt-spray test

The surface of the samples of the wires, when tested according ISO 9227, shall not show more than 5 % dark brown rust after the minimum hours defined below.

The minimum number of hours of salt spray resistance depends on type of coating, wire diameter and specified minimum coating explained in Table 1.

Table 2 is applicable to wires with minimum 1,6 mm diameter and minimum 100 g/m² coating weight.

The minimum number of hours will be calculated by multiplying minimum coating in g/m² and the normalised coefficient (h/g/m²) reported in Table 2.

Table 2 — Coating requirements[b]

Coating type	Normalised coefficient (h/g/m²)[a]
Zinc	2
Standard zinc alu alloy coatings (Zn95Al5)	6
Advanced zinc alu alloy coatings	12

[a] h/g/m²: Multiplied by coating weight = Hours Salt spray before 5 % steel rust according to ISO 9227.

For example: Zinc Class A wire:

— dia 1,65 with 205 g/m² will stand 410 h;

— dia 10,00 with 300 g/m² will stand 600 h.

[b] The salt spray test result (e.g. 1 500h) is the average value of 6 wire samples of each minimum 20 cm length.

4.2.3 Appearance of coating

The coating applied to the wire shall be reasonably smooth and as evenly distributed as industrial technology allows and not show discontinuities such as bare patches, dross contamination, etc.

NOTE The zinc-aluminium alloy might show difference in colour and become darker with time. This does not affect the corrosion protection performance.

4.2.4 Dipping test

If agreed at the time of the enquiry and order, the dipping (immersion) test shall be carried out according to the procedure detailed in 5.3. However, it should be pointed out that there is no direct link between the number of dips and the coating mass per unit area and that the result is determined as much by the conditions of manufacture of the coating as by the uniformity of the coating.

Table 3 gives the minimum number of immersions for coatings of Classes A and AB. The dipping test does not apply to Classes B, C, D and E.

Table 3 — Minimum number of dips

Nominal diameter d mm	Class A		Class AB	
	Number of dips		Number of dips	
	of 1 min[a]	of 1/2 min[b]	of 1 min[a]	of 1/2 min[b]
0,40 ≤ d< 0,60	—	1	—	—
0,60 ≤ d< 0,90	1	—	—	1
0,90 ≤ d< 1,00	1	1	—	1
1,00 ≤ d< 1,40	1	1	1	—
1,40 ≤ d< 1,65	2	—	1	—
1,65 ≤ d< 1,85	2	—	1	—
1,85 ≤ d< 2,15	2	—	1	1
2,15 ≤ d< 2,80	2	1	1	1
2,80 ≤ d< 4,40	3	—	2	—
4,40 ≤ d< 5,20	3	1	2	—
5,20 ≤ d< 8,20	3	1	—	—
8,20 ≤ d ≤ 10,00	4	—	—	—

[a] For Zinc-Alu alloy coatings one dip equals 45 s instead of 1 min.

[b] For Zinc-Alu alloy coatings one dip equals 22 s instead of 1/2 min.

4.2.5 Special finishes

If drawing after galvanizing is required, it shall be stipulated at the time of enquiry and order or in the appropriate product standard. The same also applies for other special finishes such as wax coating, a polished surface or an exceptionally smooth surface.

4.2.6 Adherence of coating

4.2.6.1 Wrapping test

During the test carried out in accordance with ISO 7802, the coating shall adhere to the steel when subjected to the conditions of wrapping test for adherence. It shall not crack or split to such an extent that slivers of coating can be removed by simply rubbing with the bare fingers. The loosening or detachment during testing of small particles of zinc resulting from mechanical polishing of the surface of the zinc or zinc-alloy coating shall not be considered to be a cause for rejection.

The wrapping test shall be carried out according to ISO 7989-1:2006, 5.3.

4.2.6.2 Assessment of adherence

To assess the adherence of the coating as may be specified in the relevant product standard or for evaluating different conditions of manufacturing, the following procedure may be applied.

Compare the coiled wire to the reference chart (see Figure 1). Allocate a value of 1 to 5 to the quality of adherence of the coating in accordance with the reference chart in Figure 1.

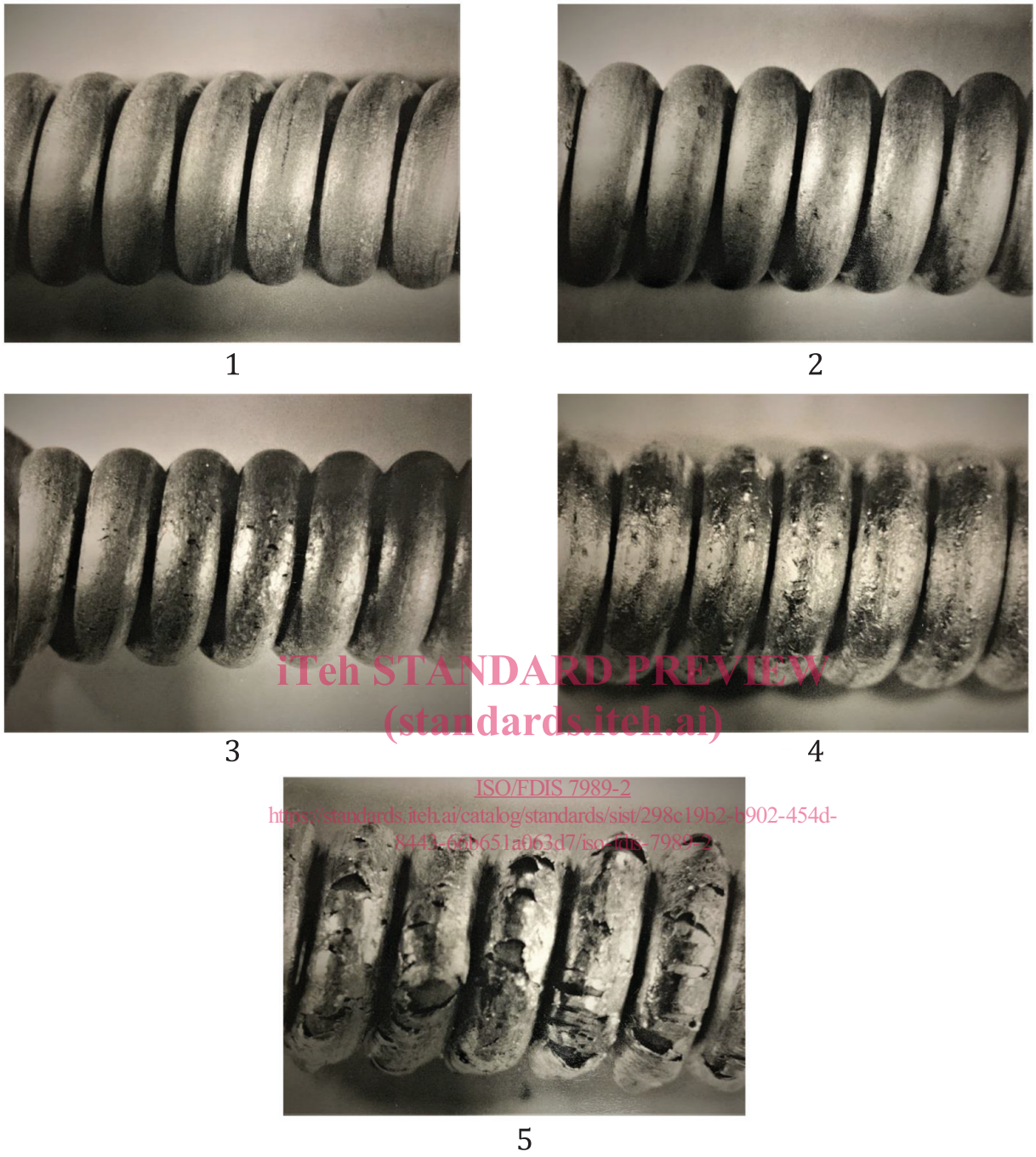

Figure 1 — Assessment of the adherence of the coating

5 Test conditions

5.1 Selection of samples

The number and the basis for the selection of test pieces shall be defined in the product standards. In the absence of such a standard, the manufacturer and purchaser shall agree between them on the degree of sampling.

When taking the samples, care shall be taken to avoid damaging the surface. Parts of the wire which are visibly damaged shall not be used.

A test piece of wire, which is of a suitable length for the specified tests shall be taken from one or both ends of each reel selected for sampling.

In the case of coated wire products, the product standard shall specify the length of the samples to be taken.

5.2 Determination of coating mass per unit area

5.2.1 General

In the case of wire with a zinc or zinc-alloy coating, the coating mass per unit area shall be determined either by the gravimetric method or the volumetric method. The second offers an acceptable degree of accuracy and has the advantage of being quick. This is why it is the preferred method for routine testing of wire of all dimensions which can easily be fitted into the measuring equipment. In the event of any dispute, the gravimetric method shall be used as the reference test method.

The test methods in this document do not necessarily include in detail all the precautions necessary to satisfy hygiene and safety requirements in the workplace, etc. Care should be taken to ensure that all necessary precautions are taken and procedures are implemented only by people who have received suitable training.

5.2.2 Gravimetric method

5.2.2.1 General

The method shall be applied in accordance with ISO 7989-1 with the following additional requirements.

5.2.2.2 Reagents

5.2.2.2.1 Hydrochloric acid, used as a stripping solution, with a concentration of 1,13 g/ml to 1,19 g/ml by density to which an appropriate inhibitor is added.

5.2.2.2.2 Inhibitor, added to the stripping solution.

Dissolve 3,5 g of hexamethylene-tetramine ($C_6H_{12}N_4$) in 500 ml of concentrated hydrochloric acid (ρ = 1,19 g/ml). Dilute this solution to 1 000 ml with distilled water.

Any other suitable inhibitor can be used.

It is recommended that preference be given to inhibitors which do not contain antimony.

5.2.2.3 Calculation of coating mass per unit area

The coating mass of zinc or zinc alloy per unit area shall be calculated according Formulae (1) and (2):

$$m_A = \frac{\Delta m}{A} \times 10^6 \quad (1)$$

where

A is the coated surface of the sample, in square millimetres (mm^2) (surface of the stripped wire);

Δm is the mass loss of the sample by chemical stripping, in grams (g);

m_A is the coating mass, in grams per square metre (g/m^2).