IEC 63248

Edition 1.0 2022-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Conductors for overhead lines – Coated or cladded metallic wire for concentric lay stranded conductors

Conducteurs pour lignes aériennes – Fil métallique revêtu ou recouvert pour conducteurs toronnés à couches concentriques

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CONDUCTORS FOR OVERHEAD LINES – COATED OR CLADDED METALLIC WIRE FOR CONCENTRIC LAY STRANDED CONDUCTORS

FOREWORD

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IEC 63248 has been prepared by IEC technical committee 7: Overhead electrical conductors. It is an International Standard.

This first edition cancels and replaces the first edition of IEC 61232 published in 1993 and the first edition of IEC 60888 published in 1987. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous editions of IEC 61232 and IEC 60888:

a) wire designations have been modified and grouped;
b) wires with zinc coating class 2 were removed;
c) new wire designations have been added;
d) aluminium-clad FeNi36 wires have been added;
e) advanced zinc-aluminium alloy coated steel wires have been added.

The text of this International Standard is based on the following documents:

Draft	Report on voting
7/715/FDIS	7/720/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

The purpose of this document is to group together similar wire materials that share the same general characteristics and therefore the same test procedures and requirements. Included in this document are existing wire types from IEC 60888 and IEC 61232 as well as new wire materials that are already in use around the world in new types of conductors.

Zinc coating class 2 according to IEC 60888 has not been included in this document, as the demand for this class of zinc coating is extremely rare. Extra corrosion protection can be provided by other means, including the use of zinc-aluminium alloy coatings.

CONDUCTORS FOR OVERHEAD LINES – COATED OR CLADDED METALLIC WIRE FOR CONCENTRIC LAY STRANDED CONDUCTORS

1 Scope

This document specifies the properties of wires in the diameter range of, but not limited to, 1,25 mm to 5,50 mm. This document is applicable to coated or cladded metallic wires before stranding used either as concentric lay overhead stranded conductors, or in the manufacture of cores for concentric lay overhead stranded conductors, for power transmission purposes.

The various wire types and their designations are listed in Table A.1. For calculation purposes the values listed in Annex B are used.

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.

IEC 60050 (all parts), *International Electro-technical Vocabulary (IEV)* (available at www.electropedia.org)

IEC 60468, *Method of measurement of resistivity of metallic materials*

ISO 752, *Zinc ingots*

ISO 6892-1, *Metallic materials – Tensile testing – Part 1: Method of test at room temperature*

ISO 7500-1, *Metallic materials – Calibration and verification of static uniaxial testing machines – Part 1: Tension/compression testing machines – Calibration and verification of the force-measuring system*

ISO 7800, *Metallic materials – Wire – Simple torsion test*

ISO 7801, *Metallic materials – Wire – Reverse bend test*

ISO 7802, *Metallic materials – Wire – Wrapping test*

ISO 7989-2, *Steel wire and wire products – Non-ferrous metallic coatings on steel wire – Part 2: Zinc or zinc-alloy coating*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050 (all parts) and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
cladded metallic wire
result of a process by which a metal is bonded under high pressure by co-rolling, co-extrusion, or other, onto a wire creating a metallic bond between them

3.2
class
number attributed to aluminium-clad wires for the purpose of providing an approximate conductivity value

3.3
coated metallic wire
result of a process by which a metal is deposited onto a wire by hot-dip or electrolytic process, creating a chemical or metallic bond between them

3.4
equivalent diameter
diameter of a round wire, which would have the same cross sectional area as a given formed wire

3.5
formed wire
drawn or rolled metal wire having a constant non-circular cross-section

3.6
group
designation given to wire types that share a common coating or cladding, or property, for a similar purpose

3.7
FeNi36
grade of steel-nickel alloy designed to have a very low coefficient of thermal expansion

3.8
lot
group of production units of one type and size of wire, which was manufactured by the same manufacturer during the same time period under similar conditions of production

Note 1 to entry: A lot can consist of part or all of a purchased quantity.

3.9
nominal
value of a measurable property to which tolerance is applied

Note 1 to entry: Nominal values are target values.

3.10
production unit
coil, reel, spool, or other package of wire that represents a single usable length

3.11
sample
specimen or specimens removed from a production unit or units and considered to have properties representative of a lot

3.12
specimen
length of wire removed for test purposes

3.13
zinc-aluminium alloy
mixture of zinc and aluminium coating applied onto the wire for the purpose of protecting it against corrosion

Note 1 to entry: Some of these alloys with particular mixture are called mischmetal.

3.14
advanced zinc-aluminium alloy
zinc-aluminium alloy reaching specific requirements as specified in ISO7989-2

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

4 Material

4.1 Steel

The base metal shall be steel produced by the open hearth, electric furnace, or basic oxygen process and shall be of such composition that the finished wire shall have the properties and characteristics given in this document.

4.2 Aluminium

The aluminium used for coating or cladding shall have a minimum purity of 99,5 % and be of sufficient quality to meet the thickness and electrical resistance requirements of this document.

4.3 Zinc

The ingot of zinc used for coating shall meet the requirements of ZN-3 in accordance with ISO 752.

The zinc coating shall be applied by either the hot-dip or electroplating method. Unless agreed between the purchaser and the manufacturer, the method of coating shall be at the discretion of the manufacturer.

4.4 Zinc-aluminium alloy

The ingot of zinc-aluminium alloy used for coating shall be in accordance with Table A.3.

4.5 Advanced zinc-aluminium alloy

The ingot of advanced zinc-aluminium alloy used for coating shall be in accordance with Table A.3.

5 Freedom from defects

The wires shall be smooth and free from all imperfections such as cracks, roughness, grooves, inclusions and other defects which can compromise the performance of the final product.

6 Joints

No joints shall be made in the finished coated or cladded wire.

Joints may be made at any stage of processing prior to final cold drawing by the electric butt-weld or flash-welding process.

Welding equipment and procedure shall be such that it can be demonstrated that the ultimate tensile strength of a finished wire specimen containing the welded section shall be not less than 96 % of the specified minimum stress at 1 % extension.

A welded section shall not be required to meet the stress at 1 % extension, elongation, torsion, bend, and wrap tests. All other requirements need to be met.

No joints are allowed after heat treatment on wires, which will be used in single-wire conductors.

7 Tests

7.1 General

Tests shall be made by the manufacturer on the wires to demonstrate their conformity to this document. Tests shall be made in accordance with Table A.2.

Tests shall be performed between 10 °C and 30 °C.

7.2 Place of testing

Unless otherwise agreed between the purchaser and the manufacturer at time of ordering, all tests shall be carried out at the manufacturer's premises.

7.3 Sampling rate

The specimen for tests specified in 7.4 shall be taken by the manufacturer from samples of at least 10 % of each lot.

Alternatively, if a quality assessment procedure is in place and implemented, the sampling rate shall be subject to agreement between the manufacturer and purchaser.

7.4 Test methods

7.4.1 Visual test

The surface of the wire shall be visually examined to ensure that it is smooth and free from all imperfections including, but not limited to, cracks, unevenness, holes and inclusion of impurities.

7.4.2 Diameter

7.4.2.1 Unit for diameter

The nominal diameter of a wire shall be expressed in millimetres to two decimal places.

7.4.2.2 Diameter from direct measurements

The diameter of a round wire shall be the mean of two measurements at right angle taken at the same cross-section. The measurement apparatus shall have an accuracy of at least 0,001 mm.

When tested in accordance with 7.4.2.2, the diameter shall not vary from its nominal value by more than the appropriate value indicated in Table A.4, Table A.5, or Table A.6.

7.4.2.3 Diameter from weight measurements

The equivalent diameter of a formed wire shall be obtained from weight measurements made on a sample not less than 1,0 m in length, and with its density as defined in Table B.1.

The equivalent diameter, D, of the formed wire shall be calculated by Formula (1).

$$D = \sqrt{\frac{4A}{\pi \rho L}} \tag{1}$$

where:

D is the equivalent diameter of the sample in mm;

A is the weight of the sample with length L in g;

L is the length of the sample in m;

ρ is the density of the sample in g/cm^3.

When tested in accordance with 7.4.2.3 the equivalent diameter shall not vary from its nominal value by more than the tolerance value indicated in Table A.4, Table A.5, or Table A.6.

7.4.2.4 Diameter from volume measurement

Alternatively the equivalent diameter of a formed wire shall be obtained from the volume and weight measurements as described in Annex C.

When tested in accordance with 7.4.2.4 the equivalent diameter shall not vary from its nominal value by more than the tolerance value indicated in Table A.4, Table A.5, or Table A.6.

7.4.3 Stress at 1 % extension, tensile strength and elongation

7.4.3.1 Sample preparation

The wire samples shall be free from bends or kinks other than the curvature resulting from the usual coiling operation. They shall be straightened before being inserted in the grips of the tensile testing equipment with a roller type wire straightening arrangement or by any other means designed to exert the minimum effect upon the mechanical properties of the sample. Samples for tests shall not be less than 450 mm long and shall be fitted in the testing machine so as to leave a free length of minimum 300 mm between the grips.

7.4.3.2 Stress at 1 % extension and tensile strength

The test shall be performed in accordance with ISO 6892-1.

The force-measuring system of the testing machine shall be calibrated in accordance with ISO 7500-1, class 1, or better.

The rate of separation of the jaws of the testing machine shall be between 25 mm/min and 100 mm/min.

In order to obtain a straight test piece and ensure the alignment of the test piece and grip arrangement, a preliminary load corresponding with the initial stress in accordance with Table A.7 shall be applied.

This load shall be maintained while a 250 mm gauge is marked on the sample and a suitable extensometer applied on a 250 mm gauge length (not necessarily corresponding with the marked gauge length).

A correction of the extension, in accordance with Table A.7, should be carried out to take into account the effect of the preliminary load.

This load shall then be increased uniformly until the extensometer indicates an extension of 2,5 mm in 250 mm (1 % extension).

At this point the tensile testing equipment may be stopped if necessary, and the load read. The value of stress at 1 % extension is calculated by dividing this load by the area of the wire based on wire diameter measurements according to 7.4.2. Following this operation, the extensometer may be removed. The specimen shall then be loaded to rupture and its tensile strength determined.

When tested in accordance with 7.4.3.2 the wire shall conform to the requirements specified in Table A.4, Table A.5, or Table A.6.

7.4.3.3 Elongation after break

The test shall be performed in accordance with ISO 6892-1.

The gauge length to be applied is 250 mm.

When tested in accordance with 7.4.3.3 the wire shall conform to the requirements specified in Table A.4, Table A.5, or Table A.6.

7.4.3.4 Elongation at break

The test shall be performed in accordance with ISO 6892-1.

The gauge length to be applied is 250 mm.

When tested in accordance with 7.4.3.4 the wire shall conform to the requirements specified in Table A.5, or Table A.6.

7.4.4 Ductility tests

7.4.4.1 Torsion test

The test shall be performed in accordance with ISO 7800.

The free length between the grips will be 100 times the nominal diameter.

The number of torsions obtained shall not be less than the value given in Table A.4, Table A.5 or Table A.6.

7.4.4.2 Wrapping test

The test shall be performed in accordance with ISO 7802.

The specimen shall be wrapped 8 turns in a close spiral around a mandrel, at a rate not exceeding 15 turns per minute.

The mandrel diameter shall be in accordance with the value given in Table A.4, Table A.5, or Table A.6.

When tested in accordance with 7.4.4.2, the sample shall not completely break.

7.4.4.3 Reverse bend test

The test shall be performed in accordance with ISO 7801.

The minimum number of reverse bends to be achieved shall be agreed between purchaser and manufacturer.

NOTE In order to have a reference on the minimum achievable reverse bends one can refer to ISO 2232 [4][1], quality A.

7.4.5 Coating or cladding tests

7.4.5.1 Coating mass or cladding thickness test

7.4.5.1.1 Zinc or zinc-aluminium alloy coating mass

The mass of coating can be obtained by the gas volumetric method, or by the gravimetric method tested in accordance with ISO 7989-2.

In case of dispute, the gravimetric method shall be accepted as the arbitration method.

The mass of coating shall not be less than the value given in Table A.8.

7.4.5.1.2 Aluminium cladding thickness

The thickness of aluminium cladding of a specimen shall be determined using an optical microscope or by using suitable electrical indicating instruments operating on the permeameter principle and properly calibrated on the actual diameter of the specimen.

The measurement by microscope shall be read to three decimal places and rounded to two decimal places. For reference purposes, the measurement by microscope shall be used to determine aluminium thickness on specimens taken from the end of the coils.

The thickness of the aluminium shall not be less than the value given in Table A.9.

The ratio of aluminium and steel or FeNi36 is described in Annex D.

7.4.5.2 Adherence of coating or cladding test

7.4.5.2.1 Zinc or zinc-aluminium alloy coating

The test shall be performed in accordance with ISO 7802.

The specimen shall be wrapped 8 turns in a close spiral around a mandrel, at a rate not exceeding 15 turns per minute.

The mandrel diameter shall be in accordance with the value given in Table A.4.

The coating shall remain firmly adherent to the steel and shall not crack or flake to such an extent that any coating can be removed by rubbing with the bare fingers.

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1 Numbers in square brackets refer to the Bibliography.