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Conductors for overhead lines — Fiber reinforced composite core used as supporting member material

Part 2: Metallic matrix composite cores

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The UK participation in its preparation was entrusted to Technical Committee GEL/7, Overhead electrical conductors.

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CONDUCTORS FOR OVERHEAD LINES – FIBER REINFORCED COMPOSITE CORE USED AS SUPPORTING MEMBER MATERIAL –

Part 2: Metallic matrix composite cores

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IEC TS 62818-2 has been prepared by IEC technical committee 7: Overhead Electrical Conductors. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
7/753/DTS	7/755/RVDTS

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 Technical Specification is English.

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A list of all parts in the IEC 62818 series, published under the general title *Conductors for overhead lines – Fiber reinforced composite core used as supporting member material*, can be found on the IEC website.

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/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- withdrawn, or
- revised.

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INTRODUCTION

The first conductors using a composite core were installed in the early 2000s. Since then, they have been increasingly used by utilities worldwide. As a result, there is a need for an IEC publication to agree on tests methods to qualify these cores.

Because of the potential variety of products possible for this purpose, this document does not set minima or maxima (usually provided by the manufacturer, but rather standardizes testing methods to ascertain the numerical values of the basic properties needed by the purchaser to choose the right supporting member material according to the properties of the overhead line conductors. Future discussion items for review may include: performance level and acceptance criteria, other ageing tests and criteria or other relevant tests.

In a future document, tests on the complete conductor which include the composite core will be covered in detail (for example salt fog, corrosion test, mechanical tests, etc.).

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CONDUCTORS FOR OVERHEAD LINES – FIBER REINFORCED COMPOSITE CORE USED AS SUPPORTING MEMBER MATERIAL –

Part 2: Metallic matrix composite cores

1 Scope

This part of IEC 62818, which is a Technical Specification, establishes a system of fiber reinforced composite cores used as supporting member material in conductors for overhead lines which may be used as the basis for specifications. This document is applicable to fiber reinforced composite core, with a metallic matrix, used as supporting member material in conductors for overhead lines.

This document gives guidance on:

– defining the common terms used for fiber reinforced composite cores with a metallic matrix,
– prescribing common methods and recommendations to characterize the properties of fiber reinforced composite cores based on single or multi-wires, with MMC (Metallic Matrix Composite) used as a supporting member material in conductors,
– prescribing or recommending acceptance or failure criteria when applicable.

These tests, criteria and recommendations are intended to ensure a satisfactory use and quality under normal operating and environmental conditions.

This document does not prescribe performance or compliance criteria which may be required but indicative values could be given in Annexes for guidance.

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 60068-2-11:2021, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60216-1:2013, *Electrical insulating materials – Thermal endurance properties – Part 1: Ageing procedures and evaluation of test results*

IEC 60468:1974, *Method of measurement of resistivity of metallic materials*

IEC 63248:2022, *Conductors for overhead lines – Coated or cladded metallic wire for concentric lay stranded conductors*

ISO 527-5:2021, *Plastics: Determination of tensile properties – Part 5: Test conditions for unidirectional fiber-reinforced plastic composites*

ISO 11359-1:2023, *Plastics – Thermomechanical analysis (TMA) – Part 1: General principles*

ISO 11359-2:2021, *Plastics – Thermomechanical analysis (TMA) – Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature*

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ISO 14125:1998, *Fiber-reinforced plastic composites – Determination of flexural properties*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1
metallic matrix composite wire
MMC
assembly of continuous fibers (such as aluminum oxide, silicon carbide, or other ceramic fibers) embedded longitudinally in a metal matrix (such as aluminium)

3.2
composite core
MMC single or multi-wires including additional protection (metallic or non-metallic) if existing in the final application

3.3
external protective layer
outer layer made of a metal or alloy applied onto the MMC for the purpose of protecting it against external aggressions (such as corrosion, oxidation, etc)

Note 1 to entry: In case of a core based on an assembly of composite wires, this protective layer could be applied to:
- each individual wire,
- the assembly of wires.

Note 2 to entry: Individual wires could be protected with different materials. In this case, testing protocols shall be adapted in relation to the specific material.

3.4
fiber reinforced
continuous fibers incorporated within a metallic matrix in order to increase its performance

Note 1 to entry: It is achieved through specific processes such as infiltration, casting, etc.

3.5
fiber
organic or inorganic bundle of filaments that is essentially continuous

3.6
metal
matrix component of the MMC

Note 1 to entry: Many metals and alloys are possible, but aluminium is commonly used

3.7
porosity
measurement of the void fraction in the material over the total volume

Note 1 to entry: It results from a lack of matrix infiltration or from solidification shrinkage. It distinguishes itself from composite crack or fracture by that it is a lack of matrix but not a matrix mechanical fracture.

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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 may consist of part or all of a purchased quantity.

Note 2 to entry: If agreed between the purchaser and the manufacturer, for example for the Type tests, a Lot could be composed of only one Production unit.

3.9
production unit
coil, reel, spool, or other package of individual composite core that represents a single usable length

3.10
sample
specimen(s) removed from a production unit(s) which is considered to have properties representative of a lot

3.11
specimen
length of composite core removed for test purposes

3.12
equivalent diameter
diameter of a circle which would have the same cross-sectional area as a given formed wire

4 Symbols and abbreviation terms

CTE	coefficient of thermal expansion (°C^{-1})
DC	direct current (A)
F_f	flexural load at break (N)
F_t	tensile load at break (N)
RTS	rated tensile strength (kN)
SEM	scanning electron microscope
TMA	thermo-mechanical analysis
$T_{C,CORE}$	maximum continuous temperature (°C) of the composite core
$T_{P,CORE}$	maximum peak-load temperature (°C) of the composite core
σ_f	flexural stress at break (MPa)

5 Requirements

5.1 Composite core manufacturing

Composite cores shall be produced according to the dimensional, mechanical and thermal properties agreed between purchaser and manufacturer, respecting the acceptance values and tolerances. These properties shall be uniform along the lot and every production unit shall be free of internal and external imperfections (e.g. high porosity, unwanted inclusions, scratches, notches, cracks). Each composite wire shall be produced with a single assembly of continuous fibers; no fiber end-to-end joint is allowed, unless clearly agreed between both parties.

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