IEC 62724

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Railway applications – Fixed installations – Electric traction – Insulating synthetic rope assemblies for support of overhead contact lines

Applications ferroviaires – Installations fixes – Traction électrique – Montages mettant en œuvre des câbles synthétiques isolants pour le support des lignes aériennes de contact

IEC 62724:2013

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RAILWAY APPLICATIONS – FIXED INSTALLATIONS – ELECTRIC TRACTION – INSULATING SYNTHETIC ROPE ASSEMBLIES FOR SUPPORT OF OVERHEAD CONTACT LINES

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This standard is derived from EN 50345.

The text of this standard is based on the following documents:

FDIS	Report on voting
9/1853/FDIS	9/1870/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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INTRODUCTION

This International standard has been prepared to provide general guidance and to define special requirements for the design and testing of insulating synthetic ropes, their sheaths and their terminations for use in electric traction overhead contact lines.

Special preferences will include such requirements as to comply with local procurement policies, working practices, compatibility with existing systems, to combat environmental pollution and to provide a supporting assembly with insulation which will give reliable service over its target life span.

These insulating synthetic ropes offer an alternative to the use of metallic cables associated with conventional insulators.

RAILWAY APPLICATIONS – FIXED INSTALLATIONS – ELECTRIC TRACTION – INSULATING SYNTHETIC ROPE ASSEMBLIES FOR SUPPORT OF OVERHEAD CONTACT LINES

1 Scope

This International standard applies to the insulating synthetic ropes used in overhead contact lines.

This International standard specifies the requirements of insulating synthetic rope assemblies and is applicable to electric traction overhead contact lines for railways, light railways, tramways, trolleybuses and other systems.

These insulating synthetic ropes are utilised to provide mechanical support and electrical insulation for overhead contact lines.

They are generally used in the following application fields:

- delta suspension of contact wires;
- catenary cable;
- mid-point anchors;
- tie;
- dropper;
- headspan;
- noise and vibration damper;
- bridle- and pulley suspensions;
- cantilevers made of glass reinforced polymer (GRP).

This standard establishes requirements and characteristics of the rope, test methods and checking procedures to be used with the insulating synthetic ropes, together with the ordering and delivery requirements.

The synthetic ropes only for mechanical applications are not part of this international standard. Anyway the mechanical requirements and tests stated in this standard can be used for this kind of ropes.

The object of this standard is to stipulate provisions for the design and to allow provision of the service indicated by the supplier to the purchaser or informed buyer.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60695-11-10:2013, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60913:2013, *Railway applications – Fixed installations – Electric traction overhead contact lines*

IEC 61109:2008, *Insulators for overhead lines – Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria*

IEC 62217:2012, *Polymeric HV insulators for indoor and outdoor use - General definitions, test methods and acceptance criteria*

IEC 62497-1:2010, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*

IEC 62498-2, *Railway applications – Environmental conditions for equipment – Part 2: Fixed electrical installations*

ISO 4892-2:2006, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1
creepage distance
shortest distance along the surface of a solid insulating material between two conductive parts

[SOURCE: IEC 60050-151:2001, 151-15-50]

3.1.2
gauge length
distance between the centre lines of the termination anchoring pins or bolts

3.1.3
insulator
assembly of an insulating synthetic rope and its associated terminations

3.1.4
insulating synthetic rope
rope which consists of at least one organic based material with or without sheath

3.1.4.1

core of the rope
consists of synthetic fibres and is the load carrying component of the rope

3.1.4.2

sheath of the rope
envelope to protect the fibres and made of synthetic material, usually of a continuous polymeric material with appropriate insulating qualities

3.1.5
termination
means to connect the ends of an insulating synthetic rope between two points

3.2 Abbreviations

a.c. alternating current

d.c. direct current

GRP glass reinforced polymer

UV ultraviolet

4 Characteristics and requirements for the rope

4.1 General

4.1.1 Common characteristics

Two major fibre types are used actually to provide the load carrying core. These are polyester and polyaramid. Other fibre types having similar characteristics may also be used.

The fibre type is important in determining mechanical properties.

The sheath polymer type is important in determining durability, environmental performance and some electrical and mechanical properties.

4.1.2 Specific characteristics of core materials

Insulating synthetic ropes with polyaramid or similar core fibres have a smaller diameter, greater tensile fatigue resistance and smaller elongation than those of polyester or similar core fibres for a given load carrying capacity and axial stiffness.

Insulating synthetic ropes with polyester or similar core fibres have a higher impact resistance than those of polyaramid or similar core fibres, for example: from detached trolleybus poles.

Insulating synthetic ropes can operate within the following operational environmental temperatures:

– between –40 °C and +55 °C for polyester or similar;

– between –40 °C and +80 °C for polyaramid or similar.

4.1.3 Specific requirements of sheath materials

The sheath may be composed of different materials. The type of material shall be chosen to withstand local conditions as:

– UV exposure (e.g. polyethylene);

– general environmental conditions (e.g. polyethylene);

– abrasion effects (e.g. polyester / elastomer);

– flex effects (e.g. polyester / elastomer).

When the rope is used in confined spaces (e.g. tunnels, stations, etc.) the sheath material shall have further properties as:

– electrical tracking resistance (e.g. crosslinked polyethylene);
– antiflammability (e.g. crosslinked polyethylene);
– self-extinguishing (e.g. crosslinked polyethylene).

4.2 Client requirements

The client shall provide a comprehensive and specific description of the overhead contact line service parameters and functioning requirements which may affect the design of the insulated synthetic rope.

This shall include, as appropriate, but not be limited to the following:

– electrical system service parameters;
– spatial and dimensional parameters;
– angular movement deflection limitations;
– maximum working loads required;
– environmental conditions;
– end fittings connection (terminations) requirements;
– any additional requirement for special tests;
– any special delivery or packaging requirements;
– identification of inspection and tests to be witnessed by the purchaser;
– service life of the insulator.

4.3 Electrical requirements

4.3.1 Voltages

Values of voltages are shown in Table A.2 of IEC 62497-1:2010. The rated insulation voltage and the test voltage levels are based on statistical and risk consideration, which may affect the insulator during its service life.

4.3.2 Creepage distances

Creepage distances shall be determined to withstand the highest permanent voltage of the system. Consideration shall also be given to the type of insulating synthetic rope and its behaviour in polluted conditions related to the whole life of the equipment.

The minimum creepage distance, for nominal voltages equal to or below 1,5 kV d.c. or 1 kV a.c. shall be 1 m. This creepage distance can be reduced for special rope types up to 0,5 m if tests and long time experiences are available.

NOTE This distance is based on practical experience.

For nominal voltages exceeding 1,5 kV d.c. or 1 kV a.c., an additional creepage distance per extra kV of the nominal voltage shall be calculated from Table 1 and added to the minimum creepage distance.

EXAMPLE A 25 kV a.c. system with 45° inclination with no waterproof termination and for extreme unfavourable conditions requires a total creepage distance of 3 040 mm.

Table 1 – Additional creepage distance per extra kV of the nominal voltage

Additional creepage distances	Waterproof termination		No waterproof termination	
	Horizontal mm/kV	45° inclination and vertical mm/kV	Horizontal mm/kV	45° inclination and vertical mm/kV
Normal operating conditions	30	35	45	55
Unfavourable operating conditions	40	45	60	70
Extreme unfavourable operating conditions	50	55	75	85
NOTE These values are based on practical experience.				

The creepage distance values for nominal voltage up to 1,5 kV d.c. are valid for double insulation.

4.4 Mechanical requirements

4.4.1 Minimum breaking load

The dimensions and the minimum breaking loads of the insulating synthetic ropes may be taken from Table A.1 of Annex A. Other types may be agreed with the manufacturer.

4.4.2 Permissible tensile loading

The permissible tensile load shall be in accordance with 5.7 and Clause 6 of IEC 60913:2013.

4.4.3 Permissible tensile loading on a mid-span connector (non-vertical load)

The maximum working load which can be applied to a mid-span anchor shall not exceed 25 % of the breaking load of the rope and its associated termination.

The breaking load of the mid-span connector and rope combination shall be determined experimentally. Account shall be taken of anticipated operating conditions and of the actual direction of applied loads.

4.4.4 Time dependant properties

The supplier shall provide information on the following insulating synthetic rope properties:

– fatigue behaviour (cycling loading);

– creep behaviour (under constant loading);

– stress relaxation behaviour (between two fixed anchors).

4.4.5 Other mechanical properties

The supplier shall provide information on the load extension characteristics of the insulating synthetic ropes.

4.5 Environmental conditions

4.5.1 General

Insulating synthetic ropes shall operate within operational environmental conditions given in IEC 62498-2.

Normal operating conditions exist when there is low industrial pollution, a low population density and no thermal engines.

Unfavourable operating conditions exist when there is high industrial pollution and industrial gases, a high population density, mixed railway operation, road traffic and frequent fog.

Extremely unfavourable operating conditions exist close to large power plants, chemical industry, smelting works, with frequent fog or near the ocean.

4.5.2 Pollution

In addition to the electrical and mechanical performance requirements, the design shall address the suitability of the sheath of the insulating synthetic rope surface to cater for levels of pollution which are likely to be encountered during its service life (for example: the ability of the sheath to shed water or pollutants from the surface and the ability of the system to withstand wetting by salt water in coastal applications).

4.5.3 Corrosion

The terminations and mid-span connectors shall be suitably protected from corrosion and compatible with interface connections. When appropriate, attention shall be given to protection against moisture ingress, chemical activity or the influence of temperature variations or unidirectional current flow.

4.5.4 UV resistance

The composition of the sheath of the insulating synthetic ropes shall be suitably chosen to take into account the effects of local UV radiation levels which are likely to be encountered during its service life.

Aging test of the sheath material ISO 4892-2:2006 can be used. When the materials of sheath are the same, it is not necessary to do aging test for different diameters again.

4.6 Fire hazard

Fire hazard risks associated with each application should be assessed and appropriate core fibres and sheath polymer types selected.

Special attention shall be paid to the possibility of gas emissions for applications in confined spaces, e.g. tunnels, stations, etc.

4.7 Tracking and erosion

In addition to the electrical and mechanical performance requirements, the design shall address the suitability of the sheath of the insulating synthetic rope surface to cater for damage from tracking and erosion under conditions which are likely to be encountered during its service life.

5 Design, manufacture and workmanship

The insulating synthetic ropes shall be designed and manufactured in accordance with best practice, taking cognisance of the system in which they will operate and with the need to design end terminations to match specific rope sizes and types. All material shall be of the quality and of the type most suitable for working under conditions specified for the full service life of the insulating synthetic ropes.

The supplier shall provide a safety case for insulating synthetic ropes with novel or innovative features not previously used within the railway environment. The safety case shall quantify any additional risks and indicate how these risks are controlled.

Whenever a waterproof termination is specified, the manufacturer of the termination shall produce an extra assembly guide.

6 Testing

6.1 General

The necessary tests and the elements to which these tests are to be applied are given in Annex B.

6.2 Design tests for rope types

6.2.1 General

The design tests are intended to verify the suitability of the design materials and the method of manufacture. When an insulator is submitted to the design tests, the results shall be considered valid for the whole class of the insulator which are represented by the one test and have the same named characteristics.

The design tests shall be performed on three specimens.

The following tests shall be performed for each class of test:

- breaking test;
- endurance test;
- electrical test (dry power frequency withstand voltage test and test of tracking and erosion for housing);
- flammability test.

NOTE UV resistance of the sheath material can be proved by certificate according to ISO 4892:2:2006.

6.2.2 Test specimens and preliminary tests

6.2.2.1 Product identification and labels

Each synthetic rope shall be marked with the name or trademark of the manufacturer, the year of manufacture and the diameter of the rope. These identifications shall be printed every metre legibly and indelibly. For a correct identification, see Clause 7.

6.2.2.2 Visual check and dimensions (drawing)

The dimensions of the tested synthetic ropes shall be checked in accordance with the relevant drawings, taking note of any special tolerances. In addition, the rope sheath shall be checked visually in order to detect any surface defects such as cracks, grooves, inclusions, etc.

6.2.2.3 Breaking test

For this test the sample lengths (termination excluded) shall be at least equal to 1,0 m.

The test samples shall be subjected to a tensile load by a testing machine. The tensile load shall be increased from zero, smoothly with an extension rate up to 20 % of the gauge length per minute, up to the mechanical failure of the synthetic rope.