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

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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 oeuvre
des câbles synthétiques pour le support
des lignes aériennes de contact

Bahnanwendungen -
Ortsfeste Anlagen -
Elektrischer Zugbetrieb -
Kunststoffseile im Fahrleitungsbau

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by SC 9XC, Electric supply and earthing systems for public transport equipment and ancillary apparatus (fixed installations), of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50345 on 2003-09-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2004-09-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2006-09-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and supports the Interoperability Directive, 96/48/EC.

Contents

Introduction

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

Special preferences of the design 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.

1 Scope

This standard specifies the characteristics 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 isolation for overhead contact lines.

They are generally used in the following application fields:

- delta suspension of contact wires,
- catenary cable,
- mid point anchoring,
- tie,
- dropper,
- headspan,
- noise and vibration damper.

It is a requirement that the whole of the provisions contained in this standard be applied when insulating synthetic ropes are to be used in overhead contact lines.

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

Deviations from the requirements of this standard are permitted when the soundness of such deviations can be substantiated or additional documentation to improve design control procedures is desirable. Additional tests may be specified by the purchaser to measure the compliance of the insulating synthetic rope under particular operating conditions.

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

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.

EN 50119	2001	*Railway applications - Fixed installations - Electric traction overhead contact lines*
EN 50124-1	2001	*Railway applications - Insulation coordination - Part 1: Basic requirements, clearances and creepage distances for all electrical and electronic equipment*
EN 50125-2	2002	*Railway applications - Environmental conditions for equipment - Part 2: Fixed electrical installations*
EN 50163	1995	*Railway applications - Supply voltages of traction systems*
EN 60707	1999	*Flammability of solid non-metallic materials when exposed to flame sources - List of test methods (IEC 60707:1999)*
IEC 61109	1992	*Composite insulators for a.c. overhead lines with nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria*

3 Terms and definitions

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

3.1
insulating synthetic rope
insulating rope composed of a core protected by a sheath

3.1.1
core of the rope
consists of synthetic fibres and is the load carrying component of the rope

3.1.2
sheath of the rope
sheath of the rope is used to protect the fibres and is made of synthetic material, usually of a continuous polymeric material with appropriate insulating qualities

3.2
termination
means to connect the ends of an insulating synthetic rope between two points

3.3
creepage distance
shortest distance along the surface of the insulating material between two conductive parts
[IEC 60050 (151-15-50)]

3.4
gauge length
distance between the centre lines of the termination anchoring pins or bolts

3.5
insulator
assembly of an insulating synthetic rope and its associated terminations

4 Characteristics of the rope

4.1 General

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.

4.1.1 Specific characteristics of core materials

— Insulating synthetic ropes with polyaramid or similar core fibres have a smaller diameter and a greater tensile fatigue resistance 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.

4.1.2 Specific characteristics of sheath materials

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

— U.V. 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 Environmental conditions

Insulating synthetic ropes shall operate within operational environmental conditions given in EN 50125-2.

For information, 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.

4.4 Electrical requirements

4.4.1 System voltages

Values of standard system voltages relative to ground are shown in the following Table 1. 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.

Table 1

Nominal voltages *according to* EN 50163	**Rated insulation voltage** U_{Nm} *according to* EN 50124-1	**Rated impulse voltage** *according to* EN 50124-1	**Power frequency withstand voltage**
600 V d.c.	720 V d.c.	8 kV	8 kV
750 V d.c.	900 V d.c.	12 kV	12 kV
1 500 V d.c.	1 800 V d.c.	18 kV	18 kV
3 000 V d.c.	3 600 V d.c.	40 kV	40 kV
15 kV a.c.	17,25 kV a.c.	170 kV	70 kV
25 kV a.c.	27,5 kV a.c.	200 kV	95 kV
25 kV a.c.	36 kV a.c.	250 kV	95 kV

4.4.2 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.

NOTE 1 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 2 and added to the minimum creepage distance.

NOTE 2 For 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 2

Additional creepage distances mm/kV	**Waterproof termination**		**No waterproof termination**	
	Horizontal	**45° inclination**	**Horizontal**	**45° inclination**
Normal operating conditions	30	35	45	55
Unfavourable operating conditions	40	45	60	70
Extreme unfavourable operating conditions	50	55	75	85

NOTE 1 The values of Table 2 are based on practical experience.

NOTE 2 Normal operating conditions exist when there is low industrial pollution, a low population density and no thermal engines.

NOTE 3 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.

NOTE 4 Extremely unfavourable operating conditions exist close to large power plants, chemical industry, smelting works, with frequent fog or near the ocean.

NOTE 5 Creepage distances may be reduced by agreement between purchaser and supplier or in product standards.

4.5 Mechanical requirements

4.5.1 Minimum specified breaking load of the insulating synthetic rope and its associated terminations

The dimensions and the minimum breaking loads of the insulating synthetic ropes are presented in Table 3.

Table 3

Core fibre type	Nominal external diameter mm	Minimum specified breaking load of the rope and its associated termination kN
Polyaramid or similar	4,0	7,5
	5,0	10,6
	7,0	15,0
	8,5	30,0
	9,0	45,0
	11,0	60,0
	13,5	105,0
Polyester or similar	5,0	3,0
	6,0	4,0
	7,0	5,0
	8,5	10,0
	9,0	15,0
	11,0	20,0
	13,5	35,0
	17	50,0
	20	75,0

4.5.2 Permissible tensile loading

Refer to 5.2.7.1 of EN 50119:2001.

In addition to 4.2.7 of EN 50119:2001, the K_{clamp} of the non-adjusted termination clamp shall be verified experimentally ($K_{clamp} \geq 0,80$).

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

The maximum working load which can be applied to a mid span connector shall not exceed 25 % of the breaking load of the mid span connector and rope combination.

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.

4.5.4 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).

4.5.5 Other mechanical properties

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