BS EN 50345:2009

BSI British Standards

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

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National foreword

This British Standard is the UK implementation of EN 50345:2009. It supersedes BS EN 50345:2004 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/9, Railway electrotechnical applications, to Subcommittee GEL/9/3, Fixed equipment.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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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 - Baugruppen aus isolierenden Kunststoffseilen im Fahrleitungsbau

CENELEC

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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 2009-05-01.

This European Standard supersedes EN 50345:2004.

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)	2010-05-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-05-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive 2001/16/EC. See Annex ZZ.

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Introduction

This European 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.

1 Scope

This European Standard applies to the insulating synthetic ropes used in overhead contact lines.

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

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 50119:2009, *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 50163:2004, *Railway applications - Supply voltages of traction systems*

EN 60695-11-10:1999 + A1:2003, *Fire hazard testing - Part 11-10: Test flames - 50 W horizontal and vertical flame test methods* (IEC 60695-11-10:1999 + A1:2003)

EN 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 61109:2008)

EN 62217:2006, *Polymeric insulators for indoor and outdoor use with a nominal voltage > 1 000 V - General definitions, test methods and acceptance criteria* (IEC 62217:2005)

HD 588.1 S1:1991, *High-voltage test techniques - Part 1: General definitions and test requirements* (IEC 60060-1:1989 + corrigendum March 1990)

3 Terms and definitions

For the purposes of this document, 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
envelope to protect the fibres and 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

3.6
class of insulator
insulator which has a specific design end fitting and a specific core/sheath combination

4 Characteristics of 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 (see B.1.1) 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 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 Electrical requirements

4.3.1 Voltages

Values of voltages are shown in 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 — Voltages excerpt from EN 50124-1, Table A.2

Nominal voltages U_n [a]	Rated insulation voltage U_{Nm}	Rated impulse voltage U_{Ni} kV	Power frequency withstand voltage U_a [b] kV
600 V d.c.	720 V d.c.	8	3,6
750 V d.c.	900 V d.c.	12	5,5
1 500 V d.c.	1 800 V d.c.	18	8,3
3 000 V d.c.	3 600 V d.c.	40	18,5
15 kV a.c.	36 kV a.c.	200	95
25 kV a.c.	52 kV a.c.	250	95

a According to EN 50163.

b According to EN 50124-1, Table B.1.

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.

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 2 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 2

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 distances may be reduced by agreement between purchaser and supplier.

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 Terminations

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

Table 3

Core fibre type	Nominal external diameter of the rope mm	Minimum specified breaking load of the rope and its associated termination kN
Polyaramid or similar [a]	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
Tolerances on external diameter may be specified at the purchasing stage by the supplier.		
[a] The aramid fibre is equivalent to polyaramid fibre.		

4.4.2 Permissible tensile loading

Refer to EN 50119:2009, 5.7.

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 EN 50125-2.

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.

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 D.

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.

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 legible and indelible. 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 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 between 10 % and 20 % of the gauge length per minute, up to the mechanical failure of the synthetic rope.

The rope passes the test if the average value of the three samples shall exceed the minimum specified breaking according to Table 3 and, for each tested sample, the recorded breaking load value shall exceed 95 % of the minimum specified breaking load.

6.2.2.4 Endurance test

A cyclic load shall be applied for this test. The sample lengths shall be at least equal to 0,9 m.

The mean load shall be equal to 30 % of the minimum specified breaking load for rope as given in Table 4. The maximum and minimum loads shall be applied to ± 15 % of the mean load as shown in Figure 1.

Table 4

Core fibre type	Nominal external diameter	Minimum specified breaking load of the rope	Endurance test load		
			mean	minimum	maximum
	mm	kN	kN	kN	kN
Polyaramid or similar	4,0	7,5	2,25	1,91	2,59
	5,0	10,6	3,18	2,70	3,66
	7,0	15,0	4,5	3,83	5,18
	8,5	30,0	9,0	7,65	10,35
	9,0	45,0	13,5	11,48	15,53
	11,0	60,0	18,0	15,3	20,7
	13,5	105,0	31,5	26,78	36,23
Polyester or similar	5,0	3,0	0,9	0,77	1,04
	6,0	4,0	1,2	1,02	1,38
	7,0	5,0	1,5	1,28	1,73
	8,5	10,0	3,0	2,55	3,45
	9,0	15,0	4,5	3,83	5,18
	11,0	20,0	6,0	5,1	6,9
	13,5	35,0	10,5	8,93	12,08
	17	50,0	15,0	12,75	17,25
	20	75,0	22,5	19,13	25,88

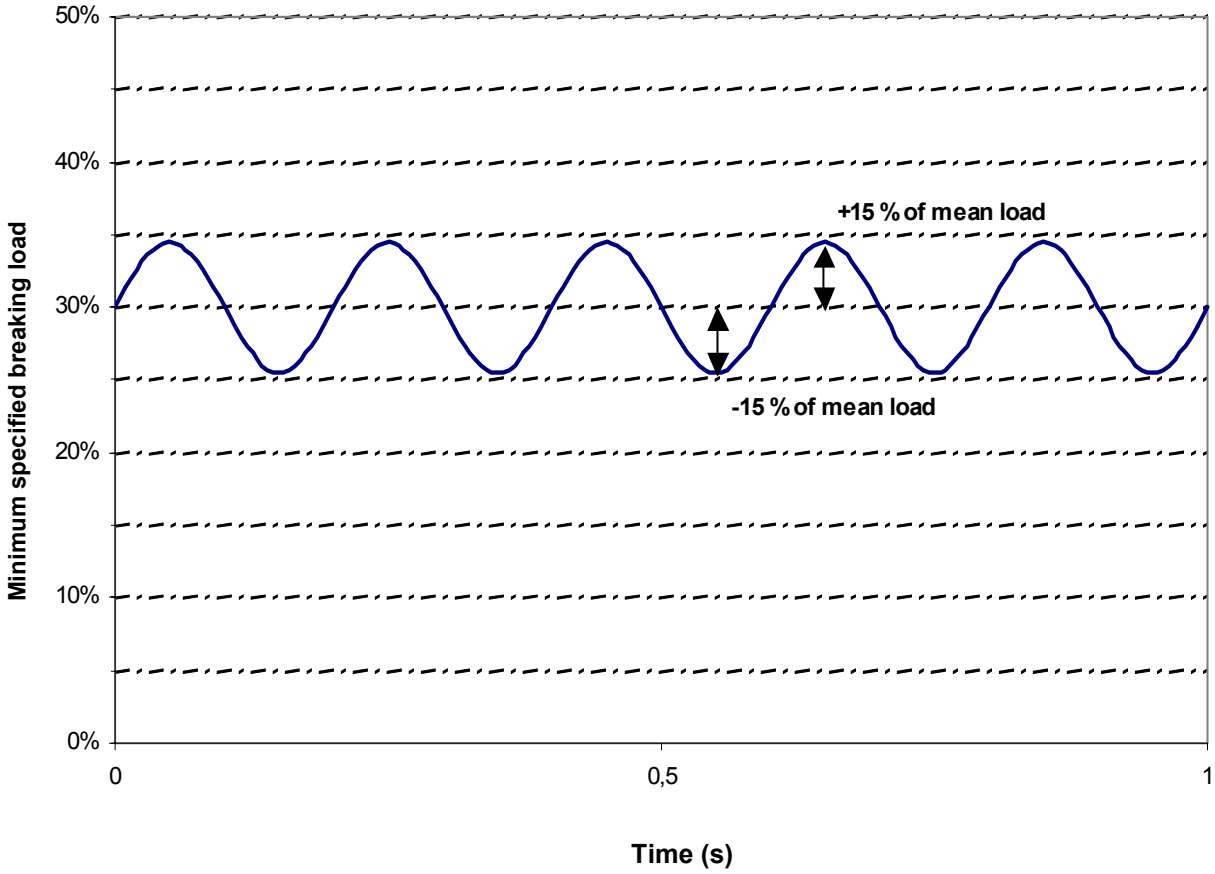

Figure 1

Unless other agreement between supplier and purchaser, the cyclic loading frequency shall be at maximum of 10 cycles per second.

The rope passes the test if for each of the three samples the minimum number of load cycles to failure shall 3×10^6 cycles for polyaramid or similar fibres and 10×10^6 cycles for polyester or similar fibres exceed.

6.2.3 Dry power frequency withstand voltage test

For this test the creepage distance shall be equal to 1,0 m.

This test is performed on insulators and conducted in two parts to allow the comparison between a dry sample and one which has been immersed in water.

The test shall be performed in accordance with EN 62217:2006, 9.2.3.

The samples shall be tested before the immersion in horizontal or 45 °inclination position, after immersion the samples shall be tested in horizontal and 45° position.

The same tests shall be repeated on samples after their immersion in water according to HD 588.1 S1:1991, Table 1, for a minimum period of 100 h. The test samples shall be dipped completely including the end terminations.

The test is fulfilled if the power frequency withstand voltages of Table 1 are achieved for all samples before and after the immersion.

The purchaser may request an additional test if necessary.

6.2.4 Test of housing: tracking and erosion

This test shall be performed only when insulators are to be used on an a.c. system with a nominal system voltage greater than 1 000 V.

Two samples are required for this test. The creepage distance shall be equal to 1,0 m.

This test shall be performed in accordance with EN 62217:2006, 9.3.3.1.

The test is a time-limited continuous test under salt fog at constant power frequency voltage of 18 kV (corresponds to a specific creepage distance of 55 mm/kV) given in Table 2. Initial NaCl content of the water shall be equal to (8 ± 0,4) kg/m^3.

The test shall be regarded as passed if on both tested ropes:

— no tracking occurs;

— no erosion cracks are present;

— no shed (if any), housing or interface is punctured.

6.2.5 Flammability test

Flammability tests may be requested by the purchaser. The flammability test for the finished insulator shall be according to EN 60695-11-10. The test is passed is the test specimen satisfies the requirements of category HB 40. The acceptance category shall be recorded.

The purchaser may request an additional test if necessary.

6.3 Type tests

6.3.1 General

An insulator type is defined for type testing purposes by the core material, the core diameter, the sheath material, the creepage distance and the method of attachment and type of the metal terminations.

The type tests shall be performed only once on insulators satisfying the above criteria for each type.

The type tests shall be repeated only when any of the above characteristics are changed.

For electrical tests, the creepage distance shall be equal or less than the distance determined from Table 2.

The tests as described in 6.3.2 to 6.3.4 shall be undertaken.

6.3.2 Dry lightning impulse withstand voltage test

The tests shall be performed in accordance with EN 61109:2008, 11.1. For the synthetic ropes, the test voltage values are given in Table 1.

6.3.3 Wet power frequency test

The tests shall be performed in accordance with EN 61109:2008, 11.1. For the synthetic ropes, the test voltage values are given in Table 1.

Deviations from the requirements are permitted when the soundness of such deviations can be substantiated.

6.3.4 Breaking load

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 between 10 % and 20 % of the gauge length per minute, up to the mechanical failure of the synthetic rope.

The rope passes the test if the average value of the three samples shall exceed the minimum specified breaking according to Table 3. Moreover, for each tested sample, the recorded breaking load value shall exceed 95 % of the minimum specified breaking load.

For mechanical tests, the sample lengths shall be at least equal to 1,0 m.

6.4 Sampling test

6.4.1 General

The sampling test is for the purpose of verifying other characteristics of insulating synthetic ropes, including those which depend on the quality of manufacture and on the materials used. It is made on insulating synthetic ropes taken at random from lots offered for acceptance.

6.4.2 Sampling test for insulating synthetic rope

The sampling tests shall consist of:

— product identification and labels;

— visual examination of the sheath;

— verification of dimensions;

— winding test.

Number of drums to submit for testing shall be according to Table 5.

Table 5

Number of drums submitted for testing Lot size *N*	**Sample size**
$N \leq 10$	1
$10 < N \leq 25$	3
$25 < N \leq 50$	5
$50 < N \leq 80$	7
$80 < N \leq 120$	9
$120 < N \leq 170$	11
$170 < N \leq 225$	13
If the number of drums exceeds 225, a sample size shall be agreed between supplier and client.	

The winding test shall be carried out by winding five turns of rope on to a cylinder, the diameter of which shall be taken equal to thirty times the external diameter of the rope.

The insulating synthetic rope shall not present, after testing, any significant defects (stretch, tears, ovality, severe changes in section) which can affect its mechanical or electrical characteristics and/or can affect the quality of the fitting of the rope into the termination.

6.4.3 Sampling test for the termination

The sampling test shall consist of:

— verification of identification marks;

— visual examination of the termination;

— verification of dimensions;

— verification that rope and termination are designed to be used together;

— verification of the specified breaking load.

The number of terminations examined shall comply with the lot size according to Table 6.

Table 6

Lot size ***N***	**Sample size**
$N \leq 300$	Subject to agreement
$300 < N \leq 2\,000$	7
$2\,000 < N \leq 5\,000$	12
$5\,000 < N \leq 10\,000$	18

6.4.4 Sampling tests for made up components (e.g. delta suspension, etc.)

The sampling test shall consist of:

— visual examination of the component;

— verification of dimensions;

— verification that rope and termination are designed to be used together;

— verification of the specified breaking load.

The number of components examined shall comply with the lot size according to Table 6.

6.4.5 Re-test procedure for sampling tests

When specified in the acceptance criteria, the following re-test procedure applies for sample tests.

If only one synthetic rope or termination fails to comply with the sampling tests, a new sample equal to twice the quantity originally submitted to that test shall be subjected to re-testing. The re-testing shall comprise the test in which failure occurred, preceded by those tests which may be considered as having influenced the results of the original test.

If two or more ropes or terminations fail to comply with any of the sampling tests, or if any failure occurs during the re-testing, the complete lot shall be considered as not complying with the requirements stated in 6.4 and shall be withdrawn by the manufacturer.

Provided the cause of the failure can be clearly identified, the manufacturer may sort the lot to eliminate all the insulators with this defect. In the case of a lot that has been divided into smaller lots and if one of the smaller lots does not comply, the investigation may be extended to the other lots. The sorted lot(s) or part thereof may then be re-submitted for testing. The number then selected shall be three times the first quantity chosen for the tests. The re-testing shall comprise the test in which failure occurred preceded by those tests which may be considered as having influenced the results of the original test. If any insulator fails during this re-testing, the complete lot shall be considered as not complying with the requirements stated in 6.4.

6.5 Manufacturer routine tests

The manufacturer shall as a routine test:

— check the appearance and condition;

— check the dimensions.

The insulating synthetic rope shall not present any significant defects (grooves, inclusions, stretch, tears, ovality and severe changes in section) which can affect its mechanical or electrical characteristics and/or can affect the quality of the fitting of the rope into the termination.

The termination shall not present any significant defects (surface defects, sharp edges, mechanical damages) which can affect its mechanical or electrical characteristics and/or can affect the quality of the fitting of the rope into the termination.

The complete insulator shall not present any significant defects which can affect its mechanical or electrical characteristics.

If intermediate clamps are used then Annex A should be applied.

7 Component identification

7.1 Rope identification

The maximum step of marking identification on the sheath of the rope shall be of 1 m.

The marking shall include:

— type of core material:

  — polyaramid (a),

  — polyester (p),

  — other core material. In this case the identification mark shall be agreed between manufacturer and customer;

— type of sheath material:

  — polyethylene (pe),

  — crosslinked polyethylene (px),

  — polyester-elastomer (pes),

  — polyurethane (pu),

— other sheath material. In this case the identification mark shall be agreed between manufacturer and customer;

— external diameter of the core of the rope in mm (e.g. D 08,5);

— week number and year of manufacturing (e.g. W24-Y97),

— name of the product;

— metre mark.

7.2 Termination identification

The termination identification shall show:

— name of the manufacturer;

— nominal breaking load in kilo Newton (kN) (e.g. NBL 30,0);

— week number and year of manufacturing (e.g. W24-Y97).

8 Verification of compliance

8.1 Certification of compliance and test results

The supplier shall provide evidence to the satisfaction of the purchaser that the insulating synthetic rope and its associated terminations comply with the requirements of this European Standard and have been satisfactorily tested.

8.2 Inspection and testing

The insulating synthetic rope, associated terminations and sample insulator shall be made available for routine inspections, and on completion for final inspection, and where appropriate, for prototype inspection at the manufacturer's works by the purchaser.

The insulating synthetic rope, associated terminations and sample insulator shall be subject to the following tests before delivery:

a) design, type, sample and routine tests in accordance with this standard;

b) any additional tests as specified in the procurement specification.

The tests may be witnessed by the purchaser and shall include those listed in this European Standard.

Test equipment used for measuring test values shall be calibrated and have valid calibration certificates from an accredited calibration service.

Any inspection or witnessing of testing by the purchaser shall not absolve the supplier of its agreed responsibility.

8.3 Test certificates

The supplier shall provide satisfactory evidence that the insulating synthetic rope and its associated terminations have been satisfactorily tested.

8.4 Drawings

If demanded by the purchaser, drawings with functional dimensions of the terminations shall be submitted to the purchaser for scrutiny with the delivery:

a) general arrangement (including dimensions, construction details and material specification and fixed dimensions as specified in the procurement specification);

b) loading, fixing and end cap requirements.

All drawings shall be of good, legible quality. Four copies of each drawing or as varied by the procurement specification shall be provided.

A remark of each revision shall be provided under consecutive revision letters or numbers together with the date.

All drawings shall be brought up to date as necessary, to provide a permanent as-fitted record and when appropriate shall be supplied in the software format specified in the procurement specification.

NOTE If quality assurance is requested, refer to Annex C.

9 Installation instructions

The supplier shall provide instructions describing the correct methods for handling the insulating synthetic rope and assembling and fitting end terminations.

The supplier together with the installer shall provide instructions for the correct installation of the insulating synthetic rope.

Particular attention shall be paid to the following:

— handling the insulating synthetic rope;

— fixing and tensioning the insulating synthetic rope;

— mechanical fitting of the end terminations;

— when appropriate, correct application of the end termination water proofing system;

— effective locking of the end terminations attaining the required working tension of the rope;

— the effect of long term creep and stress relaxation.

NOTE Annex B gives information related to installation.

10 Maintenance instructions

The manufacturer together with the installer shall specify any periodic and specialised maintenance requirements for the insulating synthetic rope and its associated terminations to achieve the performance requirements.

Specific reference shall be made to:

— cleaning requirements;

— routine maintenance including any special precautions;

— maintenance procedures and periodicity;

— drawings, illustrations and data enabling all component parts to be readily identified and allow procurement for replacement purposes.

11 Delivery and packaging

11.1 Rope

The drum of the rope shall respect the following rules:

— the radius of curvature of the insulating synthetic rope shall not be less than thirty times the external diameter of the rope;

— the markings on the drum shall be legible and indelible;

— the number of the drum shall be marked on each flange;

— a label, resistant to deterioration and indelibly marked, shall be attached to one flange, bearing the following information:

  — the name of the manufacturer;

  — the material designation (nature of the fibres, of the sheath);

  — the external diameter of the rope;

  — the nominal length of the rope;

  — the gross mass (rope-drum plus rope);

  — the nominal breaking load.

The following information shall be supplied separately to the purchaser at his request:

— a manufacturing number with at least the number of the week and the year of manufacture;

— the purchaser order or reference number.

11.2 Terminations

Terminations shall be packaged to avoid any damage in transit.

A label, resistant to deterioration and indelibly marked, shall be attached to the external of the package and shall mention:

— the name of the manufacturer;

— the number of pieces;

— the material designation.

11.3 Insulators

Insulators shall be packaged to avoid any damage in transit.

The insulators shall not be bent to a diameter less than thirty times the diameter of the core of the rope.

A label, resistant to deterioration and indelibly marked, shall be attached to the external of the package and shall mention:

— the name of the manufacturer or the name of the supplier;

— the number of pieces;

— the material designation.

Each insulator shall be individually marked, indicating the termination pin centre line to pin centre line length.

Annex A
(informative)

Intermediate clamps

If intermediate clamps which apply load through the sheath of insulating synthetic rope are to be used, their mechanical efficiency should be evaluated with regard to the following major points:

— the clamp should be clearly identified;

— under working load conditions, the clamp should not damage the sheath;

— in testing a clamp and an insulating synthetic rope combination, care should be taken to apply loads in the direction they would be applied in the service conditions;

— failure mode of a clamp and an insulating synthetic rope combination (i.e. sheath failure or breaking of the clamp).

The maximum working load of the sheath and its associated clamp and the wedging length on the sheath should be registered on the test report.

Annex B
(informative)

Mechanical, chemical and electrical recommendations

B.1 Mechanical recommendations

B.1.1 Insulating synthetic rope

The viscoelastic nature of insulating synthetic rope requires additional care to be taken during installation:

— in fixed length installations, for example cross span, relaxation of the insulating synthetic rope after fitting may cause sagging;

— in fixed load applications, for example anchorage, increases in the length of the insulating synthetic rope after fitting may cause position problems.

The following methods are available for avoiding these problems:

— in fixed length installations, install insulating synthetic rope with a tension which is higher than the required working tension. The insulating synthetic rope will then relax to the required working tension within 48 h after installation and will then hold the required working tension;

— in fixed load applications, install the insulating synthetic rope shorter then the required working length. It will then creep to the required length within 48 h;

— for fixed length or fixed load applications the insulating synthetic rope can be preconditioned by loading to 40 % of its breaking load and holding this constant load for 48 h (typically this is done for lengths of 100 m or more). Stress relaxation and creep have then been taken out of the insulating synthetic rope and it can be cut to length.

The viscoelastic properties of different synthetic fibre types vary widely. It should be noted that the viscoelastic behaviour of polyester fibres is much more prominent than that of polyaramid fibres.

The manufacturer should provide information on the viscoelastic nature of particular insulating synthetic ropes.

B.1.2 Rope and termination assembly

Three part terminations (fork or eye end, body and spike) are advised to make assembly easier and in particular for larger sizes (breaking load of the termination equal to or greater than 60 kN). The manufacturer’s instructions should be followed when fitting a termination.

The following general points should be observed:

— care should be taken not to cut or damage the fibre core when removing the outer sheath;

— the distribution of fibres around the spike should be uniform and regular;

— the termination should be made with the fitting in a vertical position. The spike should be pushed into place as the rope is simultaneously pulled through the termination. This avoids disorientation of the core fibres;

— the spike should be gently tapped into place;

— the outer sheath should not be trapped between the spike and inner wall of the body. To check this, the rope should rotate by ± 30°;

— the nose region of the termination should be long enough to ensure that when under load, core fibres are not exposed;

— the possibility of a UV degradation of the fibres necessitates, when making the assembly, to ensure that there is enough sheath into the body, taking into account the creepage under a constant load. The use of a resilient tube at one end of the body where the rope goes out, is recommended.

B.2 Chemical and electrical recommendations

Chemical compatibility, under operating conditions, between fibre type and termination material and possible pollutants should be provided. With polyaramid fibre types, it is recommended to use either aluminium or stainless steel terminations.

Moreover, to avoid any electrolytic corrosion, copper and copper alloy fittings should not be used in conjunction with aluminium or aluminium alloys materials, especially between the body and the spike of termination.

Annex C
(informative)

Quality assurance

The supplier should operate a comprehensive quality management system in accordance with EN ISO 9001. The supplier should, if requested, provide a current certificate of certified quality issued by an independent certification authority to confirm that the supplier's quality management system has been successfully audited for conformance with the standard for the scope of the work been undertaken.

The manufacturer's quality manual and all internal inspection reports should be available at the manufacturer's works for examination by the purchaser.

The supplier should provide a signed statement or certificate confirming that the insulating synthetic rope, associated terminations and sample insulator have been manufactured, inspected and tested in accordance with this European Standard and the procurement specification, and are ready for despatch.

Annex D
(normative)

Testing

Table D.1 indicates the different tests that shall be performed that are intended to verify the suitability of the insulating synthetic rope and its associated termination.

Table D.1 - Element to submit to tests

	Designation	Subclause	Core material	Core diameter	Sheath material	External diameter	Termination design	Termination material	Method of waterproofing
Design test	Product identification and labels	6.2.2.1	Y	Y	Y	Y			
	Visual check and dimensions (drawing)	6.2.2.2	Y	Y	Y	Y	Y	Y	Y
	Breaking test	6.2.2.3	Y	Y			Y	Y	
	Endurance test	6.2.2.4	Y				Y	Y	
	Dry power frequency withstand voltage test	6.2.3	Y		Y				Y
	Test of housing tracking and erosion	6.2.4			Y				
	Flammability test	6.2.5			Y				
Type test	Dry lightning impulse withstand voltage test	6.3.2			Y				
	Wet power frequency test	6.3.3			Y				
	Breaking load	6.3.4	Y	Y			Y	Y	

NOTE Y: tests to perform.

Annex ZZ
(informative)

Coverage of Essential Requirements of EC Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers all relevant essential requirements as given in Annex III of the EC Directive 2001/16/EC.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

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