

Australian/New Zealand Standard™

Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m = 36$ kV) up to 150 kV ($U_m = 170$ kV)—Test methods and requirements



AS/NZS 60840:2006

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First published as AS/NZS 60840:2006.

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-003, Electric Wires and Cables.

The objective of this Standard is to specify test methods and requirements for electric cables and their accessories for rated voltages above 30 kV ($U_m = 36$ kV) up to 150 kV ($U_m = 170$ kV) that can be referenced in Australian/New Zealand Standards for polymeric insulated electric cables covering this voltage range.

This Standard is identical with, and has been reproduced from IEC 60840, Ed. 3 (2004), *Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m = 36$ kV) up to 150 kV ($U_m = 170$ kV) – Test methods and requirements*.

The terms ‘normative’ and ‘informative’ are used to define the application of the annex to which they apply. A normative annex is an integral part of a standard, whereas an informative annex is only for information and guidance.

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- (a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.
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NOTES

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Australian/New Zealand Standard**Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m = 36$ kV) up to 150 kV ($U_m = 170$ kV)—Test methods and requirements****1 Scope**

This International Standard specifies test methods and requirements for power cable systems for fixed installations, for rated voltages above 30 kV ($U_m = 36$ kV) up to and including 150 kV ($U_m = 170$ kV). It also separately covers cables and accessories.

The requirements apply to single-core cables and to individually screened three-core cables and to their accessories for usual conditions of installation and operation, but not to special cables and their accessories, such as submarine cables, for which modifications to the standard tests may be necessary or special test conditions may need to be devised.

This standard does not cover transition joints between cables with extruded insulation and paper insulated cables.

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.

References to international standards that are struck through in this clause are replaced by references to Australian or Australian/New Zealand Standards that are listed immediately thereafter and identified by shading. Any Australian or Australian/New Zealand Standard that is identical to the International Standard it replaces is identified as such.

~~IEC 60060-1:1989, High-voltage test techniques — Part 1: General definitions and test requirements~~

AS 1931.1, *High-voltage test techniques, Part 1: General definitions and test requirements* (identical to IEC 60060-1)

IEC 60183:1984, *Guide to the selection of high-voltage cables*

IEC 60228:1978, *Conductors of insulated cables*

IEC 60229:1982, *Tests on cable oversheaths which have a special protective function and are applied by extrusion*

IEC 60230:1966, *Impulse tests on cables and their accessories*

IEC 60287-1-1:1994, *Electric cables — Calculation of the current rating — Part 1: Current rating equations (100 % load factor) and calculation of losses — Section 1: General*

~~IEC 60332-1:1993, Tests on electric cables under fire conditions — Part 1: Test on a single vertical insulated wire or cable~~

AS/NZS 1660.5.6, *Test methods for electric cables, cords and conductors*, Method 5.6: *Fire tests—Test for vertical flame propagation for a single insulated wire or cable*

IEC 60811-1-1:1993, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section 1: Measurement of thickness and overall dimensions – Tests for determining the mechanical properties*

IEC 60811-1-2:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Two: Thermal ageing methods*

IEC 60811-1-3:1993, *Insulating and sheathing materials of electric cables – Common test methods – Part 1: General application – Section 3: Methods for determining the density – Water absorption tests – Shrinkage test*

IEC 60811-1-4:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Four: Tests at low temperature*

IEC 60811-2-1:1998, *Insulating and sheathing materials of electric and optical cables – Common test methods – Part 2-1: Methods specific to elastomeric compounds – Ozone resistance, hot set and mineral oil immersion tests*

IEC 60811-3-1:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 3: Methods specific to PVC compounds – Section One: Pressure test at high temperature – Tests for resistance to cracking*

IEC 60811-3-2:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 3: Methods specific to PVC compounds – Section Two: Loss of mass test – Thermal stability test*

IEC 60811-4-1:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 4: Methods specific to polyethylene and polypropylene compounds – Section One: Resistance to environmental stress cracking – Wrapping test after thermal ageing in air – Measurement of the melt flow index – Carbon black and/or mineral content measurement in PE*

IEC 60885-3:1988, *Electrical test methods for electric cables – Part 3: Test methods for partial discharge measurements on lengths of extruded power cables*

~~ISO 48:1994, *Rubber, vulcanized or thermoplastic – Determination of hardness (hardness between 10 IRHD and 100 IRHD)*~~

AS 1683.15.2, *Methods of test for elastomers*, Method 15.2: *Durometer hardness*

3 Definitions

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

3.1 Definitions of dimensional values (thicknesses, cross-sections, etc.)

3.1.1

nominal value

value by which a quantity is designated and which is often used in tables

NOTE Usually, in this standard, nominal values give rise to values to be checked by measurements taking into account specified tolerances.

3.1.2**median value**

when several test results have been obtained and ordered in an increasing (or decreasing) succession, middle value if the number of available values is odd, and mean of the two middle values if the number is even

3.2 Definitions concerning the tests**3.2.1****routine tests**

tests made by the manufacturer on each manufactured component (length of cable or accessory) to check that the component meets the specified requirements

3.2.2**sample tests**

tests made by the manufacturer on samples of completed cable or components taken from a completed cable or accessory, at a specified frequency, so as to verify that the finished product meets the specified requirements

3.2.3**type tests**

tests made before supplying on a general commercial basis a type of cable system or cable or accessory covered by this standard, in order to demonstrate satisfactory performance characteristics to meet the intended application. Once successfully completed, these tests need not be repeated, unless changes are made in the cable or accessory materials, or design or manufacturing process which might change the performance characteristics

3.2.4**electrical tests after installation**

tests made to demonstrate the integrity of the cable system as installed

3.3**cable system**

cable with installed accessories

3.4**nominal electrical stress**

electrical stress calculated at U_0 using nominal dimensions

4 Voltage designations and materials**4.1 Rated voltages**

In this standard, the symbols U_0 , U and U_m are used to designate the rated voltages of cables and accessories where these symbols have the meanings given in IEC 60183.

4.2 Cable insulating materials

This standard applies to cables insulated with one of the materials listed in Table 1. It also specifies for each type of insulating compound the maximum operating conductor temperatures on which the specified test conditions are based.

4.3 Cable oversheathing materials

Tests are specified for four types of oversheath, as follows:

- ST_1 and ST_2 based on polyvinyl chloride;
- ST_3 and ST_7 based on polyethylene.

The choice of the type of oversheath depends on the design of the cable and the mechanical and thermal constraints during installation and operation.

The maximum conductor temperatures in normal operation for the different types of oversheathing materials covered by this standard are given in Table 2.

5 Precautions against water penetration in cables

When cable systems are installed in ground, easily flooded galleries or water, a radial water impermeable barrier around the cable is recommended.

NOTE A test for radial water penetration is not currently available.

Longitudinal water barriers may also be applied to avoid the need to replace long sections of cable in case of damage in the presence of water.

A test for longitudinal water penetration is given in 12.4.18.

6 Cable characteristics

For the purpose of carrying out the cable system or cable tests described in this standard and recording the results, the cable shall be identified. The following characteristics shall be known or declared.

- a) Name of manufacturer, type, designation and manufacturing date or date code.
- b) Rated voltage: values shall be given for U_0 , U , U_m (see 4.1 and 8.4).
- c) Type of conductor, its material and nominal cross-sectional area, in square millimetres. If the nominal cross-sectional area is not in accordance with IEC 60228, the d.c. conductor resistance and the conductor construction shall be declared. Presence, if any, and nature of measures taken to achieve longitudinal watertightness.
- d) Material and nominal thickness of insulation (see 4.2). If the insulation is XLPE, special additives shall be declared if the higher value of $\tan \delta$ according to Table 3 is applicable.
- e) Type of manufacturing process for insulation system.
- f) Presence, if any, and nature of watertightness measures in the screening area.
- g) Material and construction of metallic screen, e.g. number and diameter of wires. The d.c. resistance of the metallic screen shall be declared. Material, construction and nominal thickness of metallic sheath, or longitudinally applied metal foil, if any.
- h) Material and nominal thickness of oversheath.
- i) Nominal diameter of the conductor (d).
- j) Nominal overall diameter of the cable (D).
- k) Inner and outer nominal diameters of the insulation.
- l) Nominal capacitance between conductor and metallic screen/sheath.

7 Accessory characteristics

For the purpose of carrying out the cable system or accessory tests described in this standard and recording the results, the accessory shall be identified. The following characteristics shall be known or declared.

- a) Cables used for testing accessories shall be correctly identified as in Clause 6.
- b) Conductor connections used within the accessories shall be correctly identified, where applicable, with respect to
 - assembly technique;

- tooling, dies and necessary setting;
 - preparation of contact surfaces;
 - type, reference number and any other identification of the connector;
 - details of the type test approval of the connector.
- c) Accessories to be tested shall be correctly identified with respect to
- name of manufacturer;
 - type, designation and manufacturing date or date code;
 - rated voltage (see 6 b) above);
 - installation instructions (reference and date).

8 Test conditions

8.1 Ambient temperature

Unless otherwise specified in the details for the particular test, tests shall be carried out at an ambient temperature of $(20 \pm 15) ^\circ\text{C}$.

8.2 Frequency and waveform of power frequency test voltages

Unless otherwise indicated in this standard, the frequency of the alternating test voltages shall be in the range 49 Hz to 61 Hz. The waveform shall be substantially sinusoidal. The values quoted are r.m.s. values.

8.3 Waveform of lightning impulse test voltages

In accordance with IEC 60230, the front time of the standard lightning impulse voltage shall be between 1 μs and 5 μs . The time to half value shall be $50 \mu\text{s} \pm 10 \mu\text{s}$ as specified in IEC 60060-1.

8.4 Relationship of test voltages to rated voltages

Where test voltages are specified in this standard as multiples of the rated voltage U_0 , the value of U_0 for the determination of the test voltages shall be as specified in Table 4.

For cables and accessories of rated voltages not shown in the table, the value of U_0 for determination of test voltages may be the same as for the nearest rated voltage which is given, provided that the value of U_m for the cable and accessory is not higher than the corresponding value in the table. Otherwise, and particularly if the rated voltage is not close to one of the values in the table, the value of U_0 on which the test voltages are based shall be the rated value, i.e. U divided by $\sqrt{3}$.

The test voltages in this standard are based on the assumption that the cables and accessories are used on systems of category A or B, as defined in IEC 60183.

8.5 Determination of the cable conductor temperature

It is recommended that one of the test methods described in Annex A is used to determine the actual conductor temperature.

9 Routine tests on cables and on the main insulation of prefabricated accessories

9.1 General

The following tests shall be carried out on each manufactured length of cable:

- a) partial discharge test (see 9.2);
- b) voltage test (see 9.3);
- c) electrical test on oversheath of the cable, if required (see 9.4).

The order in which these tests are carried out is at the discretion of the manufacturer.

The main insulation of each prefabricated accessory shall undergo partial discharge (see 9.2) and voltage (see 9.3) tests according to either 1), 2) or 3) below:

- 1) on accessories installed on cable;
- 2) by using a host accessory into which a component of an accessory is substituted for test;
- 3) by using a simulated accessory rig in which the electrical stress environment of a main insulation component is reproduced.

In cases 2) and 3), the test voltage shall be selected to obtain electrical stresses at least the same as those on the component in a complete accessory when subjected to the test voltages specified in 9.2 and 9.3.

NOTE The main insulation of prefabricated accessories consists of the components that come in direct contact with the cable insulation and are necessary to control the electric stress distribution in the accessory. Examples are premoulded or precast elastomer or filled epoxy resin insulating components that may be used singly or jointly to provide the necessary insulation or screening of accessories.

9.2 Partial discharge test

The partial discharge test shall be carried out in accordance with IEC 60885-3 for cables, except that the sensitivity as defined in IEC 60885-3 shall be 10 pC or better. Testing of accessories follows the same principles, but the sensitivity shall be 5 pC or better.

The test voltage shall be raised gradually to and held at $1,75 U_0$ for 10 s and then slowly reduced to $1,5 U_0$ (see Table 4, column 5).

There shall be no detectable discharge exceeding the declared sensitivity from the test object at $1,5 U_0$.

9.3 Voltage test

The voltage test shall be made at ambient temperature using an alternating test voltage at power frequency.

The test voltage shall be raised gradually to $2,5 U_0$ (see Table 4, column 4) and then be held for 30 min between the conductor and metallic screen/sheath.

No breakdown of the insulation shall occur.

9.4 Electrical test on oversheath of the cable

When the test is required by the particular contract, the cable oversheath shall be subjected to the electrical test specified in Clause 3 of IEC 60229.

10 Sample tests on cables

10.1 General

The following tests shall be carried out on samples which, for the tests in items b) and g), may be drum lengths of cable, taken to represent batches:

- a) conductor examination (see 10.4);

- b) measurement of electrical resistance of conductor and of metallic screen (see 10.5);
- c) measurement of thickness of insulation and oversheath (see 10.6);
- d) measurement of thickness of metallic sheath (see 10.7);
- e) measurement of diameters, if required (see 10.8);
- f) hot set test for XLPE, EPR and HEPR insulations (see 10.9);
- g) measurement of capacitance (see 10.10);
- h) measurement of density of HDPE insulation (see 10.11);
- i) water penetration test, if applicable (see 12.4.18);
- j) tests on components of cables with a longitudinally applied metal foil (see 12.4.19).

10.2 Frequency of tests

The sample tests in items a) to h) of 10.1 shall be carried out on one length from each batch (manufacturing series) of the same type and cross-section of cable, but shall be limited to not more than 10 % of the number of lengths in any contract, rounded to the nearest whole number.

The frequency of the tests in items i) and j) of 10.1 shall be in accordance with agreed quality control procedures. In the absence of such an agreement, one test shall be made for contracts with a cable length above 20 km.

10.3 Repetition of tests

If the sample from any length selected for the tests fails in any of the tests in 10.1, further samples shall be taken from two further lengths of the same batch and subjected to the same tests as those in which the original sample failed. If both additional samples pass the tests, the other cables in the batch from which they were taken shall be regarded as having complied with the requirements of this standard. If either fail, this batch of cables shall be regarded as having failed to comply.

10.4 Conductor examination

Compliance with the requirements of IEC 60228 for conductor construction, or the declared construction, shall be checked by inspection and measurement when practicable.

10.5 Measurement of electrical resistance of conductor and metallic screen

The cable length, or a sample thereof, shall be placed in the test room, which shall be maintained at a reasonably constant temperature for at least 12 h before the test. If there is a doubt that the conductor or metallic screen temperature is not the same as the room temperature, the resistance shall be measured after the cable has been in the test room for 24 h. Alternatively, the resistance can be measured on a sample of conductor or metallic screen, conditioned for at least 1 h in a temperature-controlled liquid bath.

The d.c. resistance of the conductor or metallic screen shall be corrected to a temperature of 20 °C and 1 km length in accordance with the formulae and factors given in IEC 60228. For screens other than copper or aluminium, temperature coefficients and correction formulae shall be taken respectively from Table 1 and 2.1.1 of IEC 60287-1-1.

The d.c. resistance of the conductor at 20 °C shall not exceed either the appropriate maximum value specified in IEC 60228 or the declared value.

The d.c. resistance of the metallic screen at 20 °C shall not exceed the declared value.

10.6 Measurement of thickness of cable insulation and oversheath

10.6.1 General

The test method shall be in accordance with Clause 8 of IEC 60811-1-1.

Each cable length selected for the test shall be represented by a piece taken from one end after having discarded, if necessary, any portion that may have suffered damage.

10.6.2 Requirements for the insulation

The lowest measured thickness shall not fall below 90 % of the nominal thickness:

$$t_{\min} \geq 0,90 t_n$$

and additionally:

$$\frac{t_{\max} - t_{\min}}{t_{\max}} \leq 0,15$$

where

$t_{\max}$ is the maximum thickness, in millimetres;

$t_{\min}$ is the minimum thickness, in millimetres;

t_n is the nominal thickness, in millimetres.

NOTE $t_{\max}$ and $t_{\min}$ are measured at the same cross-section of the insulation.

The thickness of the semi-conducting screens on the conductor and over the insulation shall not be included in the thickness of the insulation.

10.6.3 Requirements for the cable oversheath

The lowest measured thickness shall not fall below 85 % of the nominal thickness by more than 0,1 mm:

$$t_{\min} \geq 0,85 t_n - 0,1$$

where

$t_{\min}$ is the minimum thickness, in millimetres;

t_n is the nominal thickness, in millimetres.

In addition, for oversheaths applied onto a substantially smooth surface, the average of the measured values rounded to 0,1 mm in accordance with Annex B shall be not less than the nominal thickness.

The latter requirement does not apply to oversheaths applied onto an irregular surface, such as one formed by metallic screens of wires and/or tapes or corrugated metallic sheath.

10.7 Measurement of thickness of metallic sheath

The following tests apply if the cable has a metallic sheath of lead, lead alloy or aluminium.

10.7.1 Lead or lead alloy sheath

The minimum thickness of the sheath shall not fall below 95 % of the nominal thickness by more than 0,1 mm:

$$t_{\min} \geq 0,95 t_n - 0,1$$

The thickness of the sheath shall be measured by one of the following methods, at the discretion of the manufacturer.

10.7.1.1 Strip method

The measurement shall be made with a micrometer with plane faces of 4 mm to 8 mm diameter and an accuracy of $\pm 0,01$ mm.

The measurement shall be made on a test piece of sheath about 50 mm in length removed from the completed cable. The piece shall be slit longitudinally and carefully flattened. After cleaning the test piece, a sufficient number of measurements shall be made along the circumference of the sheath and not less than 10 mm away from the edge of the flattened piece to ensure that the minimum thickness is measured.

10.7.1.2 Ring method

The measurements shall be made with a micrometer having either one flat nose and one ball nose, or one flat nose and a flat rectangular nose 0,8 mm wide and 2,4 mm long. The ball nose or the flat rectangular nose shall be applied to the inside of the ring. The accuracy of the micrometer shall be $\pm 0,01$ mm.

The measurements shall be made on a ring of the sheath carefully cut from the sample. The thickness shall be determined at a sufficient number of points around the circumference of the ring to ensure that the minimum thickness is measured.

10.7.2 Plain or corrugated aluminium sheath

The minimum thickness of the sheath shall not fall below 90 % of the nominal thickness by more than 0,1 mm for plain aluminium sheath:

$$t_{\min} \geq 0,9 t_n - 0,1$$

and 85 % of the nominal thickness by more than 0,1 mm for corrugated aluminium sheath:

$$t_{\min} \geq 0,85 t_n - 0,1$$

The measurements shall be made with a micrometer having ball noses of radii about 3 mm. The accuracy shall be $\pm 0,01$ mm.

The measurements shall be made on a ring of the sheath, about 50 mm wide, carefully removed from the completed cable. The thickness shall be determined at a sufficient number of points around the circumference of the ring to ensure that the minimum thickness is measured.

10.8 Measurement of diameter

If the purchaser requires that the diameter of the core and/or the overall diameter of the cable shall be measured, the measurements shall be carried out in accordance with 8.3 of IEC 60811-1-1.

10.9 Hot set test for XLPE, EPR and HEPR insulations

10.9.1 Procedure

The sampling and test procedure shall be carried out in accordance with Clause 9 of IEC 60811-2-1, employing the test conditions given in Table 8.

The test pieces shall be taken from that part of the insulation where the degree of cross-linking is considered to be the lowest for the curing process employed.

10.9.2 Requirements

The test results shall comply with the requirements given in Table 8.

10.10 Measurement of capacitance

The capacitance shall be measured between conductor and metallic screen/sheath.

The measured value shall not exceed the nominal value declared by the manufacturer by more than 8 %.

10.11 Measurement of density of HDPE insulation

10.11.1 Procedure

The density of HDPE shall be measured using the sampling and test procedure given in Clause 8 of IEC 60811-1-3.

10.11.2 Requirements

The results of the test shall comply with the requirements given in Table 8.

11 Sample tests on accessories

11.1 Tests on components

The characteristics of each component shall be verified in accordance with the specifications of the accessories manufacturer, either through test reports from the supplier of a given component or through internal tests.

The manufacturer of a given accessory shall provide a list of the tests to be performed on each component, indicating the frequency of each test. The components shall be inspected against their drawings. There shall be no deviations outside the declared tolerances.

NOTE As components differ from one supplier to another, it is not possible to define common sample tests on components in this standard.

11.2 Tests on complete accessory

For accessories where the main insulation cannot be routine tested (see 9.1), the following electrical tests shall be carried out by the manufacturer on a fully assembled accessory:

- a) partial discharge test (see 9.2);
- b) voltage test (see 9.3).

The sequence in which these tests are carried out is at the discretion of the manufacturer.

NOTE Examples of main insulations that are not routine tested are heat shrink insulations and insulations taped and/or moulded on site.

These tests shall be performed on one accessory of each type per contract if the number of that type in the contract is above 50.

If the sample fails either of the above two tests, two further samples of the same accessory type shall be taken from the contract and subjected to the same tests. If both additional samples pass the tests, the other accessories of the same type from the contract shall be regarded as having complied with the requirements of this standard. If either fails, this type of accessory of the contract shall be regarded as having failed to comply.

12 Type tests on cable systems

The tests specified in this clause are intended to demonstrate the satisfactory performance of cable systems.

A summary of type tests on cable systems is given in Annex C.

NOTE Tests on terminations referring to environmental conditions are not specified in this standard.

12.1 Range of type approval

When type tests have been successfully performed on one or more cable system(s) of specific cross-section(s), and of the same rated voltage and construction, the type approval shall be considered as valid for cable systems within the scope of this standard with other cross-sections, rated voltages and constructions provided that all the following conditions are met:

- a) the voltage group is not higher than that of the tested cable system(s);

NOTE In this context, cable systems of the same rated voltage group are those of rated voltages having a common value of U_m , highest voltage for equipment, and the same test voltage levels (see Table 4, columns 1 and 2). For example, tests on a cable system of rated voltage $U = 66$ kV would also cover cables systems of rated voltages $U = 60$ kV and $U = 69$ kV.

- b) the conductor cross-section is not larger than that of the tested cable;
- c) the cable and the accessories have the same or similar constructions as that of the tested cable system(s);

NOTE Cables and accessories of similar construction are those of the same type and manufacturing process of insulation and semi-conducting screens. Repetition of the electrical type tests is not necessary on account of the differences in the conductor or connector type or material or of the protective layers applied over the screened cores or over the main insulation part of the accessory, unless these are likely to have a significant effect on the results of the test. In some instances, e.g. for extension to three-core cables, it may be appropriate to repeat one or more of the type tests (e.g. bending test, heating cycle test and/or compatibility test).

- d) the calculated nominal electrical stress at the cable conductor screen does not exceed the electrical stress at the conductor screen of the tested cable system(s) by more than 10 %;
- e) the calculated nominal electrical stress at the cable insulation screen does not exceed the electrical stress at the insulation screen of the tested cable system(s);
- f) the calculated nominal electrical stresses within the main insulation parts of the accessory and at the cable and accessory interfaces do not exceed those of the tested cable system(s).

The type tests on cable components (see 12.4) only need to be carried out on samples from cables of different voltage ratings and/or conductor cross-sectional areas if different materials are used to produce them and/or different manufacturing processes. However, repetition of the ageing tests on pieces of completed cable to check compatibility of materials (see 12.4.4) may be required if the combination of materials applied over the screened core is different from that of the cable on which type tests have been carried out previously.

A type test certificate signed by the representative of a competent witnessing body, or a report by the manufacturer giving the test results and signed by the appropriate qualified officer, or a type test certificate issued by an independent test laboratory, shall be acceptable as evidence of type testing.

12.2 Summary of type tests

The type tests shall comprise the electrical tests on the complete cable system as specified in 12.3, and the appropriate non-electrical tests on cable components and completed cable specified in 12.4.

The non-electrical tests on cable components and completed cable are summarized in Table 5, indicating which tests are applicable to each insulation and oversheath material. The test under fire conditions is only required if the manufacturer wishes to claim compliance with this test as a special feature of the design of the cable.

The tests listed in 12.3.2 shall be performed on one or more samples of completed cable, depending on the number of accessories involved, at least 10 m in length excluding the accessories.

The minimum length of free cable between accessories shall be 5 m.