

LV and MV accessories for power cables with rated voltage from 0.6/1 kV ($U_m = 1.2$ kV) up to and including 20.8/36 kV ($U_m = 42$ kV) —

Part 2: Methods of test

(Implementation of parts of HD 623
and 628)

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- BEAMA Electrical Cable and Conductor Accessory Manufacturers' Association
- British Approvals Service for Cables
- British Cables Association
- Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
- Electricity Association
- ERA Technology Ltd.
- Institution of Lighting Engineers
- London Underground Ltd.
- Railway Industries Association

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Foreword

BS 7888 was prepared by Technical Subcommittee GEL/20/11. It implements the nationally applicable parts of Harmonization Documents HD 623, 628, 629.1 and 629.2, published by the European Committee for Electrotechnical Standardization (CENELEC) in accordance with the decision of the CENELEC Technical Board.

BS 7888 applies to accessories for power cables with rated voltage U_0/U from 0.6/1 kV ($U_m = 1.2$ kV) up to and including 20.8/36 kV ($U_m = 42$ kV) and is published as a series of separate parts and sections, as listed in the table in the Foreword of BS 7888-1.

BS 7888-2 implements the relevant tests of HD 623 and HD 628 and is to be read in conjunction with BS 7888-1.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

WARNING. The methods of test described in this British Standard do not detail all precautions necessary to meet the requirements of the Health and Safety at Work etc. Act 1974. Attention should be paid to any appropriate safety precautions and the tests should only be performed by authorized personnel.

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

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 21 and a back cover.

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1 Scope

BS 7888-2 collates and specifies the test methods to be used for type testing accessories for power cables with rated voltage from 0.6/1 (1.2) kV up to and including 20.8/36 (42) kV. Test methods are specified for accessories for polymeric cables in accordance with BS 7870-3 and BS 7870-4, and paper cables in accordance with BS 7894.

Full test conditions (e.g. temperatures, durations) and/or test requirements are not specified in this part of BS 7888. Such data needed to perform the tests is given in BS 7888-3 [LV 0.6/1 (1.2) kV] and BS 7888-4 [MV 3.6/6 (7.2) kV to 20.8/36 (42) kV].

Tests applicable to each type of accessory are given in the particular part or section, which state also the sequence of testing and the details for conformity.

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.

BS 923-1:1990, *Guide on high-voltage testing techniques — Part 1: General*.

BS 4828:1985, *Guide for partial discharge measurements*.

BS 7454:1991, *Method for calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects*.

BS 7870-3:2001 (all sections), *LV and MV polymeric insulated cables for use by distribution and generation utilities — Part 3: Specification for distribution cables of rated voltage 0.6/1 kV*.

BS 7870-4:1999 (all sections), *LV and MV polymeric insulated cables for use by distribution and generation utilities — Part 4: Specification for distribution cables with extruded insulation for rated voltages from 11 kV and 3 kV*.

BS 7888-1:1998, *LV and MV accessories for power cables with rated voltage from 0.6/1 kV ($U_m = 1.2$ kV) up to and including 20.8/36 kV ($U_m = 42$ kV) — Part 1: General*.

BS 7888-3:1998, *LV and MV accessories for power cables with rated voltage from 0.6/1 kV ($U_m = 1.2$ kV) up to and including 20.8/36 kV ($U_m = 42$ kV) — Part 3: Test requirements for LV accessories*.

BS 7888-4.1:1998, *Test requirements for MV accessories — Part 4.1: Accessories for cable with extruded insulation*.

BS 7888-4.2:1998, *Test requirements for MV accessories — Part 4.2: Accessories for cable with impregnated paper insulation*.

HD 48, *Impulse tests on cables and their accessories* (Implements IEC 60230).

HD 621, *Medium voltage impregnated paper insulated distribution cables*.

HD 623¹⁾, *Specification for joints, stop ends and outdoor terminations for distribution cables of rated voltage 0.6/1 kV*.

HD 628¹⁾, *Test methods for accessories for power cables with rated voltage from 3.6/6 kV ($U_m = 7.2$ kV) up to and including 20.8/36 kV ($U_m = 42$ kV)*.

HD 629-1¹⁾, *Test requirements and accessories for use on power cables of rated voltage from 3.6/6 (7.2) kV up to 20.8/36 (42) kV — Part 1: Cables with extruded insulation*.

HD 629-2¹⁾, *Test requirements and accessories for use on power cables of rated voltage from 3.6/6 (7.2) kV up to 20.8/36 (42) kV — Part 2: Cables with impregnated paper insulation*.

IEC 60885-2, *Electrical test methods for electric cables — Part 2: Partial discharge tests*.

IEC 60986, *Short-circuit temperature limits of electric cables with rated voltages from 6 kV ($U_m = 7.2$ kV) up to 30 kV ($U_m = 36$ kV)*.

¹⁾ Referred to in the foreword only.

3 Terms and definitions

For the purposes of this part of BS 7888, the definitions given in Clause 3 of BS 7888-1:1998 apply.

4 Test installations and conditions

4.1 The test methods described in this standard are intended to be used for type tests.

4.2 The arrangement and number of test samples are given in the relevant standard.

4.3 The test conditions are specified in Clauses 5 to 17 of this standard. When not, they shall be as specified in the relevant standards.

4.4 Unless otherwise stated, the testing parameters and the requirements are specified in the relevant standard.

4.5 For transition joints (either polymeric to polymeric or polymeric to paper), the testing parameters (voltage and conductor temperature) are those of the lower rated cable.

4.6 The tests shall be started not less than 24 h after installation of the accessories on the cable test loops, unless otherwise specified by the manufacturer. The time interval shall be recorded in the test report.

4.7 Cable screens and armour, if any, shall be bonded and earthed at one end only to prevent circulating currents.

4.8 All parts of an accessory which are normally earthed shall be connected to the cable screen. Any supporting metalwork shall also be earthed.

4.9 The ambient temperature shall be $(20 \pm 15) ^\circ\text{C}$.

5 A.C. voltage withstand test

5.1 Installation

The test shall be performed on joints and stop ends while immersed in the water tank (or pressure vessel) with a height of water of $(1.00^{+0.02}_0)$ m [or equivalent pressure up to a maximum of 0.5 bar²⁾], or air.

The test shall be performed on terminations in a vertical position, unless they are to be specifically installed in another orientation, with the relative spacing as under service conditions, in accordance with the manufacturer's instructions.

5.2 Method

The procedure for voltage application, including for LV, shall be as specified in 17.1 of BS 923-1:1990, at ambient temperature.

5.3 Single-phase test

Apply the voltage between the bunched phase cores and all other metallic parts and the water (if appropriate). Apply the voltage to each phase core in turn with all other phase cores, metallic parts and water earthed.

NOTE Where the neutral is insulated from the water, the neutral shall be treated as another phase core for the purposes of this test.

5.4 Three-phase test

Three-phase testing applies only to non-radial field MV accessories, and a three-phase or three single-phase transformers shall be used to energize the accessories under test. Single-phase transformers shall be star connected with the neutral point earthed.

5.5 Dry test

The set(s) of accessories shall be erected with all associated metalwork and fittings. The accessories shall be clean and dry before applying the test voltage.

²⁾ 1 bar = 10^5 N/m² = 100 kPa.

5.6 Wet test: spray

The wet test method, including for LV, shall be as specified in 9.1 of BS 923-1:1990, at ambient temperature.

6 D.C. voltage withstand test

6.1 Installation

The set(s) of accessories shall be erected with all associated metalwork and fittings. The accessories shall be clean and dry before applying the test voltage.

6.2 Method

A voltage of negative polarity shall be applied to the cable conductor. The test shall be made at ambient temperature, and the procedure for voltage application shall be as specified in 14.1 of BS 923-1:1990.

7 Impulse voltage withstand test

7.1 Installation

For preparation of the test installation, involving metal enclosures and terminal boxes, reference shall be made to the relevant standard.

In the case of three-core accessories (or three single-core terminations in an enclosure), one phase shall be tested at a time with the other two phases earthed.

7.2 Method

The test shall be conducted in accordance with HD 48.

7.3 Test at elevated temperature

Installation and the measurement of temperature are given in Annex A and Annex B respectively.

Before and during the impulse test, the cable conductor shall be heated and stabilized for at least 2 h at a temperature of either:

- for extruded insulation cables, 5 K to 10 K above the maximum cable conductor temperature in normal operation given in BS 7870-4; or
- for paper insulated cables, 0 K to 5 K above the maximum cable conductor temperature in normal operation given in HD 621.

8 Partial discharge test

8.1 Applicability

This test is only required for accessories for extruded insulation single-core cables and three-core cables with individually semiconducting screened cores. It is not required for accessories incorporating paper insulated cables.

8.2 Method

The test shall be conducted in accordance with BS 4828 and IEC 60885-2.

The partial discharge shall be measured at the test voltage given in BS 7888-4.1.

8.3 Test at elevated temperature

Installation and the measurement of temperature are given in Annex A and Annex B respectively.

Before and during the partial discharge test the cable conductor shall be heated and stabilized for at least 2 h at a temperature of 5 K to 10 K above the maximum cable conductor temperature in normal operation given in BS 7870-4.

9 Thermal cycling test

9.1 Installation

The arrangements for tests in air or water shall be as given in Annex A.

For thermal cycling in water, the accessory shall be installed in a water tank (or pressure vessel) with a height of water of $(1.00 \text{ }^{+0.02}_0)$ m (or equivalent pressure up to a maximum of 0.5 bar).

9.2 Method

In respect of the number of cycles and applied voltage, accessories shall be subjected to thermal cycling in accordance with the requirements given in BS 7888-3 or BS 7888-4 of BS 7888, as appropriate.

The method of measuring temperatures is given in Annex B.

The thermal cycle in air or water shall be of 8 h duration with at least 2 h at a steady temperature of either:

- for extruded insulation cables, 5 K to 10 K above the maximum cable conductor temperature in normal operation given in BS 7870-3 or BS 7870-4 as appropriate; or
- for paper insulated cables, 0 K to 5 K above the maximum cable conductor temperature in normal operation given in HD 621 for MV cables, or in BS 7888-3 for LV cables;

followed by at least 3 h of natural cooling to within 10 K of ambient temperature (see Figure 1).

9.3 Oversheath damage of LV cables

For accessories on LV cables, the thermal cycling under water shall be performed with oversheath damage.

Expose the core(s) of one polymeric insulated cable at the entry to the accessory by removing an annulus of the oversheath, together with any bedding or filling material, of at least 50 mm length, at a point which will be within the water and between 50 and 150 mm from the exterior of the accessory.

9.4 Immersion test for MV outdoor terminations

9.4.1 General

This test shall form the last 10 cycles of the thermal cycling test.

9.4.2 Installation

Two terminations of a test loop shall be immersed in water at ambient temperature with a height of water of $(0.03 \text{ }^{+0.02}_0)$ m above every part of the termination as shown in Figure A.5. The test loop shall be inverted in such a way that the terminations, including the end of the sealing element, are fully immersed in water.

9.4.3 Method

The test loop shall be subjected to 10 cycles under the thermal conditions specified in 10.2. The test loop shall not be energized.