BRITISH STANDARD

BS EN
60230:2002

Impulse tests on cables and their accessories

The European Standard EN 60230:2002 has the status of a British Standard

ICS 29.060.20

National foreword

This British Standard is the official English language version of EN 60230:2002. It is identical with IEC 60230:1966.

The UK participation in its preparation was entrusted by Technical Committee GEL/20, Electric cables, to Subcommittee GEL/20/16, Medium/high voltage cables, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

This British Standard, having been prepared under the direction of the Electrotechnical Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 24 May 2002

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 6, an inside back cover and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

ISBN 0 580 39642 8

EUROPEAN STANDARD **EN 60230**

NORME EUROPÉENNE

EUROPÄISCHE NORM April 2002

ICS 29.060.20

Supersedes HD 48 S1:1977

English version

Impulse tests on cables and their accessories
(IEC 60230:1966)

Essais de choc des câbles
et de leurs accessoires
(CEI 60230:1966)

Stoßspannungsprüfungen an Kabeln
und deren Garnituren
(IEC 60230:1966)

This European Standard was approved by CENELEC on 2002-03-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 60230:2002 E

Foreword

The text of the International Standard IEC 60230:1966, prepared by IEC TC 20, Electric cables, was approved by CENELEC as HD 48 S1 on 1974-05-07.

This Harmonization Document was submitted to the formal vote for conversion into a European Standard and was approved by CENELEC as EN 60230 on 2002-03-01.

The following date was 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) 2003-03-01

Endorsement notice

The text of the International Standard IEC 60230:1966 was approved by CENELEC as a European Standard without any modification.

CONTENTS

IMPULSE TESTS ON CABLES AND THEIR ACCESSORIES

SECTION ONE — GENERAL

1. Object and scope

1.1 The object of this Recommendation is to lay down the conditions and procedure for carrying out impulse tests on cables and their accessories, with a view to rationalizing the practice in different laboratories, and thus to facilitate valid comparisons between the results obtained on cables made to different specifications.

1.2 This Recommendation applies solely to the methods of carrying out the tests as such, independently of the problem of selecting the test levels to be specified.

1.3 It is applicable to high-voltage cables of all types.

1.4 The Recommendation is divided into three sections. In Section One, the characteristics and state of the test installation and those parts of the procedure which are common to withstand tests and tests above the withstand level are described. Section Two describes the procedure for carrying out withstand tests. Section Three of this Recommendation describes the procedure for carrying out tests above the withstand level and is intended for research purposes.

2. Characteristics of the test installation to be subjected to the tests

2.1 All samples of cable to be included in the test installation shall have been subjected to the bending operation included as part of the bending test in the relevant I E C Recommendation.

Note. — Different mechanical operations may be appropriate to cables for special conditions of service, e.g. submarine cables. These should be the subject of agreement between the purchaser and the manufacturer, if not described in the relevant I E C Recommendation.

2.2 The length of the sample taken shall be such that the length of cable between the lower parts of the sealing ends is at least 5 m, if the test installation is not intended to include any other accessory.

2.3 Where one joint is included in the test installation, the minimum length of free cable, between the joint and the bottom of each sealing end, shall be 5 m.

Where more than one joint is included, the same requirement shall be observed and in addition there shall be a minimum length of 3 m of free cable between successive joints.

3. State of the test installation

The test installation shall be maintained under the following conditions:

3.1 *Pressure conditions*

For gas-pressure and oil-filled cables, the pressure shall be adjusted in accordance with the relevant I E C Recommendation.

3.2 *Temperature conditions*

The temperature conditions and the method of temperature measurement shall be as described in the relevant I E C Recommendation, but other methods of temperature measurement may be used by agreement between the purchaser and the manufacturer.

4. **Shape of the impulse waves**

The impulse waves applied shall have a wave front of a duration between 1 μs and 5 μs, and a duration to half the peak value of 50 ± 10 μs. They shall further comply with I E C Publication 60, High-voltage Test Techniques, where applicable.

5. **Calibration of impulse generator**

Immediately before or during the period when the temperature of the cable is maintained at a constant value, preparatory to the application of the impulses, the generator shall be calibrated, with positive polarity, under the following conditions:

Both ends of the test assembly shall be connected to the impulse generator. A measuring sphere-gap and an oscillograph, with its associated voltage divider, shall be connected in parallel and remain so connected throughout the test.

For every setting of the sphere-gap, the charging voltage of the generator shall be so adjusted as to give 50% flashover of the gap (see Sub-clause 6.3.1.2 of I E C Publication 60) and an oscillogram of the impulse voltage shall be taken. This procedure shall be carried out for at least three different settings of the sphere-gap. The settings shall be so selected that their 50% flashover voltages are approximately 50%, 65% and 80% of the test level specified.

A curve showing the charging voltage as a function of the sphere-gap flashover voltage shall be drawn for this positive polarity. This curve, which should be a straight line, shall be extrapolated to determine the charging voltage necessary to obtain the specified level with positive polarity.

The ratio of the voltage divider shall be so selected for this polarity as to take into account the maximum flashover voltages for the sphere-gap and the voltage oscillograms that have to be obtained. This value for the ratio of the voltage divider shall be used for all the oscillograms taken in the course of the series of tests with this polarity.

Other peak voltage measuring devices may be used in place of, or in addition to, the sphere-gap, but such devices shall comply with I E C Publication 60. Thus, if a peak voltage measuring device is used in addition to an oscillograph, in conjunction with the voltage divider, and this instrument and the divider both comply with I E C Publication 60, the impulse generator may be calibrated by adjusting the charging voltage to give approximately 50%, 65% and 80% of the test level specified.

Section Two — Withstand tests

6. **Application of the impulses at the level specified**

6.1 With the sphere-gap setting increased so that no flashover occurs across the gap, and with the cable maintained at the required temperature, the test installation shall be subjected to a series of 10 positive impulses at the voltage specified. The time interval between two successive impulses shall be just sufficient to ensure that the impulse generator is charged at the correct voltage.

6.2 Immediately after the application of the 10 positive impulses, the generator shall be re-calibrated for negative polarity under the conditions specified in Clause 5, and a series of 10 negative impulses of the same specified voltage shall then be applied to the test assembly.

6.3 Oscillograms shall be taken of at least the first and tenth impulses in each series. The oscillograms shall include a timing oscillation.

6.4 The ambient temperature, the cable temperature and, where applicable, the gas or oil pressure, shall be checked during the test.

4. **Shape of the impulse waves**

The impulse waves applied shall have a wave front of a duration between 1 μs and 5 μs, and a duration to half the peak value of 50 ± 10 μs. They shall further comply with I E C Publication 60, High-voltage Test Techniques, where applicable.

5. **Calibration of impulse generator**

Immediately before or during the period when the temperature of the cable is maintained at a constant value, preparatory to the application of the impulses, the generator shall be calibrated, with positive polarity, under the following conditions:

Both ends of the test assembly shall be connected to the impulse generator. A measuring sphere-gap and an oscillograph, with its associated voltage divider, shall be connected in parallel and remain so connected throughout the test.

For every setting of the sphere-gap, the charging voltage of the generator shall be so adjusted as to give 50% flashover of the gap (see Sub-clause 6.3.1.2 of I E C Publication 60) and an oscillogram of the impulse voltage shall be taken. This procedure shall be carried out for at least three different settings of the sphere-gap. The settings shall be so selected that their 50% flashover voltages are approximately 50%, 65% and 80% of the test level specified.

A curve showing the charging voltage as a function of the sphere-gap flashover voltage shall be drawn for this positive polarity. This curve, which should be a straight line, shall be extrapolated to determine the charging voltage necessary to obtain the specified level with positive polarity.

The ratio of the voltage divider shall be so selected for this polarity as to take into account the maximum flashover voltages for the sphere-gap and the voltage oscillograms that have to be obtained. This value for the ratio of the voltage divider shall be used for all the oscillograms taken in the course of the series of tests with this polarity.

Other peak voltage measuring devices may be used in place of, or in addition to, the sphere-gap, but such devices shall comply with I E C Publication 60. Thus, if a peak voltage measuring device is used in addition to an oscillograph, in conjunction with the voltage divider, and this instrument and the divider both comply with I E C Publication 60, the impulse generator may be calibrated by adjusting the charging voltage to give approximately 50%, 65% and 80% of the test level specified.

Section Two — Withstand tests

6. **Application of the impulses at the level specified**

6.1 With the sphere-gap setting increased so that no flashover occurs across the gap, and with the cable maintained at the required temperature, the test installation shall be subjected to a series of 10 positive impulses at the voltage specified. The time interval between two successive impulses shall be just sufficient to ensure that the impulse generator is charged at the correct voltage.

6.2 Immediately after the application of the 10 positive impulses, the generator shall be re-calibrated for negative polarity under the conditions specified in Clause 5, and a series of 10 negative impulses of the same specified voltage shall then be applied to the test assembly.

6.3 Oscillograms shall be taken of at least the first and tenth impulses in each series. The oscillograms shall include a timing oscillation.

6.4 The ambient temperature, the cable temperature and, where applicable, the gas or oil pressure, shall be checked during the test.

4. **Shape of the impulse waves**

The impulse waves applied shall have a wave front of a duration between 1 μs and 5 μs, and a duration to half the peak value of 50 ± 10 μs. They shall further comply with I E C Publication 60, High-voltage Test Techniques, where applicable.

5. **Calibration of impulse generator**

Immediately before or during the period when the temperature of the cable is maintained at a constant value, preparatory to the application of the impulses, the generator shall be calibrated, with positive polarity, under the following conditions:

Both ends of the test assembly shall be connected to the impulse generator. A measuring sphere-gap and an oscillograph, with its associated voltage divider, shall be connected in parallel and remain so connected throughout the test.

For every setting of the sphere-gap, the charging voltage of the generator shall be so adjusted as to give 50% flashover of the gap (see Sub-clause 6.3.1.2 of I E C Publication 60) and an oscillogram of the impulse voltage shall be taken. This procedure shall be carried out for at least three different settings of the sphere-gap. The settings shall be so selected that their 50% flashover voltages are approximately 50%, 65% and 80% of the test level specified.

A curve showing the charging voltage as a function of the sphere-gap flashover voltage shall be drawn for this positive polarity. This curve, which should be a straight line, shall be extrapolated to determine the charging voltage necessary to obtain the specified level with positive polarity.

The ratio of the voltage divider shall be so selected for this polarity as to take into account the maximum flashover voltages for the sphere-gap and the voltage oscillograms that have to be obtained. This value for the ratio of the voltage divider shall be used for all the oscillograms taken in the course of the series of tests with this polarity.

Other peak voltage measuring devices may be used in place of, or in addition to, the sphere-gap, but such devices shall comply with I E C Publication 60. Thus, if a peak voltage measuring device is used in addition to an oscillograph, in conjunction with the voltage divider, and this instrument and the divider both comply with I E C Publication 60, the impulse generator may be calibrated by adjusting the charging voltage to give approximately 50%, 65% and 80% of the test level specified.

Section Two — Withstand tests

6. **Application of the impulses at the level specified**

6.1 With the sphere-gap setting increased so that no flashover occurs across the gap, and with the cable maintained at the required temperature, the test installation shall be subjected to a series of 10 positive impulses at the voltage specified. The time interval between two successive impulses shall be just sufficient to ensure that the impulse generator is charged at the correct voltage.

6.2 Immediately after the application of the 10 positive impulses, the generator shall be re-calibrated for negative polarity under the conditions specified in Clause 5, and a series of 10 negative impulses of the same specified voltage shall then be applied to the test assembly.

6.3 Oscillograms shall be taken of at least the first and tenth impulses in each series. The oscillograms shall include a timing oscillation.

6.4 The ambient temperature, the cable temperature and, where applicable, the gas or oil pressure, shall be checked during the test.

4. **Shape of the impulse waves**

The impulse waves applied shall have a wave front of a duration between 1 μs and 5 μs, and a duration to half the peak value of 50 ± 10 μs. They shall further comply with I E C Publication 60, High-voltage Test Techniques, where applicable.

5. **Calibration of impulse generator**

Immediately before or during the period when the temperature of the cable is maintained at a constant value, preparatory to the application of the impulses, the generator shall be calibrated, with positive polarity, under the following conditions:

Both ends of the test assembly shall be connected to the impulse generator. A measuring sphere-gap and an oscillograph, with its associated voltage divider, shall be connected in parallel and remain so connected throughout the test.

For every setting of the sphere-gap, the charging voltage of the generator shall be so adjusted as to give 50% flashover of the gap (see Sub-clause 6.3.1.2 of I E C Publication 60) and an oscillogram of the impulse voltage shall be taken. This procedure shall be carried out for at least three different settings of the sphere-gap. The settings shall be so selected that their 50% flashover voltages are approximately 50%, 65% and 80% of the test level specified.

A curve showing the charging voltage as a function of the sphere-gap flashover voltage shall be drawn for this positive polarity. This curve, which should be a straight line, shall be extrapolated to determine the charging voltage necessary to obtain the specified level with positive polarity.

The ratio of the voltage divider shall be so selected for this polarity as to take into account the maximum flashover voltages for the sphere-gap and the voltage oscillograms that have to be obtained. This value for the ratio of the voltage divider shall be used for all the oscillograms taken in the course of the series of tests with this polarity.

Other peak voltage measuring devices may be used in place of, or in addition to, the sphere-gap, but such devices shall comply with I E C Publication 60. Thus, if a peak voltage measuring device is used in addition to an oscillograph, in conjunction with the voltage divider, and this instrument and the divider both comply with I E C Publication 60, the impulse generator may be calibrated by adjusting the charging voltage to give approximately 50%, 65% and 80% of the test level specified.

Section Two — Withstand tests

6. **Application of the impulses at the level specified**

6.1 With the sphere-gap setting increased so that no flashover occurs across the gap, and with the cable maintained at the required temperature, the test installation shall be subjected to a series of 10 positive impulses at the voltage specified. The time interval between two successive impulses shall be just sufficient to ensure that the impulse generator is charged at the correct voltage.

6.2 Immediately after the application of the 10 positive impulses, the generator shall be re-calibrated for negative polarity under the conditions specified in Clause 5, and a series of 10 negative impulses of the same specified voltage shall then be applied to the test assembly.

6.3 Oscillograms shall be taken of at least the first and tenth impulses in each series. The oscillograms shall include a timing oscillation.

6.4 The ambient temperature, the cable temperature and, where applicable, the gas or oil pressure, shall be checked during the test.