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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Electric cables – Spark-test method

Câbles électriques – Méthode d'essai au défilement à sec (sparker)

IEC 62230:2006-05+AMD1:2013-11 CSV(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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ELECTROTECHNICAL
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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRIC CABLES – SPARK-TEST METHOD

FOREWORD

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IEC 62230 edition 1.1 contains the first edition (2006) [documents 20/810/FDIS and 20/816/RVD] and its amendment 1 (2013) [documents 20/1462/FDIS and 20/1470/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 62230 has been prepared by IEC technical committee 20: Electric cables.

This standard, based on the European Norm EN 50356 (2002), was prepared by CENELEC technical committee 20: Electric cables. It was submitted to the national committees for voting under fast track procedure.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

The practice of using spark-testers to detect defects in the insulation or sheathing layers of electric cables has been developed over many years of practical experience.

The operation of the equipment using the verification method described in this standard has proved to be satisfactory. This method employs an artificial fault simulator and its performance has been shown to be comparable to that using operational efficacy tests involving the detection of artificially prepared defects (i.e. faults in the insulation/sheathing material) in lengths of cable.

ELECTRIC CABLES – SPARK-TEST METHOD

1 Scope

The spark-test method specified in this standard is intended for the detection of defects in the insulation or sheathing layers of electric cables. For single-core cables with no outer metallic layer, the general process is accepted as being equivalent to subjecting samples of those cables to a voltage test in water.

This standard specifies the operational requirements for the spark-test equipment, as well as the principal characteristics, functional parameters and calibration procedures for each type of test equipment.

2 Types of voltage waveform

For the purposes of this standard, the types of voltage waveform used for spark-testing are divided into the following groups:

a.c. an alternating current (a.c.) voltage of approximately sine-wave form, at the industrial frequency of 40 Hz to 62 Hz;

d.c. a direct current (d.c.) voltage;

h.f. an alternating current (a.c.) voltage of approximately sine-wave form, at frequencies between 500 Hz and 1 MHz;

pulsed a voltage waveform comprising a fast rise time and highly damped wave-tail, as defined in 4.2.

NOTE Provided the manufacturer can demonstrate equivalent effectiveness, h.f. voltages at frequencies below 500 Hz may be used.

3 Procedure

The insulated conductor or sheathed cable shall be passed through an electrode energized at the test voltage. The method detailed in this standard provides for the application of a.c., d.c., h.f. and pulsed voltages.

The requirements for voltage waveform, frequency and test voltage are given in 4.2 and Clause 5. The maximum speed at which the cable shall pass through the electrode is determined by the minimum residence time specified in 4.6.

When used as an alternative to a voltage test in water, ~~it is recommended that~~ the test shall be restricted to layer thicknesses not greater than 2,0 mm ~~and to a.c. and d.c. test voltages~~ unless otherwise specified in the cable standard. Only the a.c. or d.c. voltage waveforms shall be used.

The requirements are not applicable to cable insulation having a rated voltage (U_0) greater than 3 kV.

Annex A provides ~~recommended~~ minimum voltages for each voltage waveform, to be used in the absence of any alternative voltages in the relevant cable standard.

4 Equipment

4.1 Safety

To limit the effect of electric shock to personnel, for all types of voltage source, the equipment shall be constructed in such a way that the short-circuit current is limited to less than 10 mA r.m.s. or equivalent.

This requirement is additional to, or may be superseded by, any national regulation that prevails at the time.

NOTE Guidance on the limiting of shock currents can be found in IEC 60479-1 and IEC 60479-2.

Further aspects of operational safety are given in Annex C.

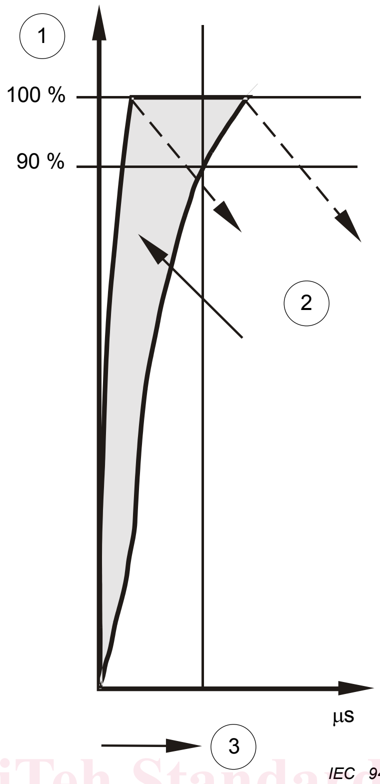
4.2 High voltage source

The high-voltage electrode shall be supplied in one of the following forms, as defined in Clause 2: a.c., d.c., h.f. or pulsed.

For a d.c. test, connection to the test electrode shall be by means of a low capacitance unscreened lead. For d.c. and pulsed voltage testing, the test electrode may be either positive or negative polarity, the other pole being earthed.

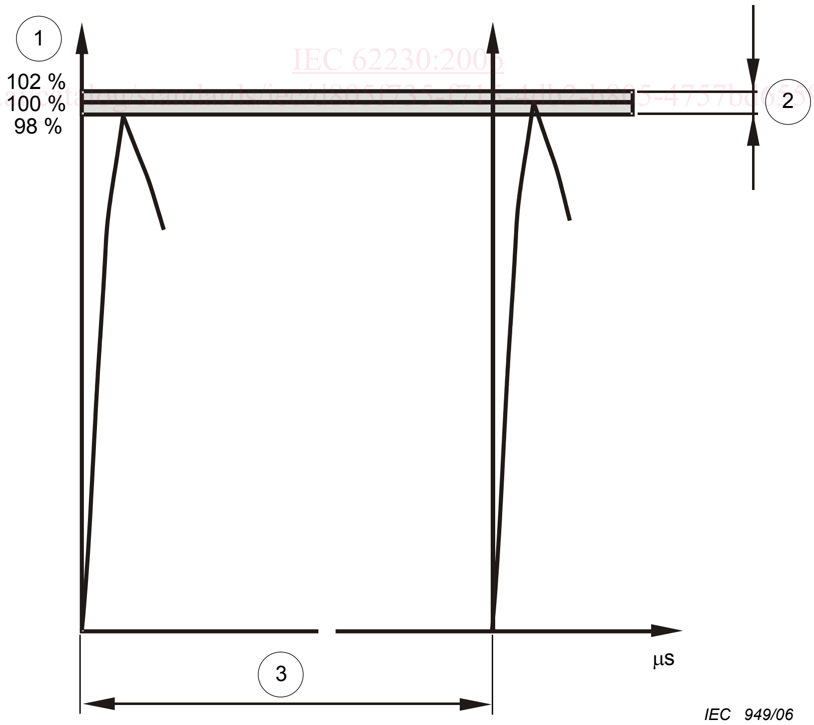
The requirements for pulsed waveforms are presented in Figures 1, 2 and 3.

For pulsed waveforms, the rise time of the wave front shall reach 90 % of the specified peak value in less than 75 μs – see Figure 1. Fluctuations of the actual peak value, due to variations of input power into the generator, shall not exceed ±2 % of the specified peak value – see Figure 2. The peak value shall not show more than 5 % reduction in the event of an increase of capacitive load of 50 pF, during the operation, from an initial load of 25 pF between electrode and instrument ground. The time that each pulse remains at a voltage greater than 80 % of the specified peak voltage shall be between 20 μs and 100 μs – see Figure 3. The pulse repetition frequency shall be greater than 170 per second and less than 500 per second. This corresponds to pulse separations between 2 000 μs and 5 880 μs. Visible or audible corona shall be evident in the electrode structure when operating at the specified voltage.



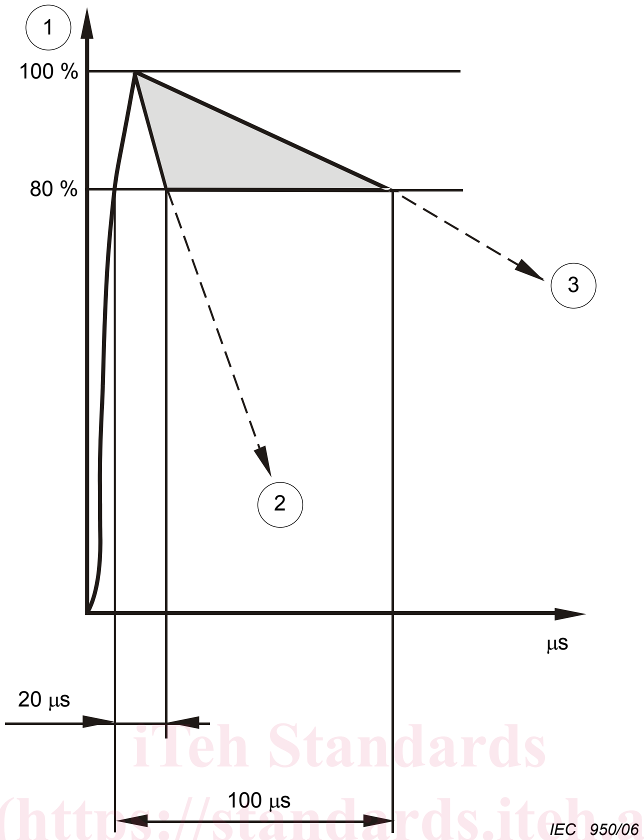
Key
1 actual voltage
2 range of rise time of wavefront
3 maximum 75 µs

Figure 1 – Requirements for pulsed waveforms – Rise time of wavefront



Key
1 actual voltage
2 fluctuation range
3 pulse repetition from 2 000 µs to 5 880 µs

Figure 2 – Requirements for pulsed waveforms – Fluctuation of peak value and pulse repetition rate



Key

1 actual voltage
2 pulse duration – minimum
3 pulse duration – maximum

Figure 3 – Requirements for pulsed waveforms – Pulse duration

4.3 Voltage monitoring equipment

For a.c., d.c. and h.f. sources, the voltage between electrode and earth shall be displayed on a meter either by connection directly to the output terminal of the high-voltage source or by any suitable equivalent arrangement. The measurement system shall have an accuracy of ±5 % of the indicated value.

For a pulse source there shall be a peak reading instrument voltmeter connected directly to the electrode, continually indicating the voltage at the electrode, with or without a grounded test wire in the test chamber. The peak reading voltmeter shall indicate full deflection at a peak value not exceeding 25 kV and with a precision level of ±5 % of the indicated value.

NOTE If the spark-tester is to be controlled remotely, it should be noted that the current drawn by the cable under test can cause variation of the test voltage. In this situation, the regulation of the voltage source needs to be sufficient to maintain the voltage within the 5 % accuracy limit.

4.4 Fault indicator

There shall be a detection circuit to provide a visible and/or audible indication of failure of the insulation or sheath to maintain the specified voltage. The fault detector shall be arranged to operate a digital display counter such that one count per discrete fault is registered. It shall also be of a totalizer type and cumulative to the end of the cable run. The counter shall maintain the indication until either the next succeeding fault is registered or until the indication is manually cancelled.

4.5 Electrodes

An appropriate choice of electrode shall be made in order to obtain the maximum effective rate of detection.

Types of cable to be tested (construction, materials, etc.) and the test conditions (linear speed, voltage source mode, etc.) form some of the parameters to be considered.

Examples of electrode types are

- contact types:
  bead chain, spring loaded hyperbola, brushes (rotating or fixed),
- non-contact types:
  metallic tube, rings.

4.6 Design of electrodes

4.6.1 Contact type

The electrode shall be of metallic construction and its length shall be such that every point of the insulated conductor or non-metallic sheath under test is in electrical contact with the electrode for times not less than the following:

a) for a.c. supply to the electrode: 0,05 s

NOTE 1 This time represents a maximum linear throughput speed of 1,2 m/min per millimetre of electrode. The minimum length of the electrode (mm) is therefore given by 0,833 v, where v is the linear throughput speed in m/min.

b) for d.c. supply to the electrode : 0,001 s

NOTE 2 This time represents a maximum linear throughput speed of 60 m/min per millimetre of electrode. The minimum length of the electrode (mm) is therefore given by 0,017 v, where v is the linear throughput speed in m/min.

c) for h.f. supply to the electrode: $\left(\frac{0{,}002\,5}{f}\right)$ s

where f is the supply frequency in kHz.

NOTE 3 This time represents a maximum linear throughput speed of 24 f m/min per millimetre of electrode. The minimum length of the electrode (mm) is therefore given by 0,042 v/f, where v is the linear throughput speed in m/min.

d) for pulse supply to the electrode: $\left(\frac{2{,}5}{p}\right)$ s

where p is the pulse repetition rate in pulses per second.

NOTE 4 This time represents a maximum linear throughput speed of 0,024 p m/min per millimetre of electrode. The minimum length of the electrode (mm) is therefore given by 42 v/p, where v is the linear throughput speed in m/min.

4.6.2 Non-contact type (d.c. test only)

The electrode shall consist of a cylindrical metal tube or series of metallic rings. In either case the internal diameter(s) shall not be greater than 15 mm. In the case of the ring type, the number of rings shall be such that a uniform electric field is formed. These electrodes shall only be used with a d.c. source and their length shall be such that every point of the insulated conductor or non-metallic sheath is in the electrode for not less than 0,001 s.

NOTE This time represents a maximum linear throughput speed of 60 m/min per millimetre of electrode. The minimum length of the electrode (mm) is therefore given by 0,017 v, where v is the linear throughput speed in m/min.