BS EN 50508:2009

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Multi-purpose insulating sticks for electrical operations on high voltage installations

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National foreword

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

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Multi-purpose insulating sticks for electrical operations on high voltage installations

Perches isolantes à usage multiple pour les opérations électriques sur les installations haute tension

Isolierende Mehrzweckstangen für elektrische Betätigungen in Hochspannungsanlagen

This European Standard was approved by CENELEC on 2008-10-21. 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.

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CENELEC

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Foreword

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Introduction

Multipurpose insulating sticks are used to operate high voltage (more than 1 kV) live equipment at distance, such as opening and closing switchgear, extracting and replacing fuses, etc. They are also used to carry out operations prior to dead working, as in the case of voltage verification, earthing and short-circuiting, etc.

In all these cases the stick has two main functions, to reach the part of the installation that needs to be operated on and to protect the worker from risk of electrical injury, by providing the insulation level and maintaining the safety distance between the worker and the live or potentially live installation.

According to the working and maintenance procedures adopted, additional protection can be added in order to attain the adequate safety level (see Annex A).

The multipurpose insulating stick is used in accordance with EN 50110.

This standard has been prepared in accordance with the requirements of EN 61477.

1 Scope

This European Standard specifies the requirements and tests to be fulfilled by the multipurpose insulating sticks intended to perform a range of operations in high voltage installations by means of the attached appropriate tools, for example:

- connection and disconnection of disconnectors or other equipment operated by the stick,
- fuse replacement with an attached tool,

operations like:

- voltage absence verification, using a detector as a separate device in accordance with EN 61243-1;
- earthing and short circuiting installations, using devices in accordance with EN 61230;
- placing insulating screens in order to provide protection against adjacent live parts;
- testing and measurement;
- any other operation or verification on the electrical installation, provided that the mechanical requirements do not exceed those assured by the stick design and the worker shall remain at a safety distance;
- rescue of accident victims.

This European Standard is applicable to the insulating sticks made of a single continuous tube or rod or multiple tube or rod sections connected to each other, to be used both indoors or outdoors on electrical systems for voltages of 1 kV to 765 kV a.c., frequencies of 50 Hz and/or 60 Hz and in the normal range of temperatures of -25 ºC to +55 ºC and at a relative humidity between 20 % and 93 %.

For the purpose of this standard, “tube” is used for “tube” and “rod”.

Annex B includes considerations about the use under wet conditions.

NOTE It is a general practice to use an insulating stick on d.c. installations with the same value of nominal voltage. That use shall comply with the national regulations.

This European Standard is not applicable to

- sticks covered by EN 60832,
- telescopic sticks covered by EN 62193,
- sticks with mobile internal or external operating rods, as those used directly for fuse replacement,
- single purpose sticks, especially designed to cover a single operation, generally as a complete equipment such as voltage detectors covered by EN 61243-1.

NOTE Except where otherwise specified, all the voltages defined in this European Standard refer to values of phase-to-phase voltages of three-phase systems. In other systems, the applicable phase-to-phase or phase-to-earth (ground) voltages should be used to determine the operating voltage.

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 60068-1	1994	Environmental testing – Part 1: General and guidance (IEC 60068-1:1988 + corrigendum Oct. 1988 + A1:1992)
EN 60068-2-32	1993	Basic environmental testing procedures – Part 2: Tests - Test Ed: Free fall (IEC 60068-2-32:1975 + A2:1990)
EN 60068-2-75	1997	Environmental testing – Part 2-75: Tests - Test Eh: Hammer tests (IEC 60068-2-75:1997)
EN 60855	1996	Insulating foam-filled tubes and solid rods for live working (IEC 60855:1985, mod.)
EN 61235	1995	Live working - Insulating hollow tubes for electrical purposes (IEC 61235:1993, mod.)
EN 61477		Live working - Minimum requirements for the utilization of tools, devices and equipment (IEC 61477)
HD 588.1 S1	1991	High-voltage test techniques – Part 1: General definitions and test requirements (IEC 60060-1:1989 + corrigendum March 1990)
IEC 60050	series	International Electrotechnical Vocabulary (IEV)
IEC 60417	Database	Graphical symbols for use on equipment
ISO 48		Rubber, vulcanized or thermoplastic - Determination of hardness (hardness between 10 IRHD and 100 IRHD)

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

NOTE Further information on terminology is illustrated in Figure 1.

3.1
cap
protection of the bottom of the stick

3.2
coupling (for multiple section sticks)
element allowing the attachement of the sections of the stick

3.3
critical defect
defect on product that judgement and experience indicate is likely to result in hazardous or unsafe conditions for individuals using and depending on the product

3.4
hand guard
physical guard or sign, visibly different, used to separate the handle from the insulating element

3.5
handle
part of the stick between the edge of the hand guard and the bottom of the stick where the user should place his hands for correct use

3.6
head
fixed element on the upper end of the stick that allows attaching tools such as operating hook, voltage detector, earthing devices, etc.

3.7
insulating element
part of the stick between the hand guard and the limit mark that provides the user with the necessary working distance and insulation related to the nominal voltage of the installation

3.8
limit mark
differentiating element or sign that indicates to the user the physical limit until which he could insert the stick among live elements or touch them

3.9
major defect
defect on product, other than critical, that is likely to result in failure, or to reduce significantly the functionality of the product

3.10
operation
changes brought about to modify the electric state of an electric installation (connection or disconnection), but not entailing any assembly or dismantling of elements

3.11
minor defect
defect on product that is not likely to reduce significantly the functionality of the product

3.12
multipurpose insulating stick
insulating stick made with one or several adaptable sections of insulating tube, sized according to the nominal voltage and the working distance, with a head, insulating element, hand guard, handle, cap, limit mark and couplings (for multiple sections sticks) (see Figure 1)

3.13
nominal voltage (U_n)
suitable approximate value of voltage used to identify a system

[IEV 601-01-21, modified]

3.14
rated voltage (U_r)
voltage value generally agreed upon by manufacturer and customer to which certain operating specifications are referred

NOTE The rated voltage of the stick is the value selected from Table 2, column 1, which should be the same as, either the nominal voltage (or the higher nominal voltage of a range of nominal voltages) or the following higher value selected in this table.

3.15
routine test
test performed on each item during or after manufacture to ascertain whether it complies with certain criteria

[IEV 151-16-17]

3.16
safety distance (see 4.4.3)
safety clearance between the worker and a live part of the installation related with the nominal voltage of the installation, provided by the length of the insulating element when the operating head is in contact with the voltage

3.17
type test
test performed on one or more items representative of the production, made to show that the product meets certain conditions of its specification

[IEV 151-16-16, modified]

4 Requirements

4.1 Materials

Tubes and rods of insulating material used in the design of insulating sticks shall meet the requirements of EN 60855 or EN 61235.

The cross-section of these tubes or rods may be circular or not, based on the physical or ergonomic reasons applicable to the sticks.

The head can be constructed of non-conductive or conductive material, even a metallic one.

The insulating element may be made of one or more parts.

Conductive elements outwardly insulated or not, between the limit mark and the hand guard are admitted if the minimum length of the insulating element (see Table 2) is kept.

The limit mark shall be permanent and clearly recognisable by the user.

The hand guard shall be an insulating disk with a higher diameter than the tube or a sign with the same characteristics as those of the limit mark, although it shall have a different colour than the limit mark. The band should have the inscription “hand limit” in national language.

Sticks to be used under wet conditions can include additional non conductive elements as discs.

4.2 Dimensions

4.2.1 Length of the stick

In order to meet the requirements of this European Standard and allow easy use by a single worker the following distances and combinations (see Annex C) are recommended:

- stick with a single section, total length: 1,5 m, 2 m, 2,5 m and 3 m;
- stick with multiple sections, nominal length of each section of: 1 m, 1,5 m, 2 m, 2,5 m and 3 m.

In sections with an end coupling, the nominal length shall be given by the total length of the element, from one end to the other, minus the part intended to be inserted in another section.

Different sizes and combinations subject to prior agreement between manufacturer and customer shall be permitted if they can pass the applicable tests.

4.2.2 Length of the insulating element

The insulating element shall meet the values specified in Table 2.

In sections with an end coupling, the insulating length shall be measured considering only the useful insulating part of the section with regard to the total length of the insulating element.

The insulating element is considered to be the length constructed with tube according to EN 60855 or EN 61235 electrical requirements.

4.2.3 Tube diameter

The diameter of the tube shall be in the range 19 mm to 51 mm. The recommended diameters are 32 mm or 39 mm according to the length of the stick (see Annex C).

4.2.4 Handle length

In order to permit proper use by the worker, the minimum length of the handle shall be as in Table 1.

Table 1 – Handle length

Total stick length mm	**Minimum handle length** mm
$L_T \leq 1\,500$	300
$1\,500 < L_T \leq 3\,000$	800
$L_T > 3\,000$	1 100

4.2.5 External perimeter of the handle

The perimeter shall not be more than 175 mm to permit a good grip by the worker.

4.2.6 Width of the limit mark

The minimum width of the limit mark is 20 mm.

4.2.7 Position of the limit mark

An assembled stick shall not have more than one limit mark. If the stick has more than two sections, the limit mark shall be in the head section.

Where no limit is shown on the stick, the head shall be considered as the limit mark.

4.2.8 Dimensions of the hand guard

When the hand guard is a guard, it shall have a minimum height of 20 mm. If the hand guard is a band, it shall be 20 mm wide.

4.2.9 Type of head

The heads are defined by the dimensions and constructive characteristics of the work tool pins that connect the work tool with the head. Annex D includes a set of test tools for the recommended heads.

4.3 Mechanical requirements

4.3.1 Couplings and connections between elements

All the elements of the stick, different sections, handle and head, shall be firmly attached to each other.

The head shall be solidly fixed to the upper part of the stick.

The sections shall be joined to each other by means of a rigid coupling that shall not permit the accidental loosening of the stick sections.

On interchangeable tool heads the fitting and removal of tools shall not require excessive effort.

The guard of the hand guard, if it exists, shall be solidly fixed.

The stick assembled according to the instructions for use shall meet the mechanical requirements mentioned in 4.3.3 to 4.3.5.

4.3.2 Holding force and deflection

The stick shall be designed in order to enable a good control of the tool. The stick shall be designed so that it allows a controlled movement of the head within the installation. The deflection originated when using it with its accessories, should be as small as possible.

4.3.3 Resistance to shocks

At low temperature the coupling elements shall withstand mechanical shocks.

4.3.4 Resistance to falls

The complete stick shall withstand falls.

4.3.5 Resistance to torque

The stick shall withstand the necessary torsion force needed for its use.

4.4 Electrical requirements

4.4.1 Protection against bridging

The part of the stick between the head and the limit mark shall be so designed that, under working conditions, it does not cause electrical discharges or short circuits between elements at different potential.

This condition is applicable to sticks with a length not exceeding 2 m, to be used in indoor installations with nominal voltages equal or below 52 kV. Higher voltage values are not considered as the distances between parts of the installation are much bigger.

4.4.2 Leakage current

The stick shall be built so that the user is provided with adequate protection against leakage current.

For a multiple section stick, the leakage current shall be measured on all combinations.

4.4.3 Safety distance

The length measured from the limit mark to the hand guard shall provide the necessary safety distance to the user against electrical risks, as indicated in Table 2.

Table 2 – Minimum length of insulating element

Nominal voltage of the installation U_n (kV)	Minimum insulating distance [a] [b] mm	Ergonomic distance [b] mm	Minimum length of insulating element mm
≤ 15	160	500	660
≤ 30	320	500	820
≤ 45	480	500	980
≤ 66	630	500	1 130
≤ 110	1 100	500	1 600
≤ 132	1 300	500	1 800
≤ 150	1 500	500	2 000
≤ 220	2 100	500	2 600
≤ 380	3 400	500	3 900
≤ 480	4 100	500	4 600
≤ 735 / 800	6 400	500	6 900

[a] According to HD 637 S1, considering operation and lightning overvoltages.

[b] The values can be changed according national regulations.

4.4.4 Sections of the stick

The stick can be made up of a single piece or several sections, depending on the characteristics of the installation where it is to be used and the requirements for transportation, storing, etc.

Every multiple sections stick shall have at least a bottom section, with handle, and a top section with the head and the limit mark. One or more intermediate sections may be assembled in order to achieve the required length to reach parts of the installation or increase the insulation level and the safety distance.

A stick with more than two sections can be used at different voltage level, adding or removing intermediate sections. The manufacturer shall provide information about this possible use, the sections shall be marked according to this European Standard and the different combinations shall fulfil independently the requirements of this standard.

The intermediate sections may be interchangeable; in that case, they shall have at least the same insulating properties.

4.4.5 Length of sticks according to nominal voltage

Different values of total length and diameter can be used. The manufacturer shall specify those values in the instructions for use.

Table C.1 provides recommended values.

4.5 Marking

All the stick sections shall have the following information:

- double triangle (symbol IEC 60417-5216 suitable for live working) (see Note);
- reference to this standard;
- manufacturer’s name or trademark;
- serial or batch number or month and year of manufacture of the section;
- manufacturer’s reference for the section.

NOTE This symbol identifies products covered by an IEC/TC 78 International Standard. A product marked with this symbol is to be considered in that sense, as a live working tool. However, it does not mean that this product is suitable only to carry out live working operations, in accordance with the working procedures specified by EN 50110 or by national regulations.

In addition to the previous information, the handle section shall contain a label with the nominal voltages of use according to the possible mounting combinations. A stick reference can be added to this label if necessary (see Annex E).

In the case the hand guard is a band, it shall have the marking “hand limit” in national language.

The marking shall be legible and indelible or be firmly adhered; the characters shall be at least 3 mm high. The marking shall not affect the quality of the stick.

4.6 Instructions for use

Each tool shall come with the manufacturer’s instructions for use and care. These instructions shall include as a minimum

- assembly,
- attachments (fittings),
- rated voltages according to the assembly,
- maximum mechanical rating,
- cleaning, storage, transportation, periodic testing, possible refinishing and possible disposal,
- maintenance.

See Annex A.

5 Verification and testing

5.1 General

All tests, except where otherwise stated, shall be performed with the stick fully assembled according to the manufacturer’s instructions.

Any type of element fixed to the stick, such as rain disks, shall be kept on the stick while performing the electrical and mechanical tests defined in this standard.

Atmospheric conditions shall be in accordance with EN 60068-1.

Except when otherwise stated, the tests and verifications shall be carried out in the following normal atmospheric conditions:

- room temperature: 15 °C to 35 °C,
- relative humidity: 25 % to 75 %,
- atmospheric pressure: 86 kPa to 106 kPa.

The stick shall be subjected to these conditions for a minimum of 4 h before being subjected to the group of tests.

The type tests shall be performed on three complete sticks. Tests shall be performed in the sequence defined in Annex G. If more than one stick does not pass, the test has failed. If only one stick fails, the entire sequence for the type test shall be repeated on three other sticks. If, again, any of the sticks does not pass, the type test is considered to have failed.

5.2 Electrical test

5.2.1 Test methods

Tests shall be carried out using an a.c. power source in accordance with the requirements given in HD 588.1.

Tests shall be performed in dry conditions for all types of sticks.

Unless otherwise stated:

- a tolerance of ± 3 % is allowed for all required values;
- tests shall be carried out at 50 Hz and/or 60 Hz.

If a stick can be used for the same voltage range with different combination of sections, it shall be tested for the combination of shorter length.

If a stick can be used with different combinations of sections and for different voltage ranges, it shall be tested for all the voltage ranges. Each test shall be performed with the combination of shorter length for that voltage range.

No correction factor due to climatic conditions shall be applied to test voltages.

5.2.2 Leakage current test

In the case of a multiple section stick with different section compositions, the test shall be carried out for all the compositions and at the maximum nominal voltage that the concerned composition allows.

The test voltage shall be 1,2 U_r for a stick having a nominal voltage lower than or equal to 123 kV.

The test voltage shall be 1,2 U_r / √3 but shall be greater than 148 kV (≈ 1,2 times 123 kV) for a stick having a nominal voltage higher than 123 kV.

This test shall be performed between the limit mark and the hand guard.

Two conductive band electrodes, having a width as proposed in Table 3, shall be placed in the insulating part of the stick surrounding the tube, one adjacent to the hand guard and the other adjacent to the limit mark.

Both band electrodes shall be shielded by concentric rings having the dimensions suggested in Table 3. The rings shall be electrically connected to the band electrodes (see Figure 3).

The test voltage shall be applied for 1 min. The test shall be considered as passed if the leakage current never exceeds 50 µA.

Table 3 - Dimensions for the concentric rings and band electrodes

Nominal voltage U_n	**Width of band electrodes**	**Concentric rings**	
		Outside diameter	**Cross-section diameter**
kV	mm	mm	mm
$U_n \leq 245$	20	200	30
$U_n > 245$	40	600	160

5.2.3 Bridging test

This test shall be performed only on sticks that can be used with nominal voltages equal or lower than to 52 kV.

For the test, two bars shall be used according Figure 4a.

The distance d1 between bars shall be adjusted according to Table 4. The distance d_2 (Figure 4a) shall be calculated as follows:

$$d_2=A_i+d_1+200 \text{ (all dimensions are in mm)}$$

where A_i is the distance between the head and the limit mark (Figure 1).

The test voltage shall be applied to the bars as indicated in Figure 4b.

Table 4 – Distances d_1 between V-bars for the bridging test set-up

U_n kV	d_1 Distance between iron bars mm
$U_n \leq 7{,}2$	50
$7{,}2 < U_n \leq 12$	60
$12 < U_n \leq 17{,}5$	85
$17{,}5 < U_n \leq 24$	115
$24 < U_n \leq 36$	180
$36 < U_n \leq 52$	240

The test voltage shall be 1,2 U_r.

For a stick with a range of nominal voltages, the test shall be performed at the higher and lower nominal voltages. If the highest voltage is higher than 52 kV, the test shall be performed at 52 kV.

5.2.3.1 Surface stress test

The head of the stick shall be placed on bar A at the narrow point d_1 and the insulating part shall be laid on bar B (Figure 4c). The stick still staying at the narrow point, is then pushed forward toward bar A until the limit mark plus 200 mm reaches bar B.

The test shall be considered as passed if no flashover or breakdown occurs.

5.2.3.2 Radial and surface stress test

The head of the stick shall be placed on bar A at the narrow point d_1 and the insulating part shall be laid on bar B. The stick is then rolled along the bars until the limit mark plus 200 mm reaches bar B, while the head remains always in contact with bar A.

The test shall be considered as passed if no flashover or breakdown occurs.

5.2.4 Water penetration test

The test is carried out on the insulating element of a stick which has undergone the mechanical tests.

The complete stick in one piece, or disassembled if it is composed of several sections, is immersed for 24 h in water having a resistivity of $(100 \pm 15)\ \Omega$.m measured at 20 ºC and then removed from the water bath, assembled if necessary and wiped carefully dry prior to the voltage test.

In less than 30 min after removal from the water bath, the leakage current test shall be performed according 5.2.2.

The test shall be considered as passed if the leakage current never exceeds 50 µA.

5.3 Mechanical verifications and tests

5.3.1 Visual verification

The stick shall be visually checked for compliance with 4.1. Verifications shall include

- the good condition of the insulating part of the stick, the couplings, the head, the limit mark, the handle, the hand guard and the cap,
- the correct assembly of the different sections,
- the fixing of the hand guard,
- the contrast colour of limit mark and the hand guard.

The test shall be considered as passed if all the requirements are fulfilled.

5.3.2 Dimensions

For the dimensions, a tolerance of ± 2 mm shall be admitted unless otherwise stated.

The stick dimensions shall be measured for compliance with 4.2 as indicated below:

- total length of the stick (tolerance ± 1 %) (L_T, see Figure 1);
- length of the sections (± 1 %);
- length of the handle (L_E, see Figure 1);
- perimeter of the handle;
- width of the limit mark;
- dimensions of the hand guard;
- minimum length between the limit mark and the hand guard (L_D, see Figure 1);
- length of the insulating element (L_A, see Figure 1).

The test shall be considered as passed if all the dimensions are within the required limits.

5.3.3 Head verification

The dimensions of the head affecting the coupling of the tool shall be verified.

This verification shall be performed measuring the head or alternatively using a suitable test tool. For recommended type heads, see test tools in Annex D.

The test shall be considered as passed if the measured values are within the required limits or the test of fitting and removal of tools attached to the head is passed (see 5.4.4).

5.3.4 Insulating tube verification

The insulating tube shall be visually verified for compliance with the requirements indicated in 4.1 and 4.2.2.

5.3.5 Marking verification

The complete marking pointed out in 4.5 shall be checked.

5.4 Mechanical tests

5.4.1 Bending test

This test shall be performed for sticks with a total length greater than or equal to 2 m. For a multiple section stick, the test shall be performed for the longest combination of sections.

For this test the bottom part of the stick handle is fixed to a swivelling support at a point as close as possible to the cap. At a defined distance of this point the handle is freely laid on a semi-cylindrical support. If the hand guard interferes with this support, it can be removed.

The semi-cylindrical support shall be provided with a groove, covered with neoprene or similar material with a degree of hardness of 40 IRHD to 50 IRHD (International Rubber Hardness Degree) according to ISO 48 and a thickness of 6 mm.

The dimensions and arrangement of the supports are given in Figure 5.

The stick shall be locked in the swivelling support. Then a bending force of 50 N for sticks of up to 3 m, or 100 N for sticks longer than 3 m, shall be applied progressively to the head and the deflection measured after 30 s.

The test shall be considered as passed if the deflection (δ) does not exceed the value on Table 5 (see Annex F).

The maximum deflection values are suitable for sticks with a maximum length of 6 m. For longer sticks other maximum deflection values should be defined. Deflection calculation method in Annex F can be used for that.

Table 5 – Maximum deflection

Total length (m)	**2**	**2,5**	**3**	**3,5**	**4**	**4,5**	**5**	**5,5**	**6**
Maximum deflection δ (mm)	90	200	240	420	700	1 080	1 600	2 250	3 070

Immediately after the measurement of the deflection, the bending force shall be increased to 75 N for sticks up to 3 m and to 150 N for sticks longer than 3 m. The bending force shall be maintained for 30 s.

The test shall be considered as passed if the stick shows no signs of breakdown or mechanical damage.

5.4.2 Torsion test

The stick shall be rigidly clamped by the handle close to the hand guard. A torque of T (Nm), shall be applied around the axis of the stick with the help of a test tool (see Annex D) appropriate to the type of head, as specified in Figure 6.

T (Nm) = tube Ø (measured in mm)

For tubes with Ø > 39 mm, 40 Nm shall be applied.

For a multiple section stick, the test shall be performed for the longest combination.

The torque shall be applied with a rate of rise of 5 Nm/s.

The stick shall not be exposed to bending forces during the test.

The torque shall be applied in one direction for 1 min and then in the inverse direction for 1 min. The torsion angle in each direction shall be measured.

The test shall be considered as passed if the sum of the absolute values of the angles measured in both directions does not exceed 25°/m of the total length of the stick.

Then the torque shall be increased up to 1,2 *T* (Nm) for both directions and maintained for 30 s.

The test shall be considered as passed if the stick shows no signs of mechanical damage or lasting deformation.

5.4.3 Pulling test

With the stick supported on a flat surface or on one or several intermediate supports, the handle shall be rigidly held with a knot whose edge is 50 mm from the hand guard and a pulling force is progressively applied on the head by means of a test tool appropriate to the type of head (see Annex D). The applied force shall reach 1 500 N and be maintained for 1 min.

The force shall be applied with a rate of rise of 10 N/s.

For a multiple section stick, the test shall be performed for the longest combination.

The test shall be considered as passed if all the elements of the stick show no signs of loosening or mechanical damage.

5.4.4 Test of fitting and removal of tools attached to the head

This test shall be performed for stick heads that permit automatic disengagement of the tool.

The head section of the stick shall be rigidly fixed to the proximity of the head. A test tool appropriate to the type of head (see Annex D) shall be introduced inside the head up to the point where the connection takes place. The push force value shall be measured.

In the Bayonet type head, this point shall be the one that allows the rod rotation and establishes the connection.

The test shall be considered as passed if the value of the measured force is neither higher than 12 N nor lower than 7 N for a Hexagonal type head or 50 N and 40 N respectively for a Bayonet type head.

5.4.5 Drop resistance

For a multiple section stick, the test shall be performed for the longest combination.

This test shall be performed in accordance with EN 60068-2-32, procedure 1, with the following parameters:

- the test surface shall be concrete or steel;
- the test surface shall be smooth, hard and rigid;
- the stick shall be dropped from a diagonal static position, a horizontal position and a vertical rest position;
- the height of fall shall be 1 m, both for vertical and horizontal position;
- in the vertical position the head shall point down;
- for diagonal position the height of the fall shall be 1 m plus 20 % of the overall length of the stick. The height shall be measured between the end of the head and the floor, maintaining the cap on the floor;
- the number of falls shall be one per position.

The test shall be considered as passed if the stick does not show signs of mechanical damage and the head maintains its function.

5.4.6 Shock resistance on couplings

The test is designed to check the sturdiness of couplings. The method of testing shall be in agreement with EN 60068-2-75. The temperature shall be –25 ºC and the energy 5 J.

The test shall be performed on three test samples of 1 m length with the coupling in the middle, taken from each stick.

The test shall begin within 2 min after removal from the climatic chamber and shall be performed continuously.

The most fragile part of the coupling shall be submitted to shock five times. The same location shall be subjected to shock only once.

The test shall be considered as passed if the coupling shows no signs of mechanical damage and the connection is still working properly.

5.4.7 Durability of the marking

The durability of the marking shall be verified by thoroughly cleaning the marking for at least 1 min with a piece of lint-free cloth soaked with water and then rubbing it vigorously for a further 1 min minimum with a piece of lint-free cloth soaked with isopropanol (CH_3-CH(OH)-CH_3).

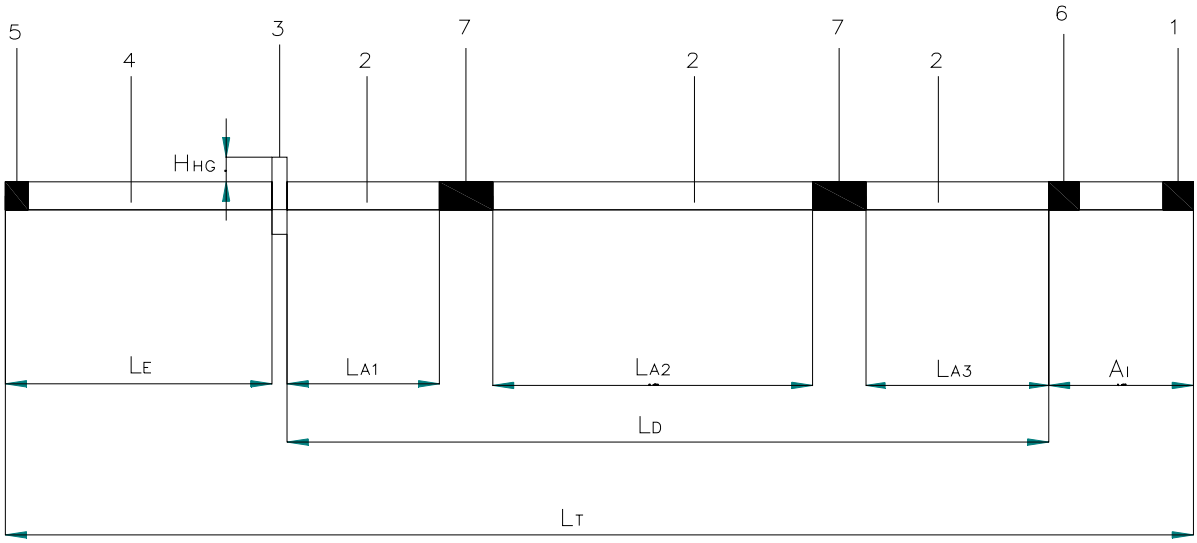
The test shall be considered as passed if the marking remains legible and the letters do not smear.

The surface of the tool may change. No signs of loosening shall be present for labels.

NOTE Marking made by moulding or engraving need not be subjected to this test.

6 Classification of defects

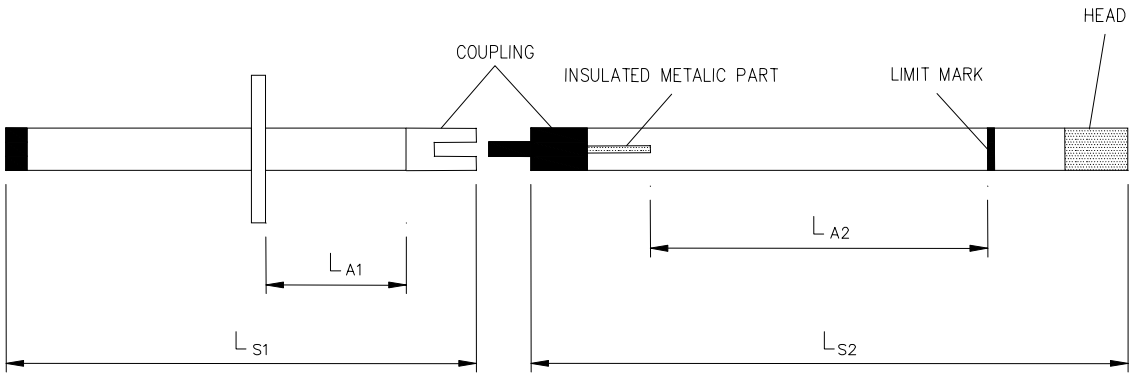
Annex H provides information related to the classification of defects and the routine tests.



Key

1	head	5	cap	L_T	total length
2	insulating element	6	limit mark	L_E	handle length
3	hand guard	7	section couplings	L_D	safety distance
4	handle			A_I	insertion depth
				$L_A = L_{A1} + L_{A2} + L_{A3}$	insulating element length
				H_{HG}	guard height of hand guard

Figure 1 – Insulating stick with three sections (see Clause 3)



Key

L_{S1} length section 1

L_{S2} length section 2

L_{A1} length of insulating element section 1

L_{A2} length of insulating element section 2

$L_A = L_{A1} + L_{A2}$ insulating element length

$L_T = L_{S1} + L_{S2}$ total length

Figure 2 – Length of sections (see 4.2.1 and 4.2.2)

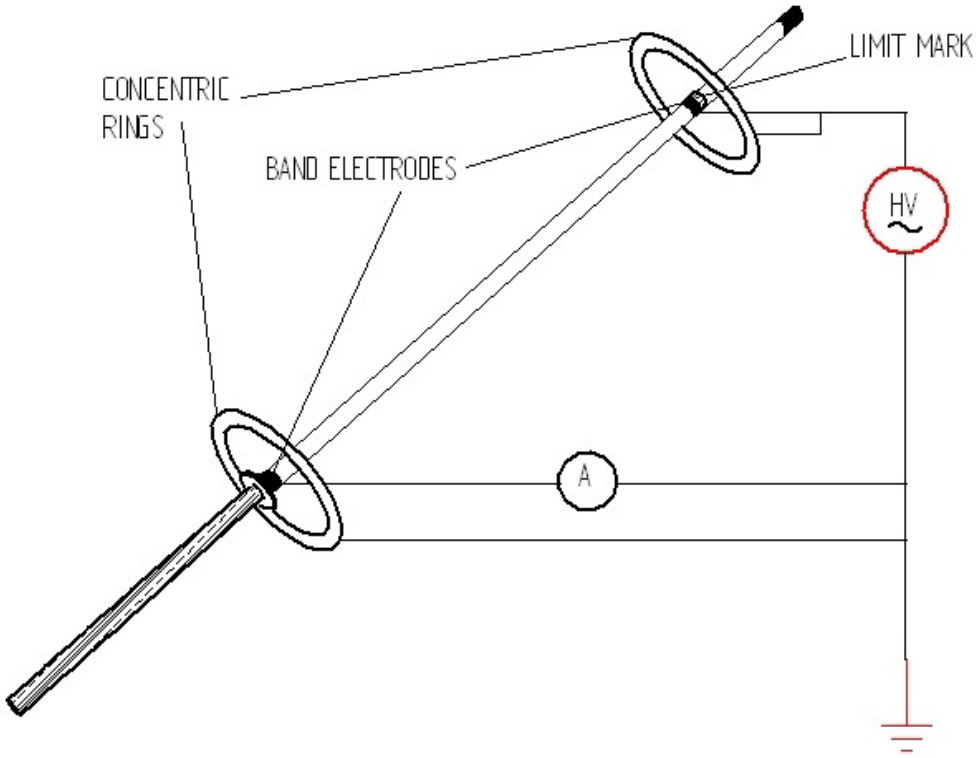
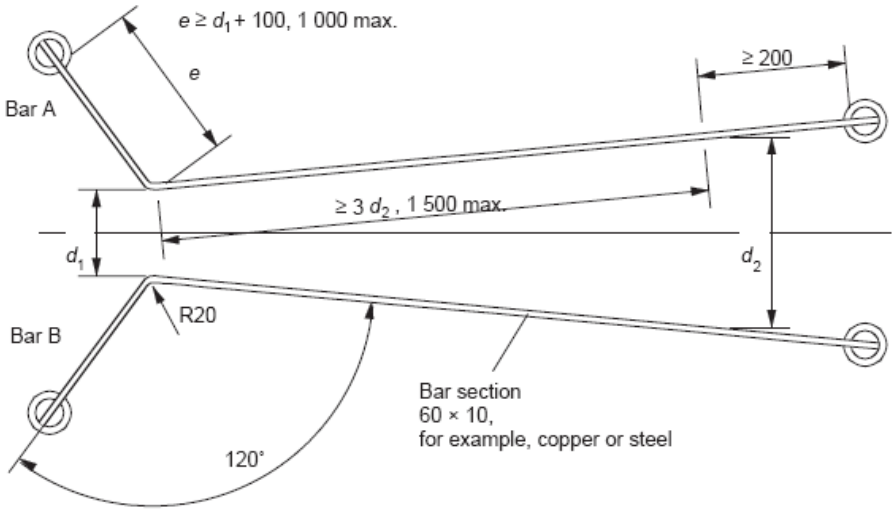


Figure 3 – Leakage current test (see 5.2.2)



Dimensions in millimetres

Figure 4a – Bridging test – Test arrangement and dimensions of the bars (see 5.2.3)

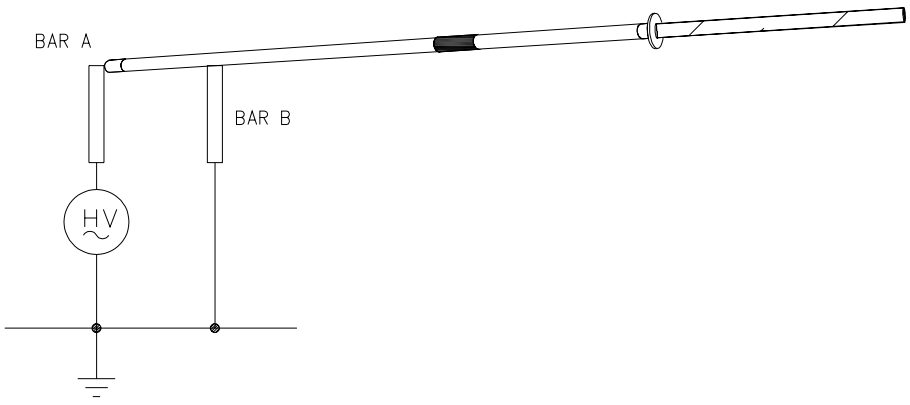


Figure 4b – Bridging test – Connection of the shape bars (see 5.2.3)

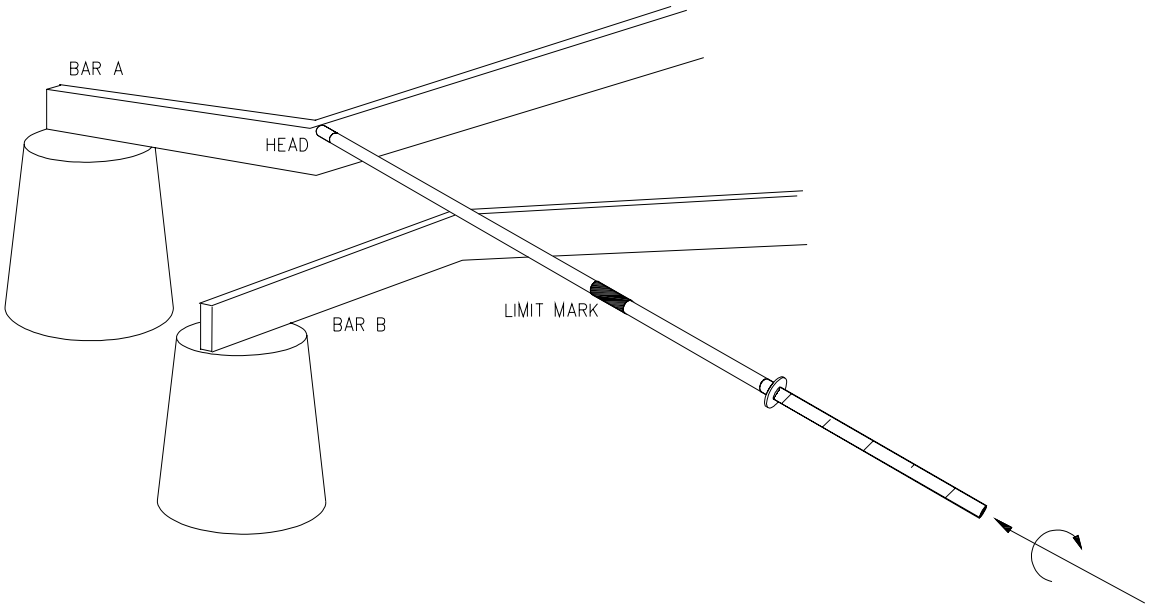
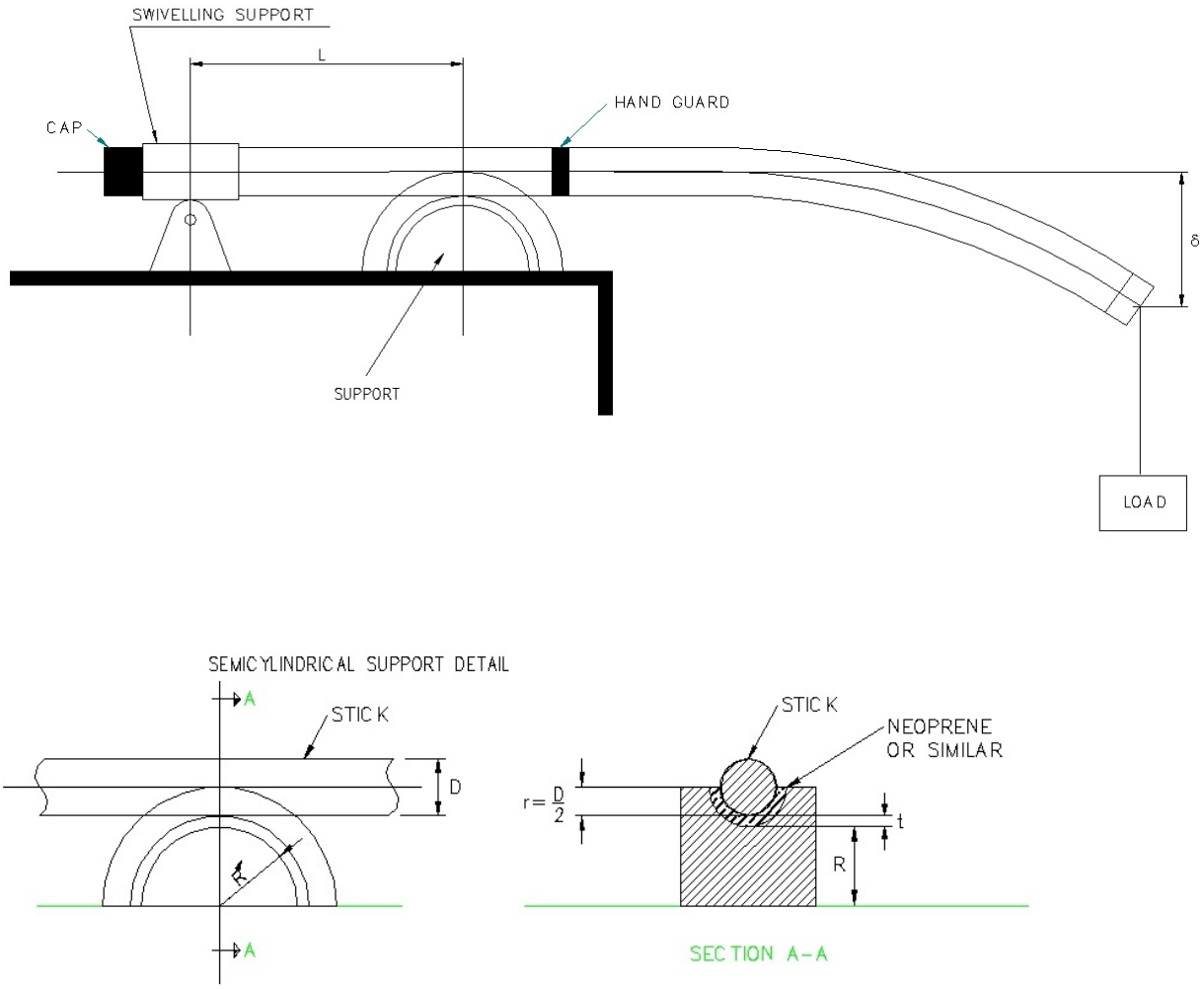


Figure 4c – Bridging test – Initial stick position (see 5.2.3.1 and 5.2.3.2)



Key

δ deflection

t thickness of neoprene = 6 mm

L distance between supports:
1 000 mm for stick length > 3 000 mm;
500 mm for stick length ≤ 3 000 mm

D diameter of the test stick

R internal radius of support = 100 mm

r radius of groove = D/2

Figure 5 – Assembly for bending test (see 5.4.1)

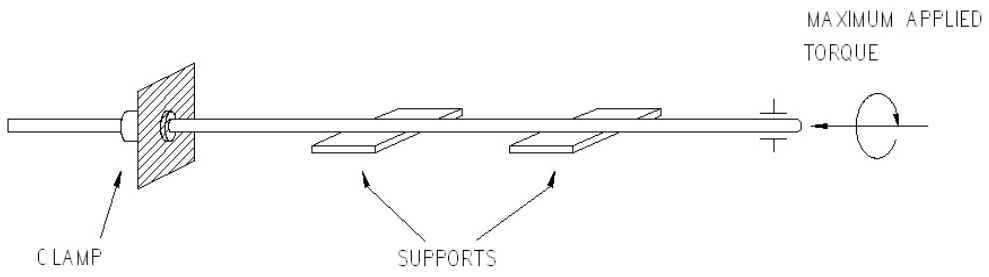


Figure 6 – Assembly for torsion test (see 5.4.2)

Annex A
(normative)

Instructions for use

Operating instructions containing all the necessary information for the use and care of the stick shall be supplied with every unit.

These instructions shall include, where applicable, the following as a minimum:

- notes about the storage position, the temperature and the protection of the item;
- transport instructions;
- explanation of the labels;
- explanation of the limit mark and the hand guard;
- instructions for assembly in the case of a multiple section stick;
- instruction about the nominal voltage of the stick and the limits of the installation where it can be used;
- notes about the possible use of accessories;
- statement about visual inspection before use;
- instructions for use below 0 ºC;
- instructions for use outdoors;
- instructions for use in rain;
- note about the possible use of other protective measures;
- note about the substitution of the stick sections for others of the same code;
- note about the use of the stick in direct current installations;
- instructions for periodic maintenance (see Annex I).

Annex B
(informative)

Wet test

B.1 General

The insulating sticks have to be used not only indoors but also outdoors. In this case the user may have to perform his job under adverse atmospheric conditions: high humidity, storm, and rain.

It is not advisable to use the sticks in continuous rain, but if necessary an additional test can be performed to check that under wet conditions the required safety level for the user is maintained. Moreover, the user can be provided with additional safety elements such as insulating ladders or baskets that can help to increase the insulation.

The user should read the instructions for use and take note of the applicable limitations and recommendations in rain.

B.2 Recommended wet test

This test should be performed only on the upper part of the insulated element of the stick.

Sticks with several elements should be mounted until they reach the necessary length.

Two band electrodes, made with three or four turns of aluminium tie wire 3 mm to 4 mm in diameter, should be used for the test. Both band electrodes should be placed on the insulating element, the first one near the limit mark and the second one 1 m apart (see Figure B.1).

If a coupling between sections affects the position of a band electrode, these will be moved slightly to change the position maintaining the distance between them.

If the length of the insulating element is less than 1,1 m the second band electrode should be placed at the end of the insulating element, close to the hand guard.

The stick can be cut if necessary 20 cm before and after the band electrodes, closing the holes carefully on both ends.

Before the electrical tests, each section should be cleaned with isopropanol (CH_3-CH(OH)-CH_3) and then dried in air for 15 min.

The tests should be conducted in accordance with the revised test procedure described in HD 588.1 S1 with the following exception: the elements should not be wetted before voltage application. The average precipitation rate should be: 1,0 mm/min to 2 mm/min and the resistivity of collected water should be (100 ± 15) Ω.m, corrected to 20 °C. The test location should be at the standard atmospheric conditions of IEC 60212 and the water temperature should be within the same limits as the ambient temperature, i.e. 18 °C to 28 °C.

The stick piece should be aligned at an angle of inclination of 45° ± 5° to the vertical line. The precipitation on the test section covering the complete insulating length should be as uniform as possible.

The second band electrode should be connected to the earth. The first band electrode should be connected to the test voltage.

Contrary to the requirements of the above mentioned publication the elements should not be pre-wet before voltage application.

A voltage of 100 kV rms at industrial frequency should be applied between the electrodes, for a period of one hour. Precipitation and voltage should be applied at the same time.

The test voltage should be 1,2 U_r for a stick having an insulating element less than 1,1 m.

The test should be considered as passed if

- no flashover, no sparkover or puncture occurs during the test,
- no visual sign of tracking or erosion on the surface is found,
- no temperature rise higher than 20 ºC is measured immediately after the test.

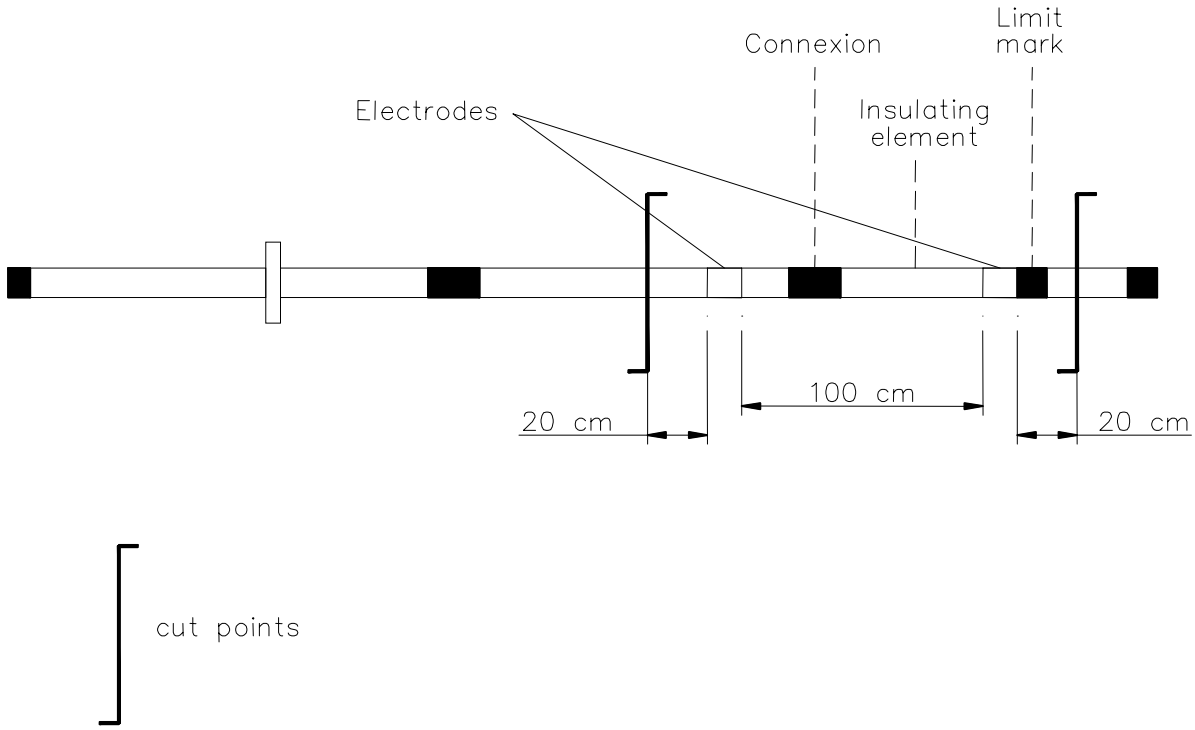


Figure B.1 – Arrangement of electrodes

Annex C
(informative)

Recommended sticks

The length of the stick depends on the lengths of the different parts of the stick. The length of the stick should be long enough to allow the installation to be reached and the insulating part should be in accordance with 4.4.3. The length of the handle should permit a comfortable use of the stick considering the weight of the attached device on the top. The diameter is related to the weight of the complete stick and the sturdiness of the tool.

Table C.1 gives the dimensions of the different parts for recommended sticks with different lengths taking into account the factors mentioned above.

Table C.1 – Dimensions of recommended sticks

Total length	**Minimum length of the handle**	**Maximum nominal voltage**	**Diameter**
m	mm	kV	mm
1	300	15	32
1,5	500	30	32
2	800	45	32
2,5	800	66	32
3	800	132	32
3,5	1 100	132	39
4	1 100	220	39
4,5	1 100	220	39
5	1 100	380	39
6	1 100	380	39

Annex D
(informative)

Test tools for recommended heads

This annex includes tests tools for recommended types of head. The figures correspond to the test tools and not to the head itself. Other types of head can be accepted subject to prior agreement between customer and manufacturer.

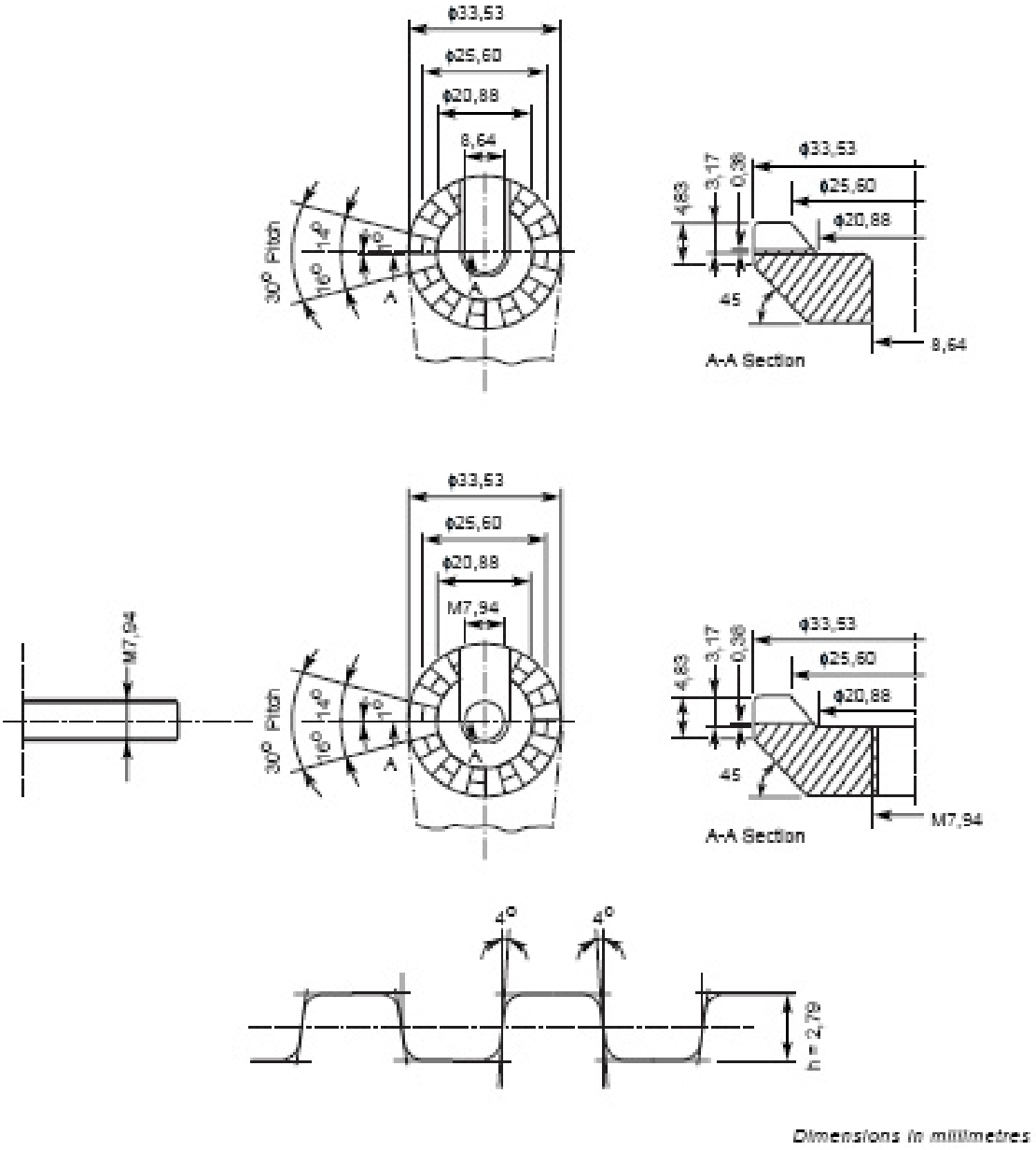
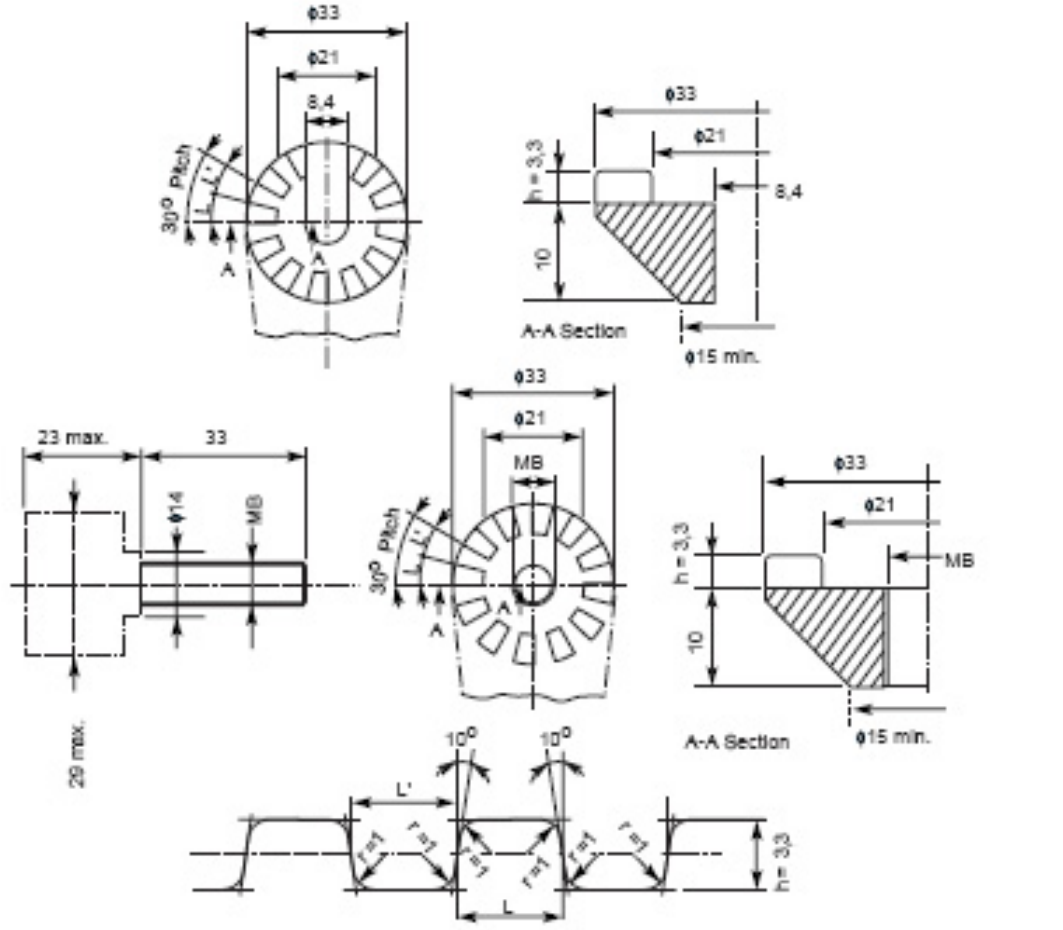


Figure D.1 – Test tool for universal type head – First example



Dimensions in millimetres

General tolerances Castings : ± 0,2
Matrix parts : ± 0,1
unless otherwise stated

L dent / Ø 33 = 4,22 + 0,2 – 0
L' hollow / Ø 33 = 4,42 – 0,2 + 0

L dent / Ø 21 = 2,65 + 0,2 – 0
L' hollow / Ø 21 = 2,85 – 0,2 + 0

Figure D.2 – Test tool for universal type head – Second example

Dimensions in mm

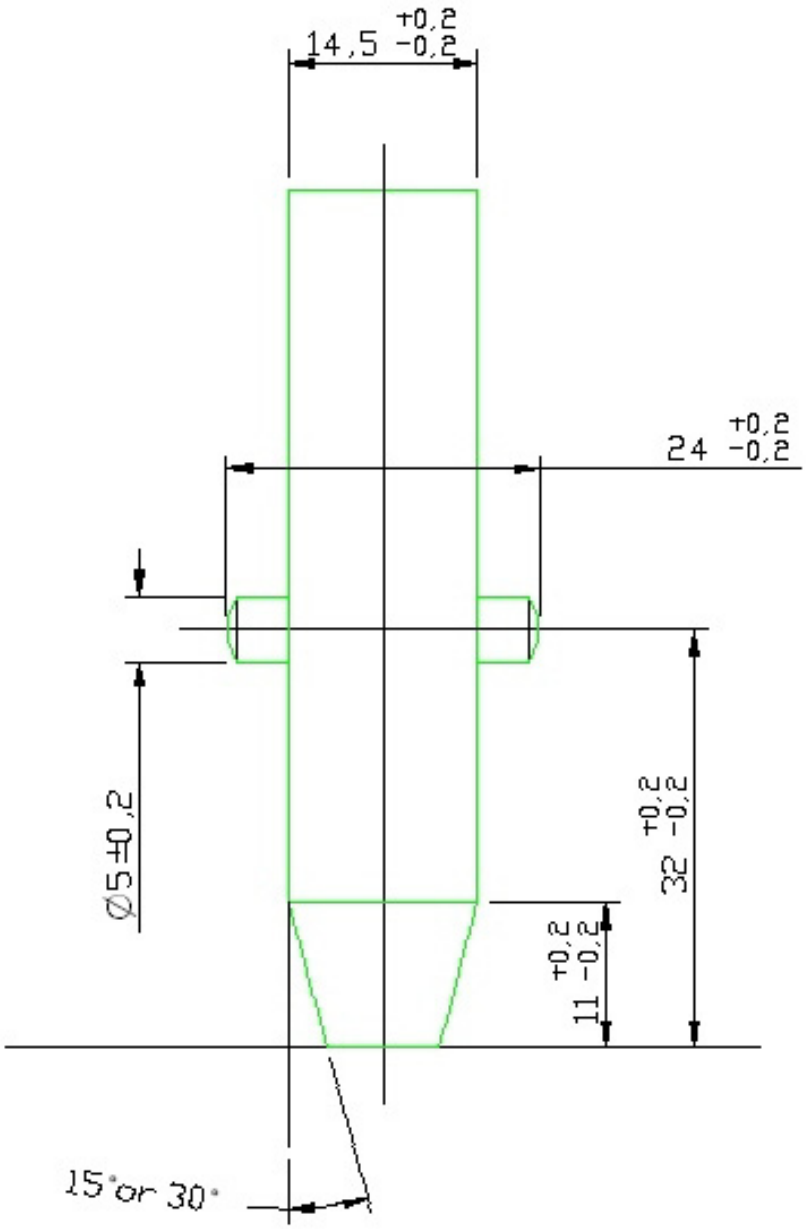


Figure D.3 – Test tool for Bayonet type head

Dimensions in mm

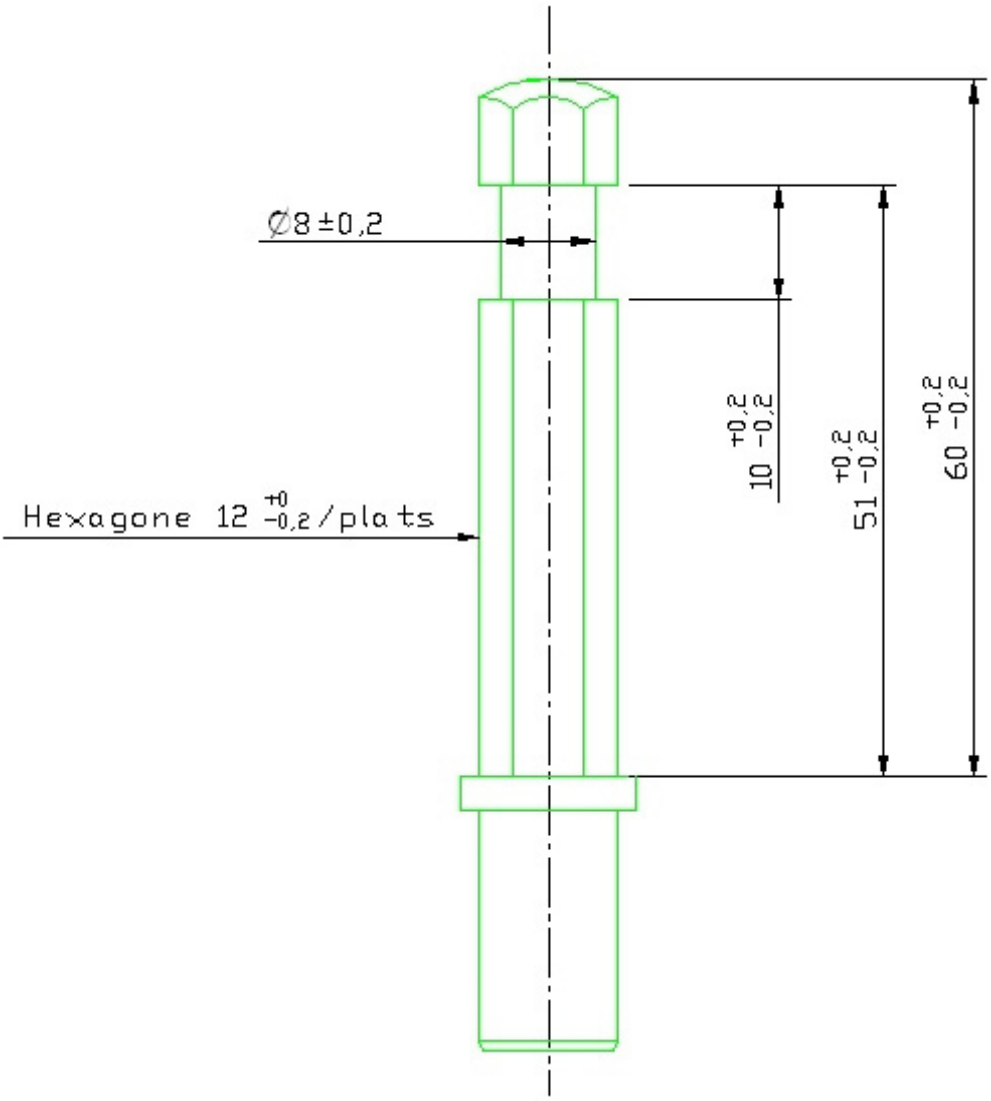


Figure D.4 – Test tool for hexagonal 12 type head

Annex E
(normative)

Marking: Information on the labels

E.1 Label in each section except handle section

EN 50508

Manufacturer _____

Serial number _____

Month and year of manufacturing _____

Section identification _____

Stick reference [a] _____

[a] Optional.

E.2 Label in the handle section or in one piece stick

EN 50508

Manufacturer _____

Serial number _____

Month and year of manufacturing _____

Section identification [a] _____

Stick reference [b] _____

Nominal voltages of use	Stick composition
_____ kV	_____
_____ kV	_____
_____ kV	_____

[a] Not necessary for one piece stick.

[b] Optional.

Annex F
(informative)

Bending calculation

The stick deflection should be based on the assumption that the stick is a beam fixed at one end by the swelling support and laid on the semi-cylindrical support. The stick is subjected to two forces, its own weight and a load applied to the head of the stick.

The deflection (δ) should be calculated using the following formula:

$$\delta = PL(L-l)2/3EI_z + Q(L-l)(3(L-l)3 + 4l(L-l)2 - l3)/24EI_z$$

where

L = length of the stick;

l = distance between supports;

Q = weight of the stick per length;

D_o = outside diameter of the tube;

D_i = inside diameter of the tube;

E = elasticity module;

I_z = 3,14(D_o4-D_i4)/64.

Only sticks longer than 2 m are considered.

Two types of tubes are used according to recommended sticks on Annex C. 32 mm is used for sticks between 2 000 mm and 3 000 mm, inclusive, and 39 mm for sticks between 3 500 mm and 6 000 mm, inclusive.

For these tubes E = 38 000 N/mm²

The force should be 50 N when tube of 32 mm is used and 100 N when 39 mm is used.

The distance between supports should be 500 mm for sticks no longer than 3 000 mm and 1 000 mm for sticks longer than 3 000 mm.

Table F.1 - Tube values

Ø Outside (D_o) mm	**Ø Inside (D_i)** mm	**Weight (Q)** N/mm	I_z mm^4	EI_z N.m^2
32	26,2	0,005 30	28 328	1 076,45
39	32,4	0,007 80	59 437	2 258,59

Table F.2 - Arrangement

Sticks length (L) mm	**Ø tube (D_0)** mm	**Distance between supports (l)** mm	**Force (P)** N
$L \leq 2\,500$	32	500	50
$2\,500 < L \leq 3\,000$	32	1 000	50
$6\,000 \geq L > 3\,000$	39	1 000	100

Figure I.1 shows the result of the calculation. Table 5 has been calculated increasing the values by approximately 20 % and rounding off.

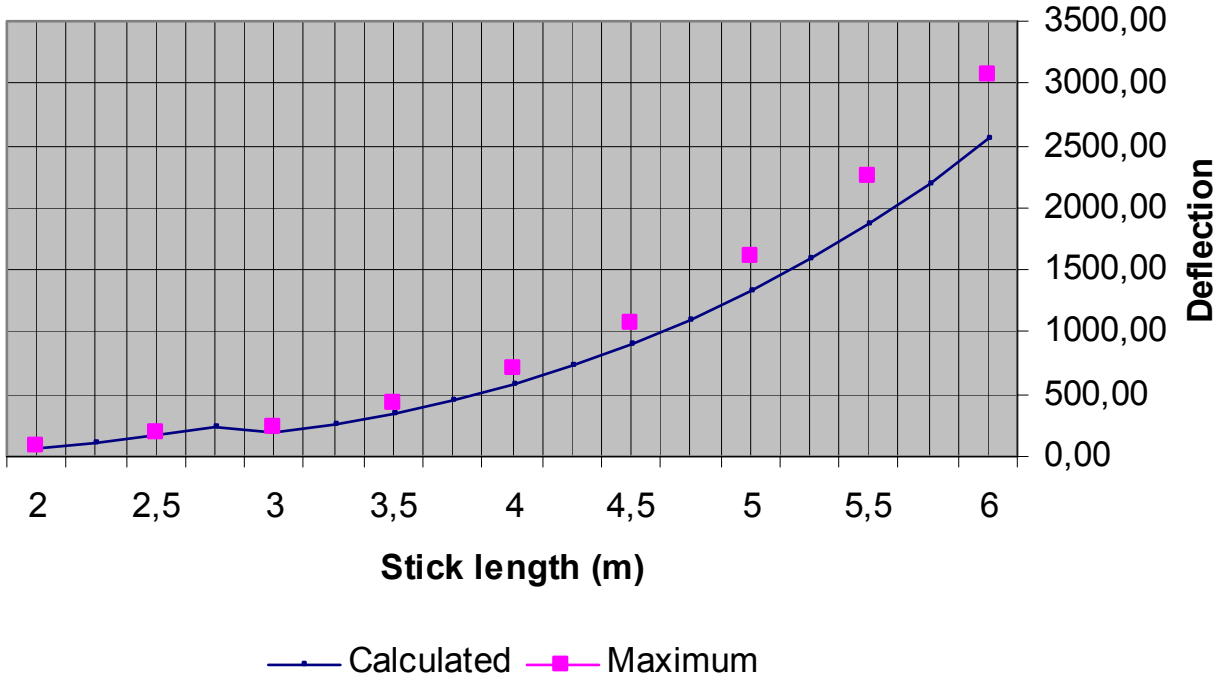


Figure I.1 - Deflection calculated versus maximum deflection (see Table 5)

Annex G
(normative)

Test sequence

Table G.1 – Sequential order for performing tests

Requirement	Test Subclause	Test description	Tests sequence
4.1	5.3.1	Visual verification	1
4.2	5.3.2	Dimensions	2
4.2.9	5.3.3	Head verification	3
4.3.1	5.4.4	Fitting and removal of tools in the head	4
4.1 and 4.2.2	5.3.4	Insulating tube verification	5
4.4.1	5.2.3	Bridging test	6
4.5	5.3.5	Marking verification	7
4.4.2	5.2.2.1	Leakage current	8
4.3.1	5.4.3	Pulling test	9
4.3.2	5.4.1	Bending test	10
4.3.5	5.4.2	Torsion test	11
4.3.4	5.4.5	Drop resistance	12
4.3.3	5.4.6	Shock resistance on couplings	13
4.5	5.4.7	Durability of marking	14
4.4.2	5.2.4	Water penetration	15

Annex H
(informative)

Classification of defects

Table H.1 – Classification of defects and associated requirements and routine tests

Requirements	Description	Type of defects			Tests
		Minor	Major	Critical	
4.4.2	Dry leakage current			X	5.2.2.1
4.1	Visual verification	X			5.3.1
4.2.9	Head verification		X		5.3.3
4.1 and 4.2.2	Insulating tube verification			X	5.3.4
4.5	Marking verification		X		5.3.5
4.5	Durability of marking	X			5.4.7

Annex I
(informative)

Periodic maintenance test

I.1 General

Maintenance on live equipment in service is recognised as a basis for insuring their good functioning and the safety of the user. It is the responsibility of the user to elaborate the maintenance schedule, taking into account the use conditions (storage, regular care, training of the user, etc.). However no stick, even those held in storage, should be used unless re-testing within a maximum period of 6 years.

It is recommended that the maintenance be done by the manufacturer or at an agreed trained repair facility.

In any time, when a stick is to be used, a visual inspection should be done. If there is a serious doubt that the device is not in a good condition, it should be discarded for testing, then returned to the manufacturer for repair or rejection.

I.2 Testing

Table I.1 lists the tests which permit to verify the physical integrity, the functioning of the stick and its insulation performance.

Table I.1 – In-service testing

Test Subclause	Test description
5.3.1	Visual and dimensional inspection
5.2.2	Leakage current test [a]
5.2.3	Bridging test
[a] When the test is performed as a periodic testing, the maximum admissible leakage current shall be 200 µA.	

NOTE 1 Test arrangements according this standard can be modified if they provide the same results related to safety.

NOTE 2 According to the design of the stick and its fabrication process the manufacturer may specify additional tests.

Bibliography

EN 50110-1	2004	Operation of electrical installations
EN 50110-2	1996	Operation of electrical installations (national annexes)
EN 60071-1	2006	Insulation co-ordination – Part 1: Definitions, principles and rules (IEC 60071-1:2006)
EN 60832	1996	Insulating poles (insulating sticks) and universal tool attachments (fittings) for live working (IEC 60832:1988, mod.)
EN 61230		Live working - Portable equipment for earthing or earthing and short-circuiting (IEC 61230)
EN 61243-1		Live working - Voltage detectors – Part 1: Capacitive type to be used for voltages exceeding 1 kV a.c. (IEC 61243-1, mod.)
EN 61243-2		Live working - Voltage detectors – Part 2: Resistive type to be used for voltages of 1 kV to 36 kV a.c. (IEC 61243-2, mod.)
EN 61318		Live working - Conformity assessment applicable to tools, devices and equipment (IEC 61318)
EN 62193		Live working - Telescopic sticks and telescopic measuring sticks (IEC 62193)
HD 637 S1	1999	Power installations exceeding 1 kV a.c.
IEC 60050-151	2001	International Electrotechnical Vocabulary (IEV) - Part 151: Electrical and magnetic devices
IEC 60050-601	1985	International Electrotechnical Vocabulary (IEV) - Chapter 601: Generation, transmission and distribution of electricity - General
IEC 60212	1971	Standard conditions for use prior to and during the testing of solid electrical insulating materials
IEC 60694 [1)]	2007	Common specifications for high-voltage switchgear and controlgear standards

1) Superseded by IEC 62271-1:2007, which is harmonized as EN 62271-1:2008.

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