BRITISH STANDARD

BS EN 60900:2004

Live working — Hand tools for use up to 1 000 V a.c. and 1 500 V d.c.

The European Standard EN 60900:2004 has the status of a British Standard

ICS 13.260; 29.240.20; 29.260.99

British Standards

National foreword

This British Standard is the official English language version of EN 60900:2004. It is identical with IEC 60900:2004. It supersedes BS EN 60900:1994 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/78, Tools for live working, 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 committee can be obtained on request to its secretary.

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Summary of pages

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EUROPEAN STANDARD **EN 60900**

NORME EUROPÉENNE

EUROPÄISCHE NORM May 2004

ICS 29.260.99; 13.260; 29.240.20 Supersedes EN 60900:1993 + A1:1995 + A11:1997 + A2:2002

English version

Live working – Hand tools for use up to 1 000 V a.c. and 1 500 V d.c.
(IEC 60900:2004)

Travaux sous tension – Outils à main pour usage jusqu'à 1 000 V en courant alternatif et 1 500 V en courant continu (CEI 60900:2004)

Arbeiten unter Spannung - Handwerkzeuge zum Gebrauch bis AC 1 000 V und DC 1 500 V (IEC 60900:2004)

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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

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Foreword

The text of document 78/547/FDIS, future edition 2 of IEC 60900, prepared by IEC TC 78, Live working, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60900 on 2004-03-16.

This European Standard supersedes EN 60900:1993 + A1:1995 + A11:1997 + A2:2002.

This new EN 60900

– adds requirements concerning interchangeable tools, where the used components are from different manufacturers;

– adds requirements and test values concerning insulating tools;

– includes bit-screwdrivers;

– includes screwdrivers with screw retaining devices;

– enlarges conditioning and test possibilities of the dielectric test;

– clarifies questions concerning quality assurance and

– includes the number of the standard with the year of publication (four digits) into the marking requirements.

The following dates were 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) 2005-01-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2007-04-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60900:2004 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60743	NOTE	Harmonized as EN 60743:2001 (not modified).
ISO 9001	NOTE	Harmonized as EN ISO 9001:2001 (not modified).

Contents

INTRODUCTION

This International Standard has been prepared in accordance with the requirements of IEC 61477 where applicable.

LIVE WORKING – HAND TOOLS FOR USE UP TO 1 000 V AC AND 1 500 V DC

1 Scope

This International Standard is applicable to insulated and insulating hand tools used for working live or close to live parts at nominal voltages up to 1 000 V a.c. and 1 500 V d.c.

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.

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

IEC 60212:1971, *Standard conditions for use prior to and during the testing of solid electrical insulating materials*

IEC 60417-DB:2002[1], *Graphical symbol for use on equipment*

IEC 61318:2003 *Live working – Quality assurance plans applicable to tools, devices and equipments*

IEC 61477:2001, *Live working – Minimum requirements for the utilization of tools, devices and equipment*
Amendment 1 (2002)[2]

ISO 1174-1:1996*, Assembly tools for screw and nuts – Driving squares – Part 1: Driving squares for hand socket tools*

ISO 9654:1989, *Pliers and nippers for electronics – Single-purpose nippers – Cutting nippers*

ISO 9655:1989, *Pliers and nippers for electronics – Single-purpose nippers – Pliers for gripping and manipulating*

ISO 9656:1989*, Pliers and nippers for electronics – Test methods*

ISO 9657:1989*, Pliers and nippers for electronics – General technical requirements*

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[1] "DB" refers to the IEC on-line database.

[2] There exists a consolidated edition 1.1 (2002) that includes edition 1 and its amendment.

3 Terms and definitions

For the purpose of this document, the following terms and definitions and those of IEC 61318 apply.

NOTE For the definitions of general terms in this document, reference should be made to IEC 60050 or to special definitions laid down in IEC 60743. Nomenclature of hand tools are found in the relevant ISO standards such as ISO 1703, ISO 5742 and ISO 8979.

3.1
hand tool (in live working)
insulated or insulating tool designed to be used with the insulating glove working method at low voltage

NOTE These tools are generally ordinary tools such as screwdrivers, pliers, wrenches or knives.

[IEV 651-01-27]

3.2
insulated hand tool
hand tool made of conductive materials, fully or partially covered by insulating materials

[Definition 2.3.1 of IEC 60743 and IEV 651-01-25, modified]

3.3
insulating hand tool
hand tool made totally or essentially from insulating materials except for inserts made from conductive materials used for reinforcement, but with no exposed conductive parts

[Definition 2.3.2 of IEC 60743 and IEV 651-01-26, modified]

4 Requirements

4.1 General requirements

4.1.1 Safety

Insulated hand tools shall be manufactured and dimensioned in such a way that they protect the user from electric shock and, when fully covered by insulating materials and used in the correct manner, minimize the risk of short-circuits between two parts at different potentials.

Insulating hand tools shall be manufactured and dimensioned in such a way that they protect the user from electric shock and they avoid short-circuits between two parts at different potentials when used in the correct manner.

4.1.2 Performance under load

The mechanical specifications for insulated hand tools shall comply with the corresponding ISO Standards, or, where no ISO standard exists, with a standard specified by the manufacturer or the customer, (for example a national standard). The mechanical specifications for the working parts of the tools shall be retained even after application of an insulating layer.

Insulating tools specially designed for live working may have lower stress resistance than insulated tools, but they shall withstand the expected work loads without failing due to remaining deformation or breaking. These tools can be equipped with devices, that limit the workloads that can be applied with them, for example by overload slipping clutches (see also Annex A).

4.1.3 Double-ended tools

Double-ended tools, such as box wrenches, keys for hexagonal socket screws, double-ended socket-wrenches, double-head open-end wrenches, etc., are not allowed for insulated tools but are allowed for insulating tools.

4.1.4 Marking

All markings shall be clearly identifiable by persons with normal or corrected sight without further magnification. Each tool and/or tool component shall be legibly and permanently marked with the following inscriptions:

- on the insulating material layer or on the metal part:
  - marking of the origin (manufacturer's name or trade mark);
- on the insulating material layer:
  - model/type reference;
  - year of manufacture (at least the last two digits of the year);
  - symbol IEC-60417-5216 (DB:2002-10) – Suitable for live working; double triangle, with indication 1 000 V (i.e. the electrical working limit for alternating current). The symbol shall be at least 3 mm high; the letter and the figures shall be at least 2 mm (see Figure 1);

    NOTE For the symbol, the exact ratio of the height of the figure to the base of the triangle is 1,43. For the purpose of convenience, this ratio can be between the values of 1,4 and 1,5.
  - number of the relevant IEC standard immediately adjacent to the symbol with year of publication (four digits), (IEC 60900:2004). Where there is a lack of space on the product itself, it is permissible to limit this marking to the number of the standard. In such a case, the complete marking including the year of publication shall appear with the smallest packaging for shipping;
  - for tools designed for use at extremely low temperature: letter "C" (see 4.2.2);
  - additional marking for tools capable of being assembled and designed to be interchangeable between different manufacturers (see Figure 2);
  - additional marking where specified by the customer (for example ownership mark).

The tools shall bear no voltage marking apart from those described above.

NOTE For example, the indication of test voltage may lead to the assumption that the tool is suitable for work at that voltage.

4.1.5 Separating of covers

If tools have conductive elements (for example: torque adjusting screws, operating direction switches, etc.) which are insulated with covers of insulating materials, these covers shall be well fastened, so that they don't come off during normal use (see 5.7.5).

4.1.6 Instructions for use

In the case of tools which require assembly or adjustment, the proper method shall be stated in the instructions for use, in accordance with the general provisions given in IEC 61477.

NOTE Other instructions, such as verification before use and test methods, should be given by the manufacturer or the user (see Annex B).

4.2 General requirements concerning insulating materials

4.2.1 Specifications concerning the insulating materials

The insulating material shall be selected according to the electrical, mechanical and thermal stresses to which it may be exposed during use. In addition, the insulating material shall have an adequate resistance to ageing and be flame retardant.

The insulating coating may consist of one or more layers. If two or more layers are adopted, contrasting colours may be used.

The design and construction of the handles shall provide a secure handhold and prevent unintentional hand slipping.

4.2.2 Thermal stability

The service ability of the tools shall not be impaired within the temperature range –20 °C to +70 °C.

The insulating material applied on tools shall adhere securely to the conductive part from –20 °C to +70 °C.

Tools intended for use at extremely low temperatures (down to –40 °C) shall be designated “Category C” and shall be designed for this purpose.

4.3 Additional requirements

4.3.1 Tools capable of being assembled

4.3.1.1 Retaining devices for tools capable of being assembled

Tools capable of being assembled shall have suitable retaining devices to prevent unintentional separation of the assembly. The retaining forces shall be tested according to 5.9.4.

4.3.1.2 Insulation design for tools capable of being assembled

In the case of connecting parts of tools capable of being assembled, the insulation shall be applied in such a manner that if any part becomes detached during use, no conductive part, which may still be live, can be inadvertently touched or cause a disruptive discharge.

4.3.1.3 Tools capable of being assembled with square drives

4.3.1.3.1 General

Tools capable of being assembled with square drives shall have square drives and square sockets in accordance with ISO 1174-1 (for separating forces, see 5.9.4.1). To ensure compatibility of insulation between different manufacturers, these tools shall be designed with overlapping elements described in Figure 3. Their dimensions and tolerances shall be in accordance with Table 1.

Table 1 – Dimensions and tolerances of the insulating overlapping element

Dimensions in millimetres

Nominal size	l_1 min.	l_2 $^{+2}_{0}$	l_3 $^{+0,5}_{-0,5}$	d_1 $^{0}_{-1,5}$	d_2 $^{+1,5}_{0}$	d_3 $^{0}_{-1,5}$	d_4 $^{+1,5}_{0}$
6,3	19	16	2	12,5	13	18	19
10	19	16	2	17,5	18	23	24
12,5	19	16	2	21,5	22	27	28
20	19	16	2	32	33	38	39
l_1, l_2, l_3, d_1, d_2, d_3 and d_4 are described in Figure 3.							

4.3.1.3.2 Interchangeability of components made by different manufacturers

Tools capable of being assembled and designed to be interchangeable between different manufacturers shall be specifically marked as such.

The marking symbol and the dimensions are given in Figure 2. The dimension H shall be greater than or equal to 5 mm.

There are considerable difficulties in developing a unified standard for the mechanical joining systems for components and tools from different manufacturers. For safety reasons, only mechanically locked retaining systems shall be used for this kind of tools.

Manufacturers shall include the following information in the instructions for use:

To assure that the complete assembly of insulated tool components from different manufacturers will withstand separating forces that are expected during the intended use, prior to the use of any assembly the user shall assure, by pulling by hand in a separating direction, that the retaining devices of all used elements are working efficiently and no component gets separated.

4.3.2 Screwdrivers

4.3.2.1 Uninsulated areas

For all screwdrivers, an uninsulated area having a maximum length of 18 mm is permissible on the working head (see Figure 4).

4.3.2.2 Shape of blade insulation

The blade insulation of screwdrivers shall be bonded to the handle. The outer diameter of the insulation, over a length of 30 mm, in area c of Figure 4, shall not exceed by more than 2 mm the width of the blade at the tip. This area may be parallel or tapered towards the tip.

This specification does not apply to insulated bit sockets (or insulated socket drivers).

4.3.2.3 Bit screwdrivers

Bit screwdrivers are regarded as tools capable of being assembled. They shall meet the relevant requirements. The outer diameter of the insulation may exceed the dimensions of 4.3.2.2.

4.3.2.4 Screwdrivers with screw retaining devices

If a screwdriver has a screw retaining device, the screwdriver itself shall meet the requirements of this standard. The outer diameter of the retaining device may exceed the dimensions of 4.3.2.2. The retaining device shall be made from insulating material.

4.3.3 Wrenches – uninsulated areas

The following uninsulated areas and lengths on the working head are permissible (see Figure 4):

- engineers' wrenches: the working surface;

  NOTE At the request of the customer, the uninsulated area may be extended to the working head.
- box wrenches, socket-wrenches, tee wrenches: the working surface and the contact area.

4.3.4 Pliers, strippers, cable scissors, cable-cutting tools

The handle insulation shall have a guard so that the hand is prevented from slipping towards the uncovered conductive parts of the head (see Figure 5 as an example).

The height of the guard shall be sufficient to prevent the slipping of the fingers towards the uncovered conductive parts during the work.

For pliers, the minimum dimensions of the guard shall be (see Figure 5a as an example):

- 10 mm on the left and on the right of the pliers held on a flat surface;
- 5 mm on the upper and lower part of the pliers held on a flat surface.

The minimum insulated distance between the inner edge of the guard and the non-insulated part shall be 12 mm (see Figure 5a, dimension d). The insulation portion in front of the guard shall extend as far as possible towards the working head.

In the case of a slip joint, a guard of 5 mm shall be provided for the inner part of the handles.

If the handles of the tools are longer than 400 mm, a guard is not required.

In case of insulated pliers and nippers for electronics, the dimensions of the guard shall be at least:

- 5 mm on left and right of the pliers held on a flat surface;
- 3 mm on the upper part and the lower part of the pliers held on a flat surface.

The minimum insulated distance between the inner edge of the guard and the non-insulated part shall be 12 mm. The insulation portion in front of the guard shall extend as far as possible towards the working head (see Figure 6).

Pliers and nippers for electronics shall be in accordance with ISO 9654, ISO 9655, ISO 9656 and ISO 9657.

For pliers, strippers, cable scissors and cable-cutting tools having an insulated shackle surrounding thumb and/or fingers on both handles, an additional guard is not required. The minimum insulated distance between the inner edge of the shackle and the non-insulated part shall be 12 mm. The insulation portion in front of the shackle shall extend as far as possible towards the working head.

4.3.5 Knives

The minimum length of the insulated handle shall be 100 mm.

The handle shall have a guard on the side towards the working head to prevent the slipping of the hand towards the conductive part during the work. The minimum height of the guard shall be 5 mm.

The minimum insulated distance between the inner edge of the guard and the non-insulated part shall be 12 mm (see Figure 5b, dimension d).

The uninsulated part of the knife blade shall be not longer than 65 mm (see Figure 5b, letter c).

4.3.6 Tweezers

The total length l shall be 130 mm minimum and 200 mm maximum. The length of the handles g shall be 80 mm minimum (see Figure 7).

Both handles of the tweezers shall have a guard towards the working head. The guard shall not be movable. Its height h and width b shall be sufficient (5 mm minimum) to prevent any slipping of the fingers during the work towards the uninsulated length u of the working head. On both handles, the insulated length e between the guard and the working head shall be 12 mm minimum and 35 mm maximum (see Figure 7).

The uninsulated length u of the working head shall not exceed a length of 20 mm (see Figure 7).

In the case of tweezers with a metallic working head, the metallic part shall have a minimum hardness of 35 HRC at least from the working head up to the handles.

Insulating tweezers shall not have exposed conductive parts.

5 Type tests

5.1 General

Compliance with the requirements of Clause 4 shall be verified by means of the following type tests.

The tests specified in 5.2 to 5.10 shall be carried out on at least three tools of the same design and in the sequence of the subclauses mentioned.

If there is any change in the design or manufacture of the tool since the last type test, the type test shall be repeated.

Should a tool fail any part of the type test, the type test shall be repeated on at least six further tools of the same design. Should any one of these six tools fail any part of the type test, the whole test shall be regarded as having been failed.

All tools that have failed the test shall be either destroyed or rendered unsuitable for use in live working.

Unless otherwise stated, the tests shall be carried out after a minimum storage time of 16 h under IEC climatic conditions, 23 °C ± 5 °C, relative humidity 45 % to 75 %.

Unless otherwise stated, tolerances of ±5 % from any test values required are permissible.

5.2 Visual check

The tool (in particular the insulation) shall be visually checked and shall be free from external defects.

The marking shall be checked for legibility and completeness in accordance with 4.1.4.

5.3 Dimensional check

The dimensional requirements of 4.3 shall be checked.

5.4 Impact tests

5.4.1 General

The test shall be carried out according to one of the two alternatives shown in Figures 8a and 8b.

The hammer used in the apparatus 8a and the hammer and intermediate piece used in apparatus 8b shall be made of steel with a hardness between 20 HRC and 46 HRC.

At least three points of the insulating material or insulating layer shall be selected as testing points, these being points which could be damaged when the tool drops on a flat surface.

The test shall be considered successful if the insulating material shows no breaks, exfoliations or cracks penetrating the insulating layer of the insulated tool or likely to reduce the solidity of the insulating tool.

5.4.2 Ambient temperature impact test

The tool shall be tested at the ambient temperature, 23 °C ± 5 °C, of the test room.

The height of fall H of the hammer shall be determined as a function of its weight P, so that the energy W of impact on the tool to be tested shall be equal to that of this tool falling on a hard surface from a height of 2 m:

$$H = \frac{W}{P} = \frac{2 \times F}{P}$$

where

H is the height of fall of the hammer, in metres;
F is the weight of the tool tested, in newtons;
P the weight of the hammer, in newtons.

5.4.3 Low temperature impact test

Tools, excluding those of category "C", shall be conditioned in a cooling chamber for 2 h at –25 °C ± 3 °C. The impact test shall start 120 s after removal from the cooling chamber. The ambient temperature of the test room shall be 23 °C ± 5 °C.

The height of fall H of the hammer shall be determined as a function of its weight P, so that the energy W of impact on the tool to be tested shall be equal to that of this tool falling on a hard surface from a height of 0,6 m:

$$H = \frac{W}{P} = \frac{0{,}6 \times F}{P}$$

where

H is the height of fall of the hammer, in metres;
F is the weight of the tool tested, in newtons;
P is the weight of the hammer, in newtons.

5.4.4 Extreme low temperature impact test

Tools of category "C" shall be conditioned in a cooling chamber for 2 h at –40 °C ± 3 °C.

The impact test shall be carried out according to 5.4.3.

5.5 Dielectric tests

5.5.1 General requirements

For tests to be carried out according to IEC 60060-1, the test voltage shall be increased and reduced at a uniform rate of approximately 1 000 V/s.

The dielectric testing shall be started at the latest 5 min after conditioning is completed.

5.5.2 Conditioning

5.5.2.1 General

Before testing, the tools shall be conditioned in accordance with one of the two possibilities described in 5.5.2.2 and 5.5.2.3. Tools with inner cavities having a port to the outside shall be conditioned in a wet chamber (5.5.2.3).

5.5.2.2 Water bath

The tools shall be totally immersed in a bath of tap water at room temperature as specified in 5.1 (23 °C ± 5 °C) for 24 h ± 0,5 h. After this conditioning, the tools shall be wiped dry and submitted to the dielectric test.

5.5.2.3 Wet chamber

The tools shall be stored at a relative humidity between 91 % and 95 % at a temperature of 23 °C ± 5 °C for 48 h. Tools capable of being assembled shall not be assembled prior to conditioning.

NOTE This humidity conditioning may be obtained by storing the tools in a closed chamber which contains a saturated solution of sodium sulphate decahydrate $Na_2\,SO_4\,10H_2O$ (Glauber's salt) having a large exposed surface.

5.5.3 Dielectric testing of insulated tools

The tool shall be immersed with its insulated part in a bath of tap water up to a level of 24 mm ± 2 mm from the nearest non-insulated part. The conductive part shall be above the water level (see Figure 9).

Pliers and similar tools shall be tested in such a position that the gap d between the two inner sides of the insulated handles is 2 mm to 3 mm, or the minimum possible by the tool's construction but not less than 2 mm (see Figure 9).

For tools capable of being assembled and for those tools where the design does not allow testing in a water bath, the water bath shall be replaced by a bath of nickel stainless steel balls 3 mm in diameter (measured with normal industrial tolerances).

A voltage of 10 kV r.m.s. at 50 Hz or 60 Hz shall then be continuously applied for 3 min according to IEC 60060-1, and the leakage current is measured. This current shall be smaller than 1 mA for 200 mm of coated tool. This corresponds to a maximum value of the leakage current of:

$$I_M = 5\,L$$

where

I_M is the maximum leakage current (in milliamperes) rounded to the upper value in milliamperes;

L is the unwinded length (in metres) of coating rounded to the lower value in centimetres.

NOTE Annex C gives examples of calculation of the unwinded length of coating and the limits of acceptable leakage current.

Tools capable of being assembled shall be tested in all possible variations. Tools with holding devices shall be tested on both end positions, if applicable.

The test shall be considered successful if no electrical puncture, sparkover or flashover occurs during the test period, and if the limits of leakage current are not exceeded.

5.5.3.1 Dielectric tests of tools capable of being assembled with square drives (see 4.3.1.3.1)

In case of tools capable of being assembled with square drives, the tools can be tested in separate parts, if the parts are assembled with dummies described in Figure 10. The dimensions and tolerances of the dummies shall be in accordance with Table 2.

Table 2 – Dimensions and tolerances for dummies to be used for dielectric tests

Dimensions in millimetres

Nominal size	L_1 ± 0,1	L_2 ± 0,1	E_1 ± 0,05	D_1 ± 0,05	D_2 ± 0,05	D_3 ± 0,05
6,3	19	16	8,4	11	14,5	16,5
10	19	16	12,7	16	19,5	21,5
12,5	19	16	16,9	20	23,5	25,5
20	19	16	25,4	30,5	34,5	35,6
L_1, L_2, E_1, D_1, D_2 and D_3 are described in Figure 10.						

Dummy part 1 shall be assembled with female tool ends and dummy part 2 with male tool ends.

On all single parts tested with dummies, the dielectric testing on the complete assembly is not required.

The test shall be considered successful if no electrical puncture, sparkover or flashover occurs during the test period, and if the limits of leakage current are not exceeded.

5.5.4 Dielectric testing of insulating tools

Tools having no exposed conductive parts shall be tested as follows.

NOTE The purpose of this test is to check the dielectric quality of the material used for the tool.

Electrodes of conductive tape or conductive paint, in 5 mm wide strips, shall be placed on the surface of the handle at intervals of 24 mm ± 2 mm (see Figure 11). In accordance with IEC 60060-1, a voltage of 10 kV r.m.s. at 50 Hz or 60 Hz shall then be continuously applied for 3 min between each adjacent electrode.

The test shall be considered successful if no electrical puncture, sparkover or flashover occurs during the test period, and if the leakage current is less than 0,5 mA multiplied by the number of inter-electrode spacings.

5.6 Indentation test (for insulated tools)

All parts of the insulating coating, electrically tested as indicated in 5.5, shall pass this test. The test shall be performed on the most vulnerable part(s) for screwdrivers with insulated blades, and for other tools at the external middle part of the handle or legs.

If the radius R at the test point is equal to or larger than 10 mm, the test shall be made with a test device according to Figure 12a. The part of the mass m in contact with the test piece shall be a stainless steel hemispheric nose-piece of 5 mm diameter. The applied force F shall be 20 N.

If the radius R at the test point is less than 10 mm, a rod of 4 mm diameter and at least 30 mm in length placed at right angles to the tool axis shall be used with the same force F of 20 N (see Figure 12b).

The tool shall be clamped in such a way that the insulating material coating at the test point is in a horizontal position. After setting up the testing device, the arrangement shall be held according to code 2 h/70C/<20 % of IEC 60212, in a heating chamber with ventilation. At the end of the heating time and after a cooling period outside the chamber of 5 min, a voltage of 5 kV r.m.s. at 50 Hz or 60 Hz shall be applied continuously, in accordance with IEC 60060-1, between the testing device and the metal part of the tool for 3 min, using the code 18-28C/45-75 % of IEC 60212.

The test shall be considered successful if no electrical puncture, sparkover or flashover occurs during the test period.

5.7 Test for adhesion of the insulating material coating (for insulated tools)

5.7.1 Conditioning

Before the test, the tools shall be conditioned in a heating chamber with ventilation at a temperature of 70 °C ± 3 °C for 168 h.

The following tests shall be started at ambient temperature 3 min after removal from the heating chamber, using the code 18-28C/45-75 % of IEC 60212.

5.7.2 Test on the working head

The test shall be made on the following tools:

- wrenches;
- open-jaw holding wrenches;
- tools capable of being assembled (except for pieces acting as screwdrivers).

The test may be carried out using either method A or method B as shown in Figures 13a and 13b respectively.

Method A (see Figure 13a):

A hook having a cutting edge of 5 mm width shall be placed on the working head in such a manner that it does not touch the conductive part.

A force F of 50 N shall be applied in the direction of the line dividing the insulating material coating from the conductive part for 3 min.

Method B (see Figure 13b):

A device having two cutting edges, each of 5 mm width, shall be placed on the working head in such a manner that it does not touch the conductive part.

A force F of 100 N shall then be applied in the direction of the line dividing the insulating material coating from the conductive part for 3 min.

Either test shall be considered as passed if the insulating material coating does not move more than 3 mm from its initial location on the conductive part, and without any breakage of the insulating material.

5.7.3 Test on the insulation of the blades of screwdrivers

The test shall be carried out on screwdrivers or on parts of tools capable of being assembled acting as screwdrivers with the testing apparatus as shown in Figure 14.

The penetration depth of the cutting edges s of the testing apparatus shall not exceed 50 % of the thickness t of the insulating material coating. The cutting edges shall be placed on the blade insulation at a distance a of 10 mm to 15 mm from the point where the blade emerges from the handle or from the body of the tools capable of being assembled acting as screwdrivers.

If the cutting edges slide on the insulation it is permissible to cut a groove in the blade insulation of up to 50 % of its thickness, to prevent movement.

The force F in newtons shall be equal to 35 times the blade diameter or 35 times the greatest dimension of the blade cross-section in millimetres. The maximum force to be applied is 200 N. It shall be applied in the axial direction of the blade for 1 min.

The test shall be considered as passed if the insulating coating does not move more than 3 mm from its initial location on the conductive part and if there is no breakage of the insulating material.

5.7.4 Test of adhesion of the insulation of the entire tool

The test shall be made on pliers, strippers, cable-cutting tools, cable scissors and knives with the testing apparatus according to Figure 15.

The force F of 500 N shall be applied for 3 min.

The test shall be considered as passed

– if the handle remains firmly attached to the conducting part, and

– if the guard(s) remain firmly attached to the handles.

NOTE Deformation of the insulating coating is not considered as a failure.

5.7.5 Test of adhesion of insulating covers of conductive adjusting or switching elements

A separating force of 50 N shall be applied to the cover in a possible separating direction by a suitable device for 3 min.

The test shall be considered as passed if the covers do not come off the elements they are insulating, if the function of the elements they are insulating is still given and if the dielectric test of 6.1.2 is passed after this test.

Deformation of the covers due to this test is not considered to be a failure.

If covers are used in areas that are not touched during work, this test need not be performed. Also the test need not be performed, where the design of the sealing elements does not allow application of a separating force.

5.8 Flame retardancy test

The test shall be carried out in a draught-free room. The tool to be tested shall be clamped in a horizontal position. A small burner shall be arranged in such a way that the axis of the burner nozzle and the axis of the handle of the tool are at right angles and form a vertical plane.

The gas supply shall be technical grade methane gas with a suitable regulator and meter to produce a uniform gas flow.

NOTE If natural gas is used as an alternative to methane, its heat content should be approximately 37 MJ/m^3, which has been found to provide similar results.

The nozzle of the burner shall have a diameter of 9,5 mm ± 0,5 mm to produce a 20 mm ± 2 mm high blue flame.

The burner is placed remote from the tool, ignited and adjusted in the vertical position to produce a blue flame 20 mm ± 2 mm high. The flame is then obtained by adjusting the gas supply and the air ports of the burner until a 20 mm ± 2 mm yellow-tipped blue flame is produced; the air supply is then increased until the yellow tip disappears. The height of the flame is measured again, and corrected if necessary.

The burner shall then be placed in the test position as shown in Figure 16, with the axis of the flame at right angles to that of the tool.

At the start of the test, the tip of the testing flame shall touch the insulating material at the lower part of the working head facing the tool to be tested (see Figure 16).

The horizontal reference line d of Figure 16 at the level of the lower end of the insulating material is the datum for measuring the flame height.

If different types of insulating material are used for the same tool, the test shall be made on each individual type of insulating material.

The testing flame shall act upon the tool to be tested for 10 s. After this period, the flame shall be withdrawn. It shall be ensured that no air draught interferes with the test. The propagation of the flame on the test piece shall be observed for 20 s after the withdrawal of the testing flame.

The test shall be considered as passed if the flame height on the tool does not exceed 120 mm during the 20 s of the observation period.

5.9 Mechanical tests

5.9.1 Insulated tools

The tools shall comply with all the specific mechanical requirements of ISO standards corresponding to the different types of tools. If no ISO standard exists, the tools shall comply with a standard specified by the manufacturer or the customer (for example: a national standard). The manufacturer shall provide the reports of these tests at the request of the customer.

5.9.2 Insulating tools

Insulating tools specially designed for live working may have lower stress resistance than insulated tools, but they shall withstand the expected work loads without failing due to remaining deformation or breaking (see Annex A).

5.9.3 Tweezers

A clamping force of 10 N shall be applied 10 mm behind the guard, clamping a test piece with a thickness of 2 mm, a width and length of 10 mm and a hardness of not less than 35 HRC. This stress shall not cause any permanent deformation.

5.9.4 Retaining force test

Tools that consist of more than one part shall be assembled in accordance with the manufacturer's instructions.

5.9.4.1 Not mechanically locked retaining systems

For tools capable of being assembled with retaining systems without mechanical lock (for example magnetic, spring loaded, etc.), the following values shall be used for evaluation:

– 4 N for drives up to 6,50 mm;
– 11 N for drives from 6,51 mm to 10,00 mm;
– 30 N for drives from 10,01 mm to 13,50 mm;
– 80 N when drives exceed 13,50 mm.

NOTE The nominal size of the drives is measured across flats. If there are no parallel flats (for example triangular drive, pentagon drive, etc.), the nominal size should be specified in a comparable manner.

5.9.4.2 Mechanically locked retaining systems

In the case of mechanically locked retaining systems (for example screwed fittings, etc.) a load of 500 N shall be used.

5.9.4.3 Procedure and results

The tool shall be maintained in such position that the dismantling direction of the detachable part is vertical and downwards.

The load shall be gradually applied along the dismantling direction to reach the value given in 5.9.4.1 or 5.9.4.2 within 2 s; it shall then be held for 1 min.

The test shall be considered as passed if the assembly does not come apart.

5.10 Durability of marking

The markings shall be rubbed for 15 s with a rag soaked in water, and then for 15 s with a rag soaked in isopropanol.

After this rubbing, the marking shall still be legible.

NOTE For special service requirements, the customer may specify extra tests for the durability of marking.

6 Quality assurance plan

The quality assurance plan used for manufacturing and testing of the insulated or insulating tools complying to this standard shall ascertain that the product meets the requirements contained in this standard.

6.1 Routine tests

Routine tests are performed to detect critical defects (see definition in IEC 61318).

The routine tests in accordance with 6.1.1 and 6.1.2 are mandatory for insulated and insulating hand tools for live working in compliance with this standard.

6.1.1 Visual check

A visual check according to 5.2 shall be carried out. Tools failing the visual inspection shall be either repaired where that is a suitable means, or rejected where repair is not suitable or possible.

6.1.2 Dielectric test

Tools shall be tested according to 5.5 but with the following modifications:

– conditioning as specified in 5.5.2 is not necessary;
– the test time shall be 10 s after reaching the specified voltage;
– the distance of the water level (or ball level) from the nearest exposed metal part shall be 24^{+4}_{-2} mm;
– the leakage current measurement shall not be carried out;
– the test voltage has not to be increased and reduced at a uniform rate of approximately 1 000 V/s.

6.1.2.1 Tools capable of being assembled

Tools capable of being assembled shall be tested either as a complete assembly or as separate parts.

6.1.2.2 Insulating tools without exposed conductive parts

For insulating tools without exposed conductive parts, no dielectric routine test is required.

6.2 Sampling tests

This part of the quality assurance plan can be achieved in one of the following manners:

– by performing the complete sampling tests of Annex D;
– by substituting some of the tests with alternative quality assurance methods that assure that the product would certainly pass the substituted test, if someone were to carry it out. These alternative testing methods shall be described, maintained and recorded in a written system.

NOTE The alternative test methods should be verified by an independent expert or organisation. These experts should be qualified and nationally and/or internationally accepted as experts in testing and evaluating methods and materials for live working (for example, national test laboratories).

If the customer does not accept the alternative quality assurance methods in the quality assurance plan, the sampling tests of Annex D shall be applied for verification of the quality.

6.2.1 Sampling procedure

The sampling procedure and the validation of the results shall be in conformance with Annex D. The tests shall be carried out in accordance with Clause 5.

Each lot or batch, as far as practicable, consists of items of production of a single type, grade, class, size and composition, manufactured under essentially the same conditions and at essentially the same time.

If a batch has finally failed in a sampling test, all tools from the batch shall be either destroyed or their insulation shall be removed and all markings concerning live working shall be removed.

6.3 Tools with negative test results

All tools that have failed a test shall be either destroyed or their insulation shall be removed and all markings concerning live working shall be removed.

6.4 Records

The manufacturer shall keep records of all tests in accordance with the manufacturer's quality control procedures, for inspection by a prospective customer.

6.5 Acceptance tests

The customer shall specify these tests in the contract with the manufacturer (see Annex E).

Records shall also be kept of any additional tests requested by the customer.

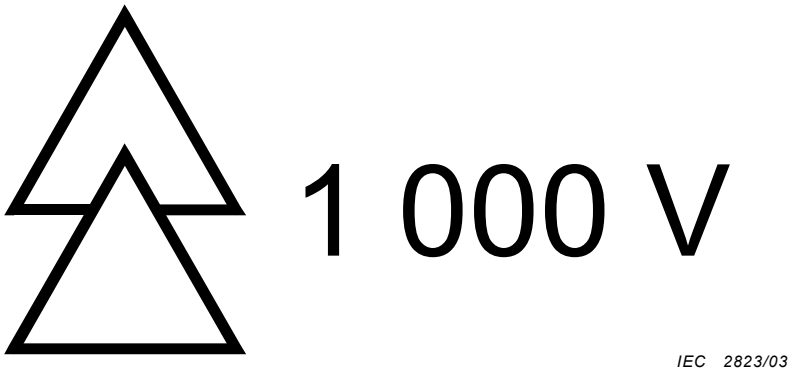
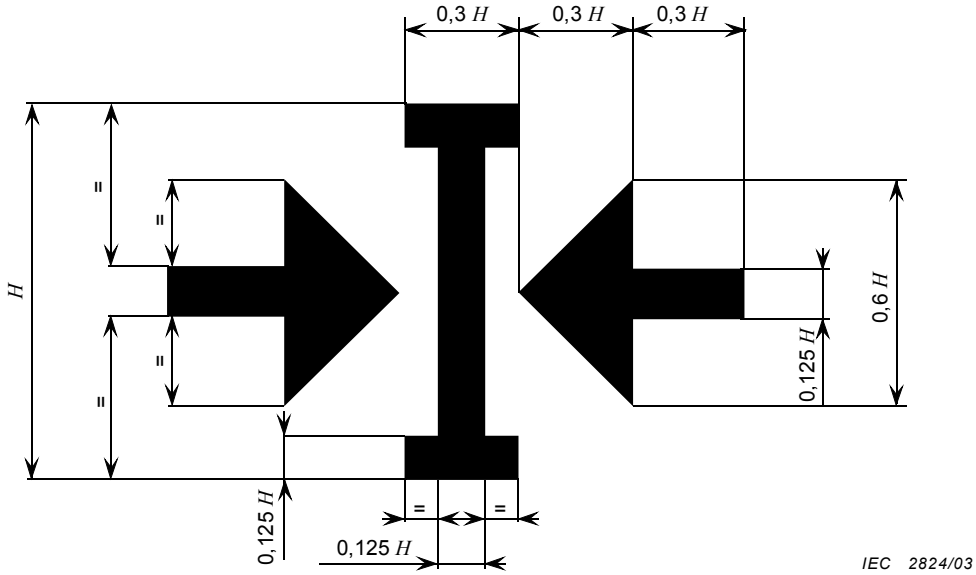


Figure 1 – Symbol IEC-60417-5216 (DB:2002-10) – Suitable for live working; double triangle, and voltage indication (see 4.1.4)



Dimensions in millimetres

Figure 2 – Marking symbol for tools capable of being assembled and designed to be interchangeable between different manufacturers (see 4.1.4 and 4.3.1.3.2)

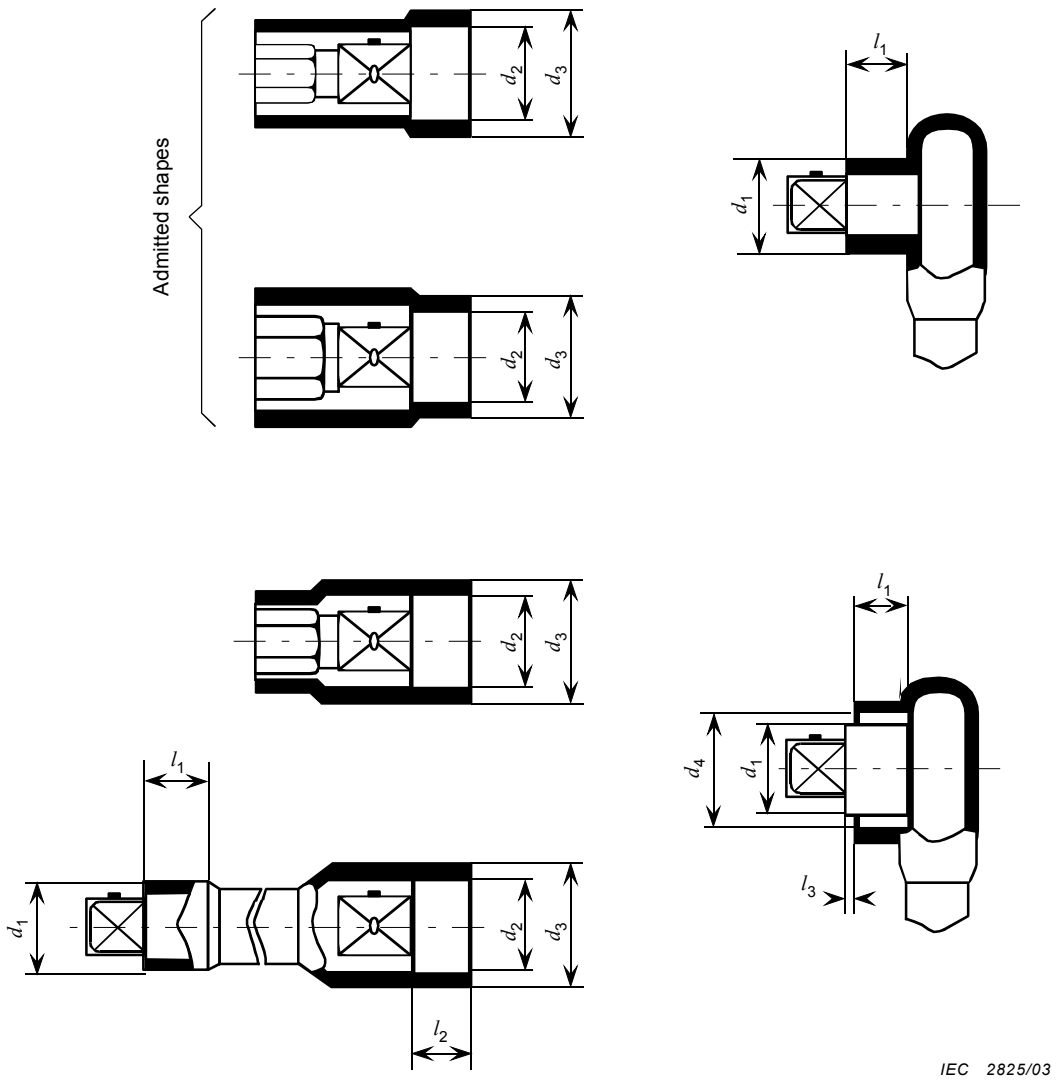
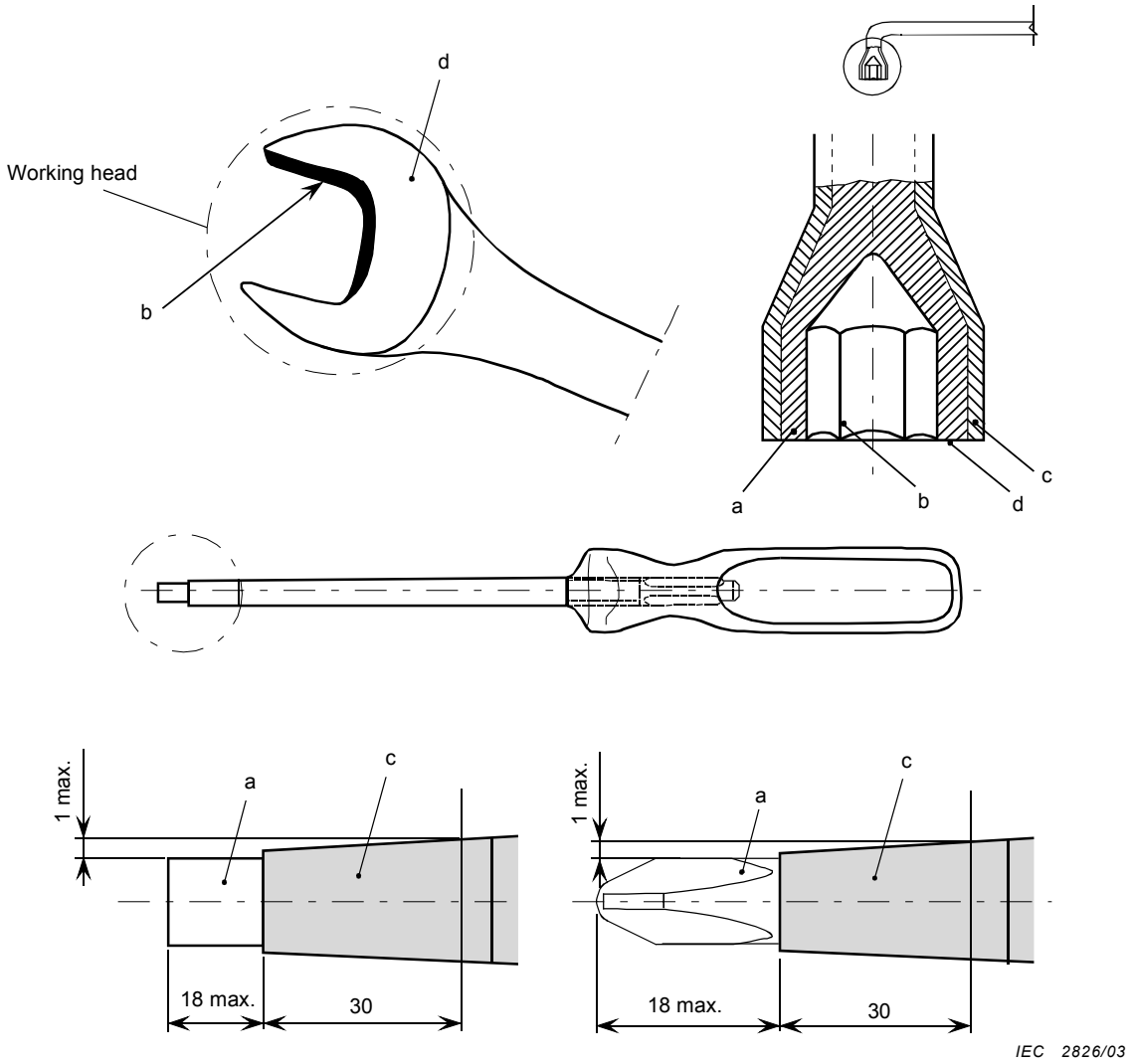


Figure 3 – Description of the insulating overlapping element and different assembly configurations for tools capable of being assembled with square drives (see 4.3.1.3.1)



Dimensions in millimetres

Key

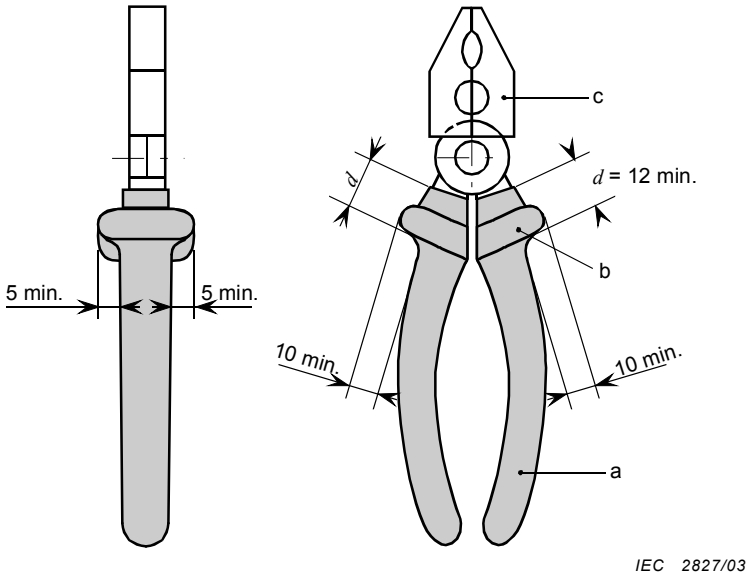
a Conductive part

b Working surface

c Insulation

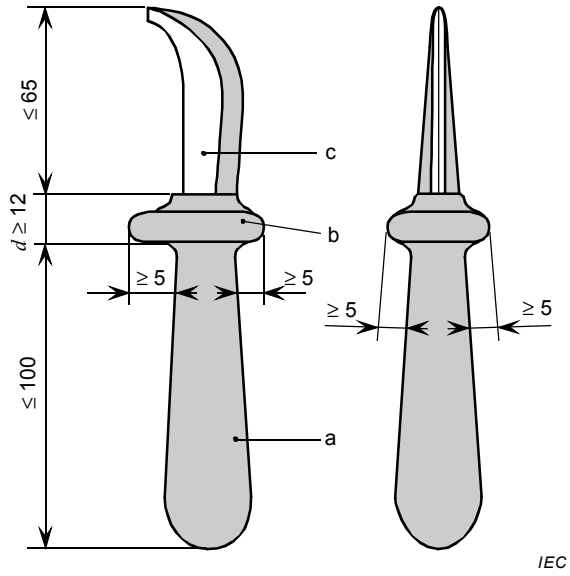
d Contact area

Figure 4 – Illustration of insulation of typical tools (see 4.3.2 and 4.3.3)



Dimensions in millimetres

Figure 5a – Insulation of pliers (see 4.3.4)



Dimensions in millimetres

Figure 5b – Insulation of knives (see 4.3.5)

Key

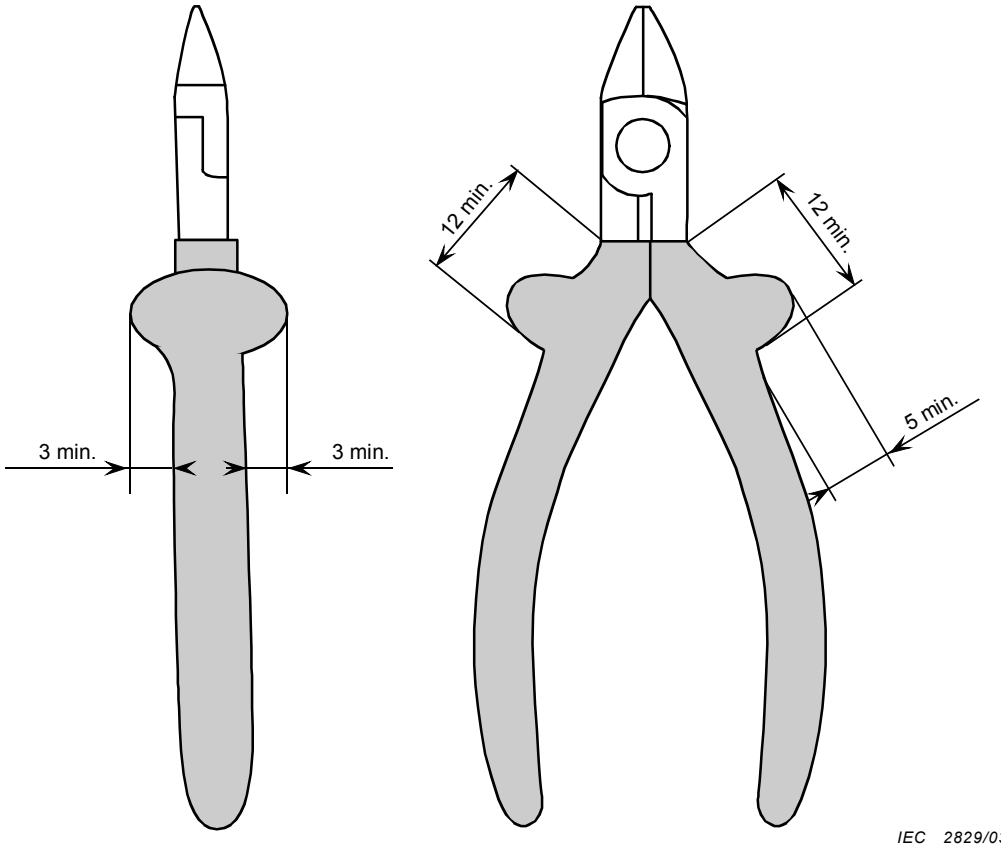
a Insulated handle or leg

b Guard

c Working head (not insulated)

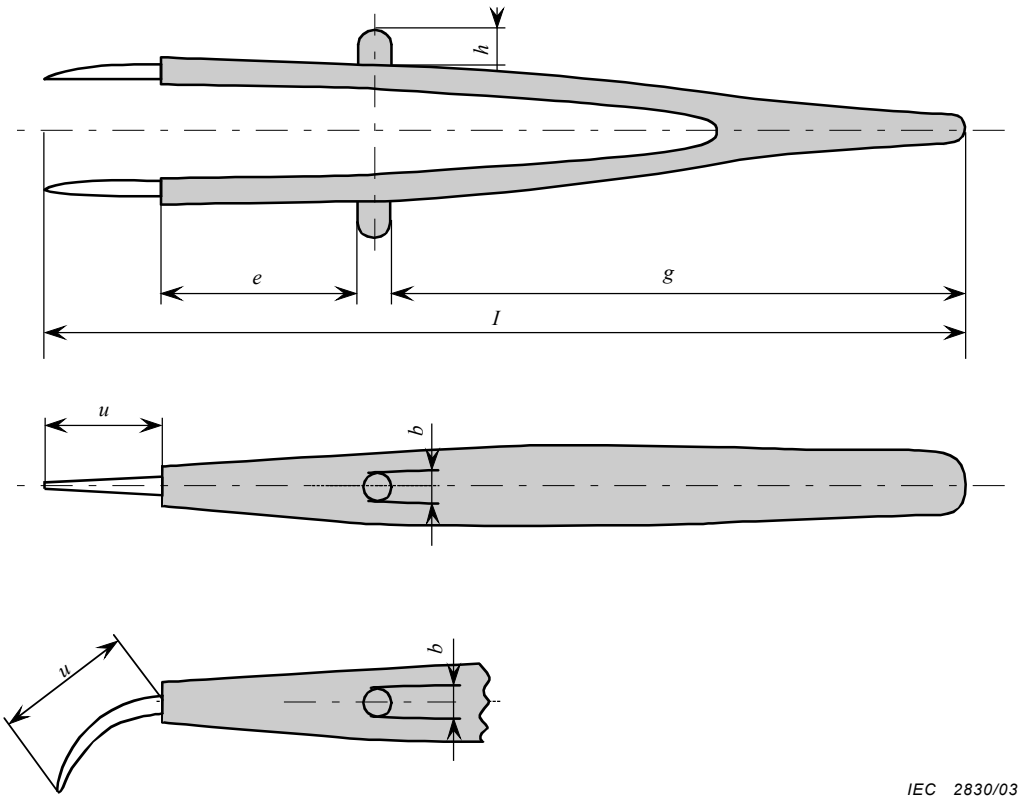
d Distance between the inner edge of the guard and the non-insulated part

Figure 5 – Illustration of insulation of pliers and knives



Dimensions in millimetres

Figure 6 – Illustration of insulation of pliers and nippers for electronics
(see 4.3.4)



Key

l	Total length of the tweezers
g	Length of the handle (grip)
b	Width of the guard
h	Height of the guard
e	Insulated part of the handle between the guard and the working head
u	Uninsulated part of the working head

Figure 7 – Example of insulation of the handles of tweezers (see 4.3.6)

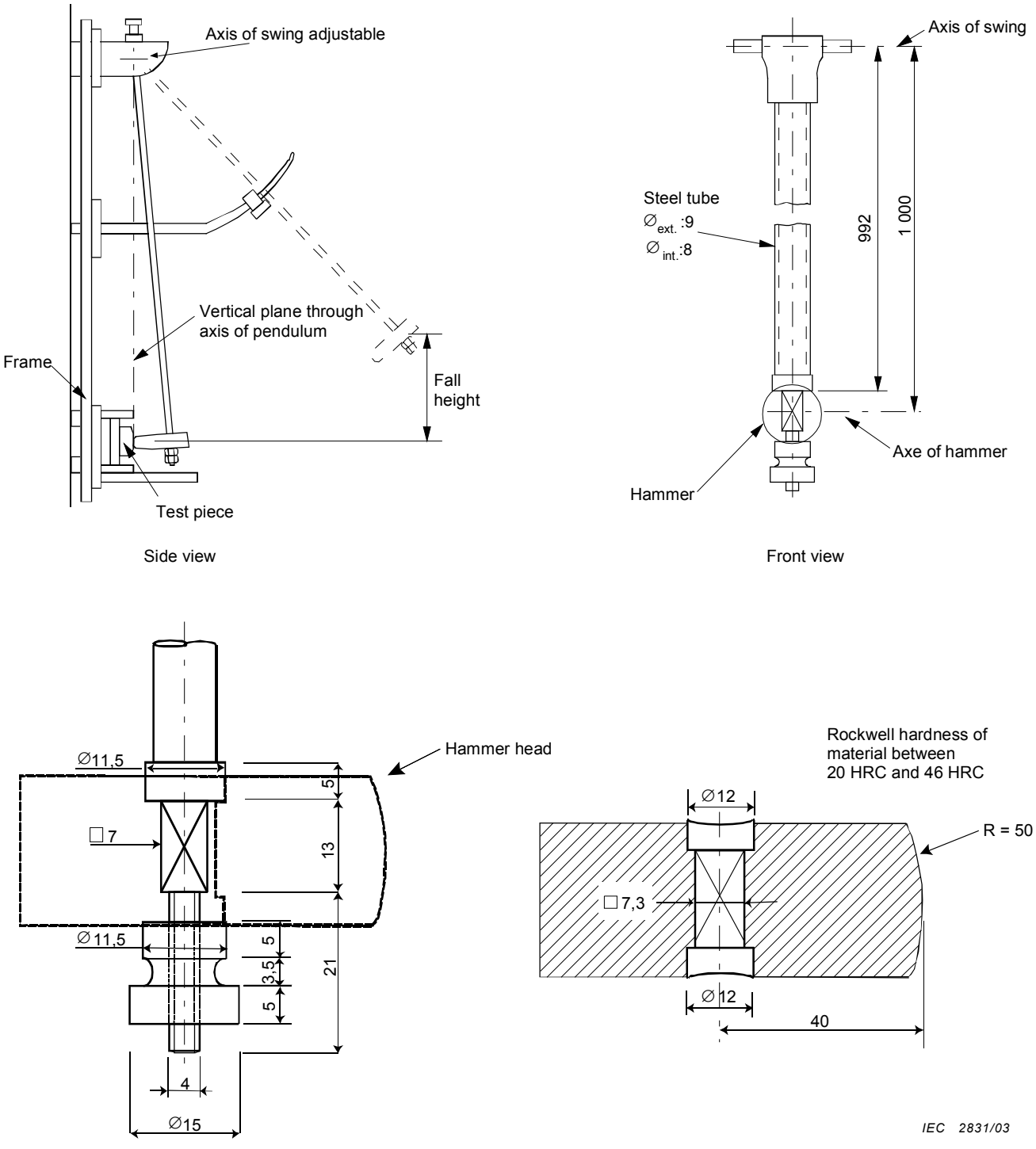


Figure 8a – Method A

Figure 8 – Examples of test arrangements for the impact test (see 5.4)

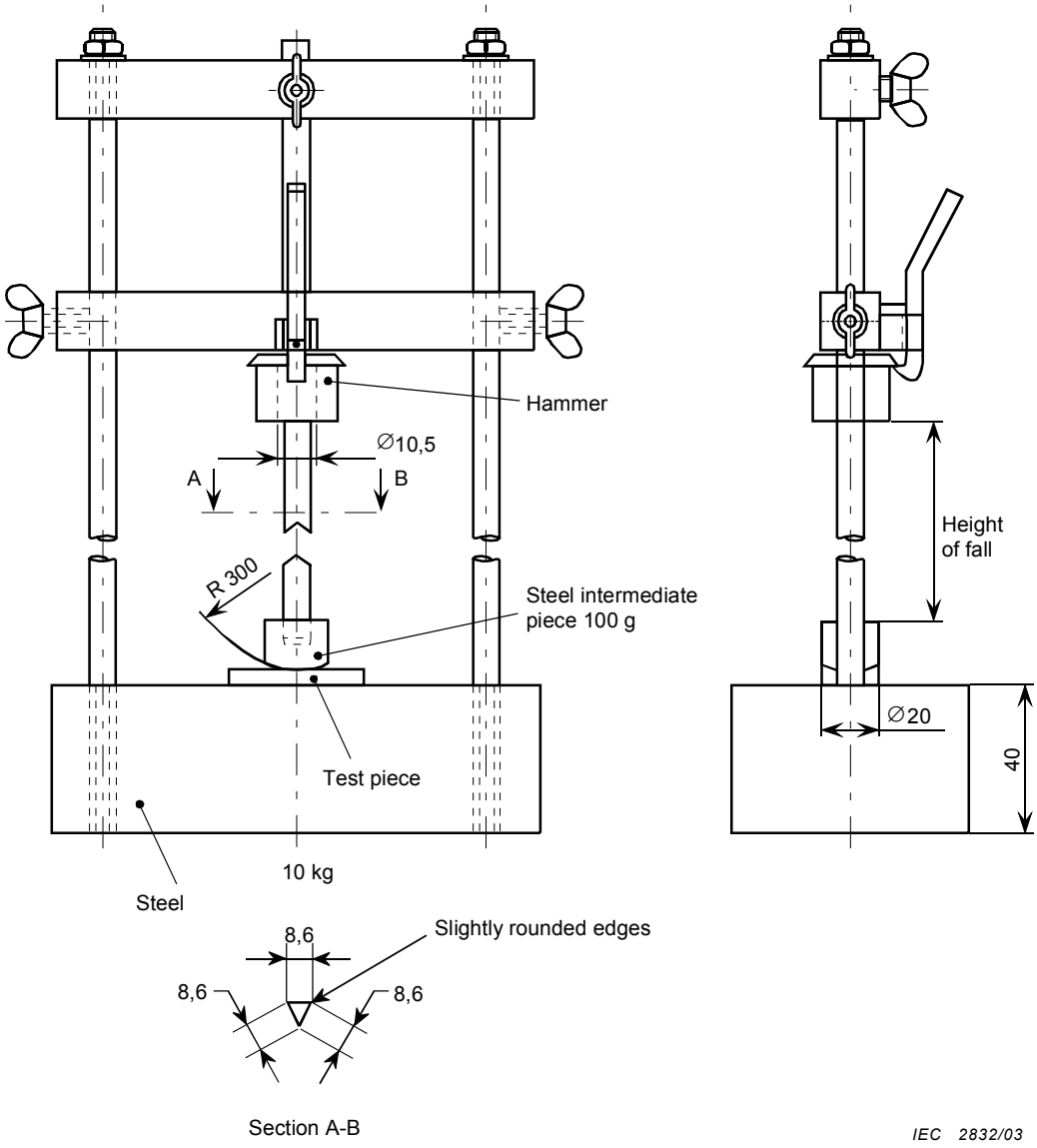
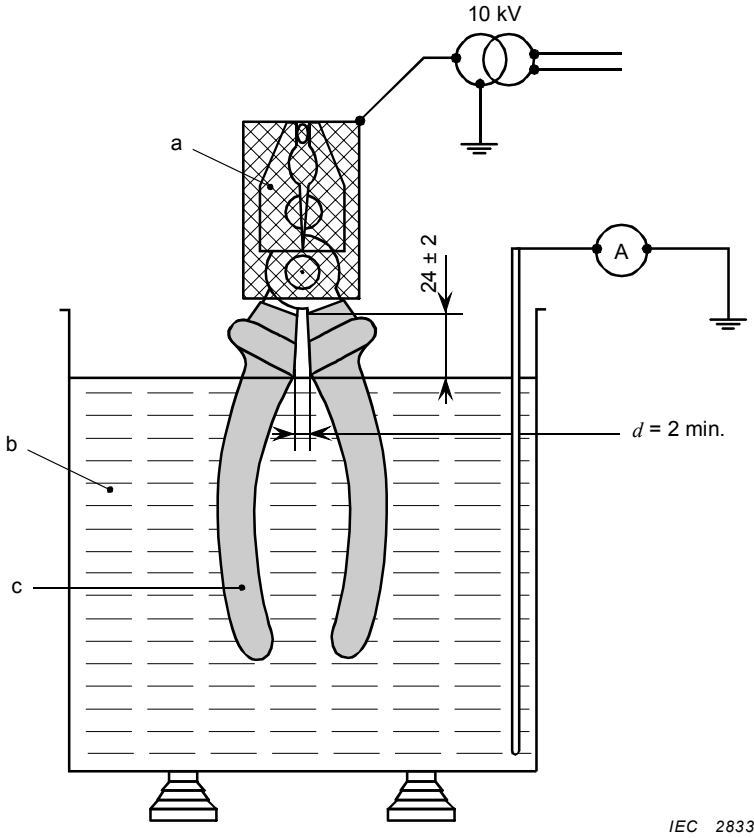


Figure 8b – Method B

Figure 8 – Examples of test arrangements for the impact test (see 5.4)



Dimensions in millimetres

Key

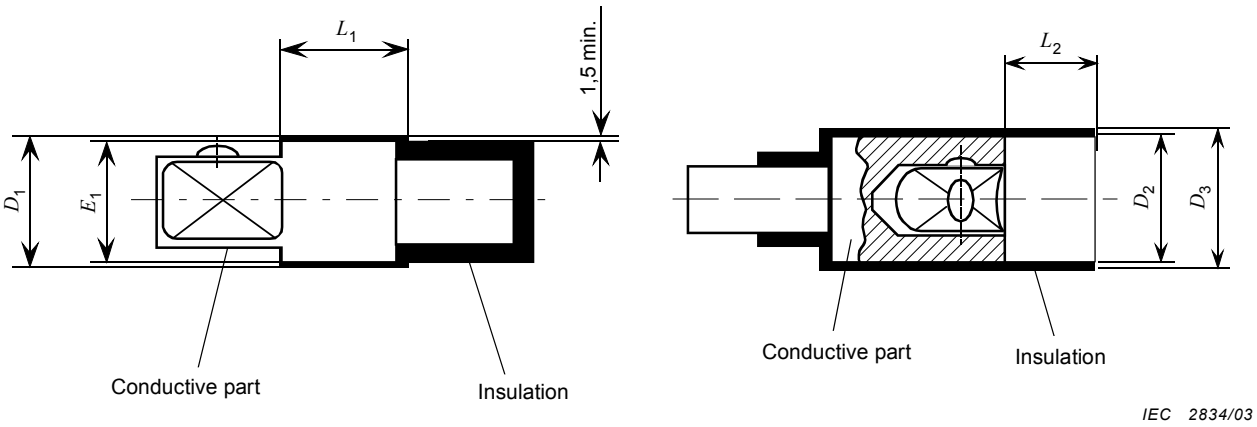
a Conductive working head

b Tap water bath

c Insulated part of the tool

d Gap to be maintained between the two inner sides of the legs

Figure 9 – Electric testing device for insulated tools (see 5.5.3)

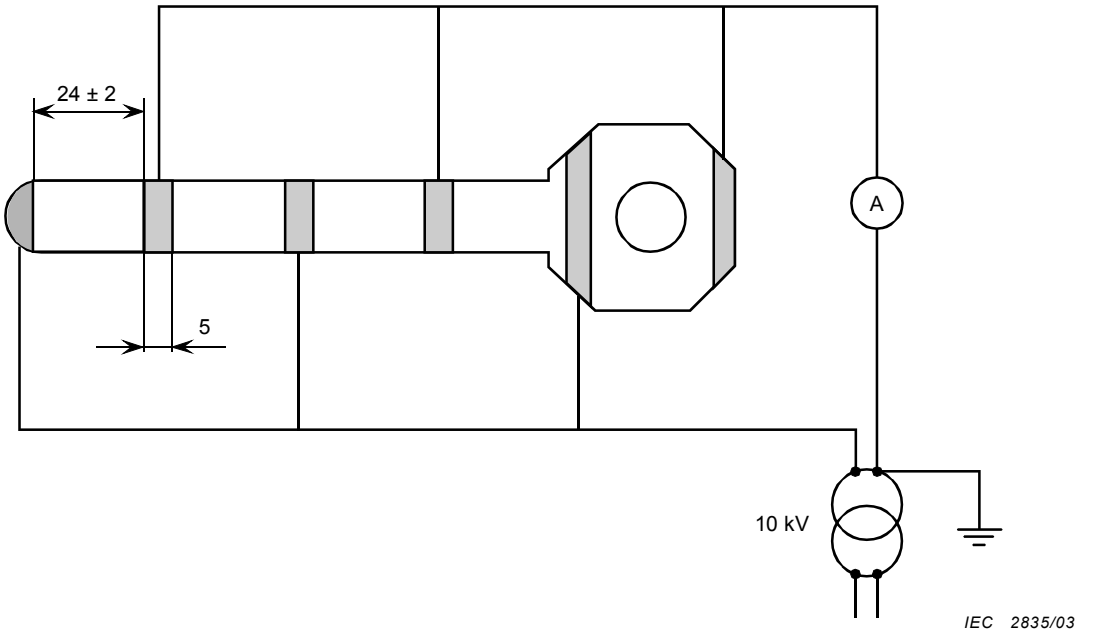


Dummy part 1 to be used with female tool ends

Dummy part 2 to be used with male tool ends

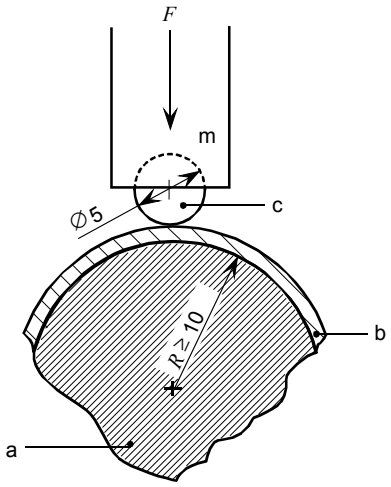
Dimensions in millimetres

Figure 10 – Description of dummies for electrical tests for tools capable of being assembled with square drives (see 5.5.3.1)



Dimensions in millimetres

Figure 11 – Dielectric testing device for insulating tools (see 5.5.4)

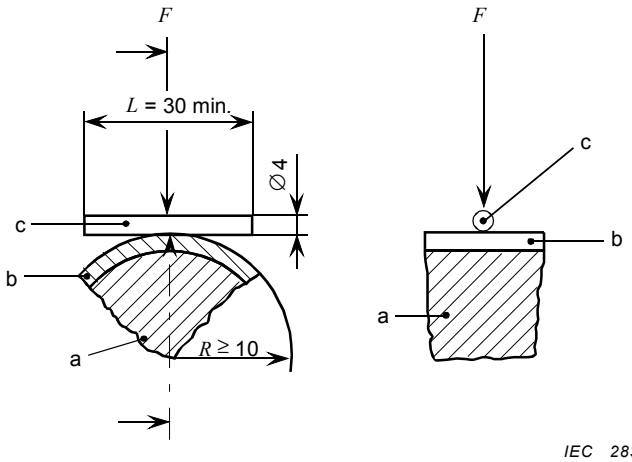


IEC 2836/03

Key

a	Conductive part
b	Insulation (test point)
c	Hemispheric nose-piece
R	Radius at the test point of the tool
m	Testing mass

Figure 12a – Radius at the test point of the tool ≥ 10 mm



IEC 2837/03

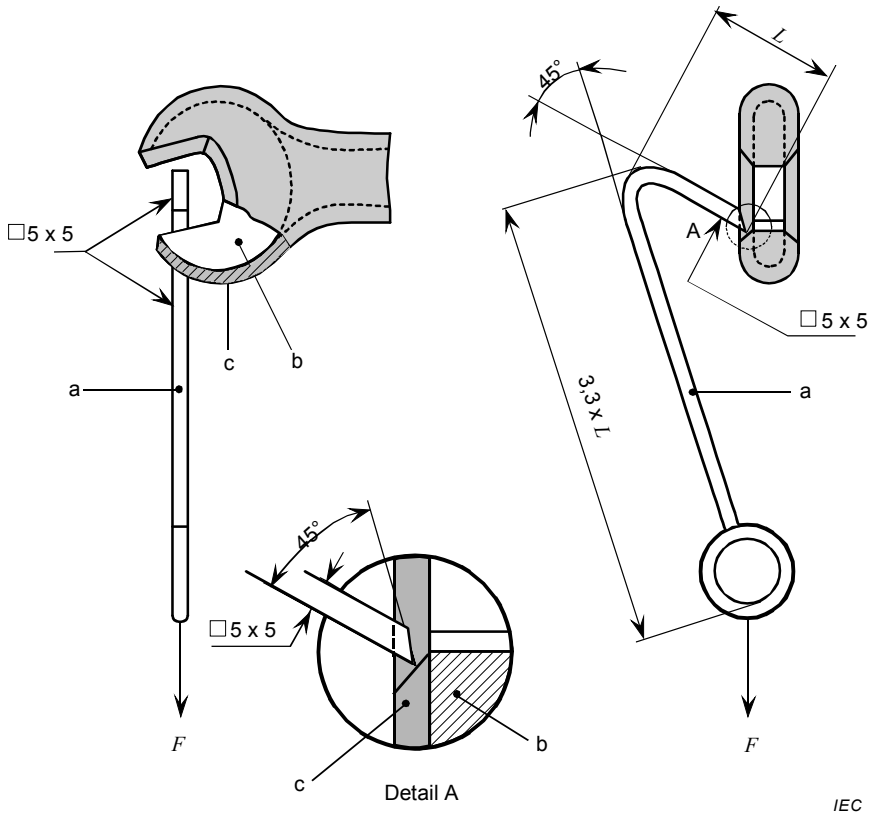
Dimensions in millimetres

Key

a	Conductive part
b	Insulation (test point)
c	Rod
R	Radius at the test point of the tool

Figure 12b – Radius at the test point of the tool < 10 mm

Figure 12 – Indentation test (see 5.6)



Dimensions in millimetres

Key

a Hook (the length of the handle depends on the size of the tool)

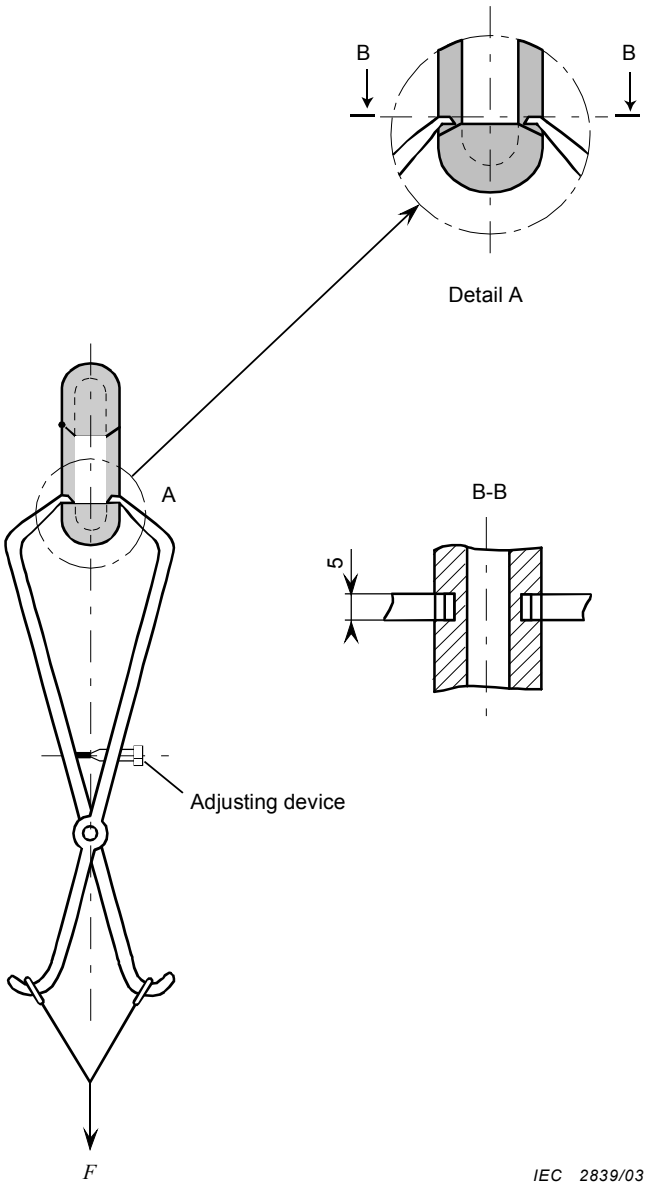
b Conductive part

c Insulating material coating

L Length of the short arm of the hook

Figure 13a – Test on the working head – Method A

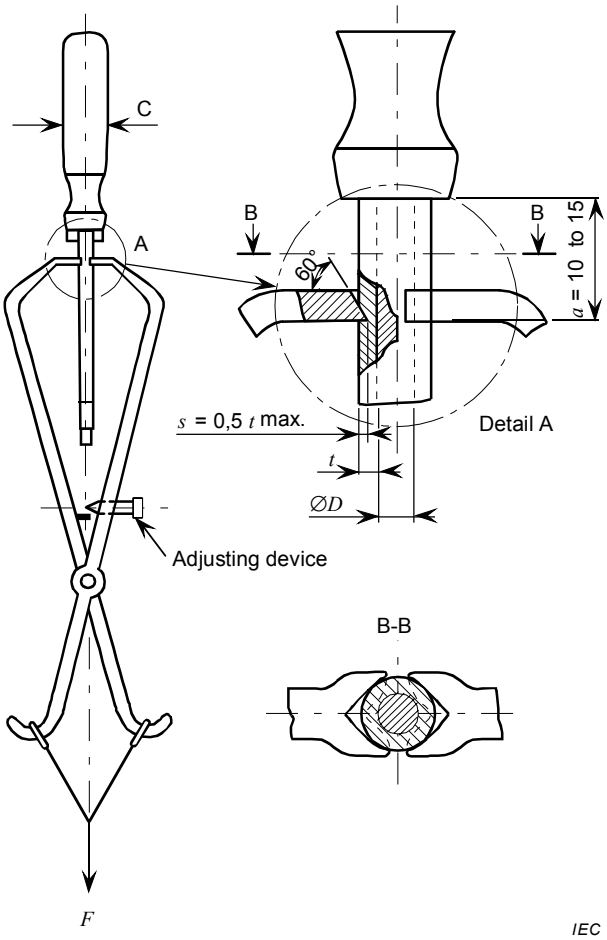
Figure 13 – Principle of the testing device for checking adhesion of the insulating coating on conductive parts of the tools (see 5.7.2)



Dimensions in millimetres

Figure 13b – Test on the working head – Method B

Figure 13 – Principle of the testing device for checking adhesion of the insulating coating on conductive parts of the tools (see 5.7.2)



Dimensions in millimetres

Key

s	Depth of penetration (s = 0,5 t max.)
t	Thickness of the insulating material coating
F	Testing force
a	Spacing between the point where the blade comes out of the handle and the cutting edge of the testing appliance
C	Suitable clamping device to hold the tested srewdriver in position with the blade vertical downwards during the test

Figure 14 – Testing device for checking adhesion of the insulating coating of screwdrivers on conductive parts and the handle (see 5.7.3)

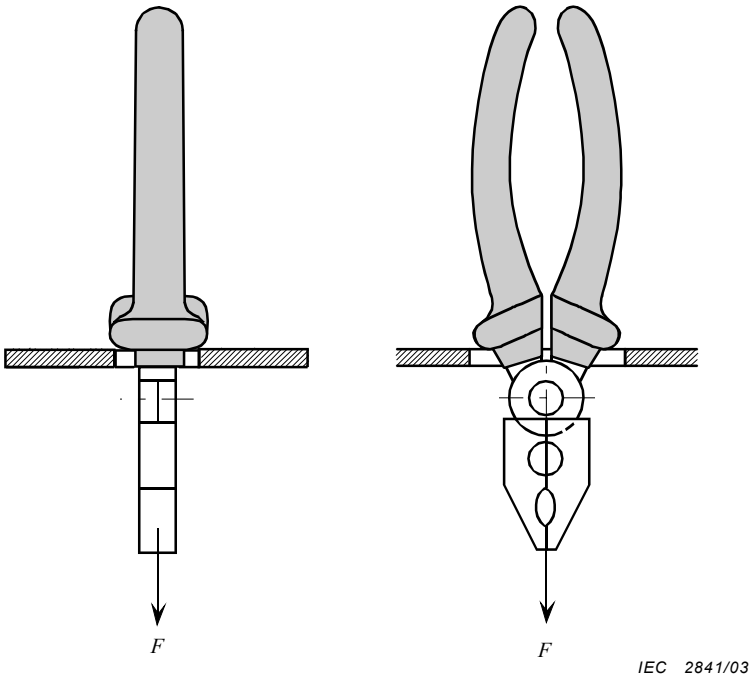


Figure 15a

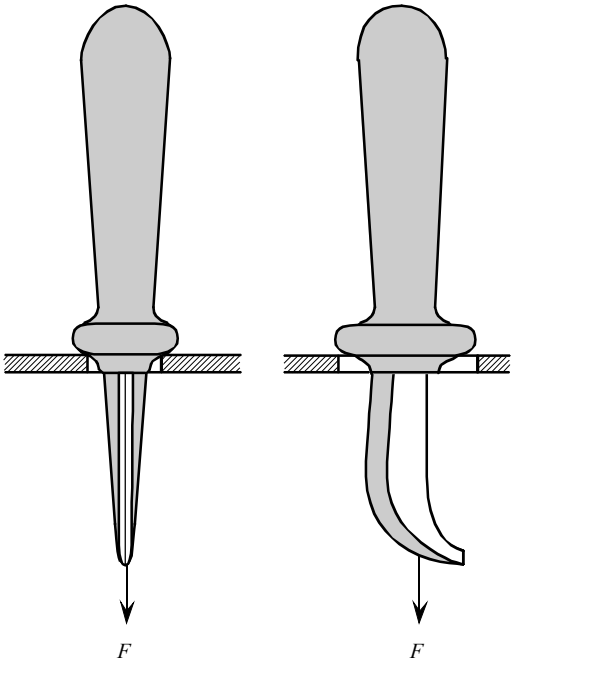
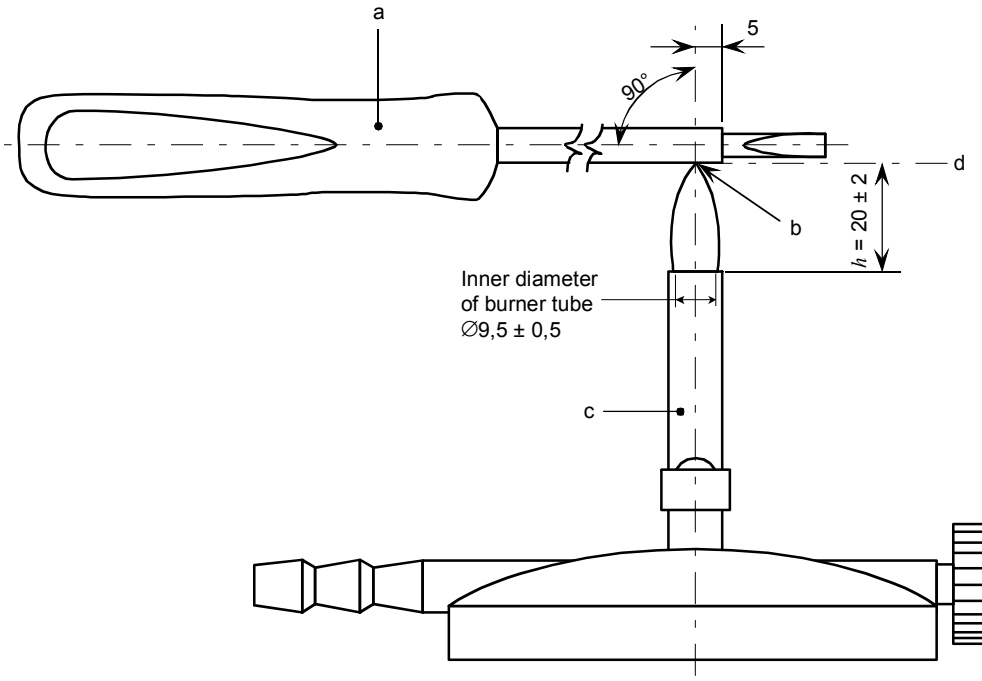


Figure 15b

Figure 15 – Example of mountings for checking stability of adhesion of the insulation of the entire tool (see 5.7.4)



Dimensions in millimetres

Key

a Test piece

b Tip of the flame

c Burner

d Horizontal reference line

h Maximum flame height

Figure 16 – Example of a flame retardancy test arrangement (see 5.8)

Annex A
(informative)

Mechanical strength of insulating tools

Hand tools complying with ISO standards are often tested with test loads far beyond loads that can really be applied by hand. Among the reasons for this are

– that the application of these universal tools is not always known in detail, and
– that such tools are required to resist various improper uses that are to be expected, without failing and endangering the user.

For live working, the workers have to have a much better training level and the applications of some tools are very well defined. The following informative proposals are based on loads that can be applied by hand only and under regular conditions.

Insulating tools specially designed for live working applications may have lower stress resistance than insulated tools, if they withstand the expected work loads without failing due to permanent deformation or breaking.

A.1 General

To check the ability of insulating tools to withstand the expected maximum workloads specified in Clauses A.2 to A.5, tests should be carried out in accordance with the test procedures defined in ISO standards for similar insulated tools. If such ISO standards do not exist, tests may be specified by the manufacturer or by the customer.

If insulating tools are equipped with devices that limit the workloads that can be applied with them, for example overload slipping clutches, these limiting devices are activated before these tools reach the test loads specified hereafter.

A.2 Insulating screwdrivers

Table A.1 – Torque values for insulating screwdrivers

Blade diameter mm	**Test torque** N·m
More than 8,0	10
6,5 to 7,9	8,0
5,5 to 6,4	5,5
4,5 to 5,4	4,5
4,0 to 4,4	2,5
3,5 to 3,9	1,3
3,0 to 3,4	0,7
2,5 to 2,9	0,4
Up to 2,4	0,3

A.3 Insulating wrenches and ratchets

Wrenches and ratchets: maximum hand force = 500 N

The force is applied 35 mm away from the outer extremities of the handles right angled to the axle of the work piece to be turned.

A.4 Insulating T- wrenches

T-wrenches: maximum hand force = 250 N

The force is applied simultaneously on both handles in opposite directions, 35 mm away from the outer extremities of the handles right angled to the axle of the work piece to be turned.

A.5 Insulating pliers and cable shears

A hand load test in accordance with ISO 5744 should be carried out with a hand load of 500 N.

The load is to be applied 35 mm away from the outer extremities of the handles squeezing the handles.

A torsion test in accordance with ISO 5744 should be carried out for gripping pliers with a flat nose. The hand force for clamping is to be 350 N, applied 35 mm away from the outer extremities of the handle. The torque to be applied is 4 N·m. The maximum permissible twist angle at this torque is 20°.

Annex B
(informative)

Recommendation for use and in-service care

The following is for guidance only concerning the maintenance, inspection, retest and use of hand tools after purchase.

B.1 Storage

Insulated or insulating hand tools should be properly stored to minimise the risk of damage to the insulation due to storage or transportation. These tools should be stored generally separated from other tools to avoid mechanical damage or confusion. Furthermore, these tools should be prevented from excessive heat (for example heating or steam pipes) as well as UV- radiation.

B.2 Inspection before use

Before use, each hand tool should be visually inspected by the user.

If there is any doubt concerning the safety of the tool it should either be scrapped or subjected to examination by a competent person and retested if necessary.

B.3 Temperature

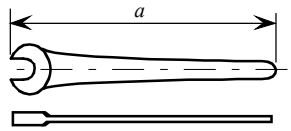
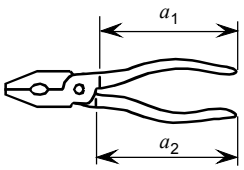
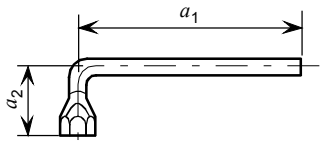
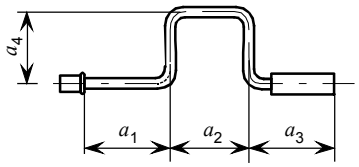
According to their capability, tools should be used only in areas having temperatures between –20 °C and +70 °C and, for tools marked “C”, between –40 °C and +70 °C.

B.4 Periodic examination and electrical retesting

An annual visual examination by a suitably trained person is recommended to determine the suitability of the tool for further service. If an electrical retest is required by national regulation or by customer specifications or in case of doubt after visual examination, the routine dielectric test should be performed.

Annex C
(normative)

Examples of calculation of the unwinded length of coating and acceptable leakage current

Designations	Unwinded length of coating L	Limits of acceptable leakage current $I_M = 5\ L$
 Engineers' wrench single head	$L = a$ *Example:* $L = a$ = 0,20 m	5 L = 1 I_M = 1 mA
 All-purpose pliers	$L = a_1 + a_2 = 2a_1$ *Example:* $a_1 = a_2$ = 0,14 m L = 0,28 m	5 L = 1,4 rounded to I_M = 2 mA
 Socket wrench, single head	$L = a_1 + a_2$ *Example:* a_1 = 0,30 m a_2 = 0,10 m L = 0,40 m	5 L = 2 I_M = 2 mA
 Speed brace	$L = a_1 + a_2 + a_3 + 2a_4$ *Example:* a_1 = 0,30 m a_2 = 0,15 m a_3 = 0,15 m a_4 = 0,25 m L = 1,10 m	5 L = 5,50 rounded to I_M = 6 mA

Annex D
(normative)

Sampling procedure

D.1 General

The sampling procedure does not follow in its entirety the sampling procedure developed in ISO 2859-1. The product covered by this standard does not lend itself to the application of the above-mentioned standard, due to its nature.

Sampling tests shall be done in accordance with and in the sequence described in Clause 5.

D.2 Classification of defects

Defects are classified as major or minor (see definitions in IEC 61318).

The following table gives the nature of defects in relation with the tests specified for the sampling procedure.

Table D.1 – Classification of defects

Description of test	Subclause	Minor defect	Major defect
Dimensional	5.3	X	
Impact	5.4		X
Dielectric	5.5		X
Indentation	5.6	X	
Adhesion	5.7		X
Flame retardancy	5.8	X	
Mechanical	5.9.1 5.9.2	X	
Retaining force	5.9.4		X
Durability of marking	5.10	X	

D.3 General sampling plan

D.3.1 Plans for major defects

The number of hand tools undergoing the tests and the acceptance criterion shall be in accordance with Table 1 of IEC 61318.

For lots equal to or larger than 35 001 items, use other test lots less than 35 000 items according to Table 1 of IEC 61318.

D.3.2 Plans for minor defects

The number of hand tools undergoing the tests and the acceptance criterion shall be in accordance with Table 3 of IEC 61318.

For lots equal to or larger than 35 001, use other test lots less than 35 000 according to Table 3 of IEC 61318.

Annex E
(normative)

Acceptance tests

An acceptance test is a contractual test to prove to the customer that the item(s) or product in question meet(s) the conditions of the customer's specification.

If the customer only requires that the product shall meet those of the governing standard the basic acceptance tests are those which are specified in the governing standard. The customer may request that they be repeated on his order.

The customer may request additional tests or increase the sampling size but shall include this in his own specification. The expansion of the acceptance testing beyond the tests required in the governing standard is subject to agreement between the customer and the supplier.

The customer shall include the acceptance test requirements in his own specification and may wish to witness the tests, have them witnessed by a third party or accept the results of the tests carried out by the manufacturer. The customer may prefer to perform the tests in his own laboratory or may specify that the tests be carried out in an independent laboratory of his choosing. This additional test expense is subject to agreement between the customer and the supplier.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60060-1 + corr. March	1989 1990	High-voltage test techniques Part 1: General definitions and test requirements	HD 588.1 S1	1991
IEC 60212	1971	Standard conditions for use prior to and during the testing of solid electrical insulating materials	HD 437 S1	1984
IEC 60417	database	Graphical symbols for use on equipment	-	-
IEC 61318	2003	Live working - Quality assurance plans applicable to tools, devices and equipment	-	-
IEC 61477	2001	Live working - Minimum requirements for the utilization of tools, devices and equipment	EN 61477	2002
A1	2002		A1	2002
ISO 1174-1	1996	Assembly tools for screw and nuts - Driving squares Part 1: Driving squares for hand socket tools	-	-
ISO 9654	1989	Pliers and nippers for electronics - Single-purpose nippers - Cutting nippers	-	-
ISO 9655	1989	Pliers and nippers for electronics - Single-purpose nippers - Pliers for gripping and manipulating	-	-
ISO 9656	1989	Pliers and nippers for electronics - Test methods	-	-
ISO 9657	1989	Pliers and nippers for electronics - General technical requirements	-	-

Bibliography

IEC 60050(151):2001, *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices*

IEC 60050(651):1999, *International Electrotechnical Vocabulary (IEV) – Part 651: Live working*

IEC 60743:2001, *Live working – Terminology for tools, equipment and devices*

ISO 1703:1983*, Assembly tools for screw and nuts – Nomenclature*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 5742:1982*, Pliers and nippers – Nomenclature*

ISO 5744:1988*, Pliers and nippers – Methods of tests*

ISO 8979:1988*, Pliers and nippers for electronics – Nomenclature*

ISO 9001:2000, *Quality management systems – Requirements*

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