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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Withdrawn

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

Travaux sous tension – Outils à main pour usage jusqu'à 1 000 V en courant alternatif et 1 500 V en courant continu

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

FOREWORD

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International Standard IEC 60900 has been prepared by IEC technical committee 78: Live working.

This third edition cancels and replaces the second edition, published in 2004. This edition constitutes a technical revision.

It includes the following significant technical changes with regard to the previous edition:

- general review of the requirements and test provisions;
- preparation of the elements of evaluation of defects, and general application of IEC 61318:2007 (Ed.3);
- deletion of Annexes D and E, not applicable according to IEC 61318 Ed.3;
- introduction of a new normative Annex D on chronology of type tests;
- introduction of a new normative Annex F on classification of defects.

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The text of this standard is based on the following documents:

FDIS	Report on voting
78/947/FDIS	78/953/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

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

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

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- withdrawn,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

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INTRODUCTION

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

The product covered by this standard may have an impact on the environment during some or all stages of its life cycle. These impacts can range from slight to significant, be of short-term or long-term, and occur at the global, regional or local level.

This standard does not include requirements and test provisions for the manufacturers of the product, or recommendations to the users of the product for environmental improvement. However, all parties intervening in its design, manufacture, packaging, distribution, use, maintenance, repair, reuse, recovery and disposal are invited to take account of environmental considerations.

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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.

The products designed and manufactured according to this standard contribute to the safety of the users provided they are used by skilled persons, in accordance with safe methods of work and the instructions for use (where appropriate).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *High-voltage test techniques – Part 1: General definitions and test requirements*

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

IEC 60417, *Graphical symbols for use on equipment*

IEC 61318, *Live working – Conformity assessment applicable to tools, devices and equipment*

IEC 61477, *Live working – Minimum requirements for the utilization of tools, devices and equipment*

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

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

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61318 and the following apply.

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NOTE For the definitions of general terms in this document, reference should be made to the IEC 60050 series 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 (for live working)
hand held insulated or insulating tool

Note 1 to entry: Hand tools are normally tools such as screwdrivers, pliers, wrenches or knives.

[SOURCE: IEC 60050-651:1999, 651-01-27, modified – The scope of the definition has been enlarged.]

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

[SOURCE: IEC 60050-651:1999, 651-01-25, modified – The definition has been changed to refer specifically to hand tools.]

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

[SOURCE: IEC 60050-651:1999, 651-01-26, modified - The definition has been changed to refer specifically to hand tools and its scope has been narrowed.]

4 Requirements

4.1 General requirements

4.1.1 Safety

Insulated and insulating hand tools shall be manufactured and dimensioned in such a way that they protect the user from electric shock.

NOTE Insulated hand tools completely covered by insulating materials and insulating tools minimize the risk of short circuits between two parts at different potentials when they are used in the correct manner.

The following requirements have been prepared in order that the hand tools covered by this standard are designed and manufactured to contribute to the safety of the users, provided they are used by persons skilled for live working, in accordance with safe methods of work and the instructions for use (where appropriate).

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 hand tools shall be retained even after application of an insulating layer.

Insulating hand tools specially designed for live working may have lower stress resistance than insulated hand tools, but they shall withstand the expected workloads without failing due to remaining deformation or breaking. These hand 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).

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4.1.3 Multiple-ended hand tools

Multiple-ended hand 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 hand tools but are allowed for insulating hand tools if the design assures that there is no conductive connection between two of the working heads.

4.1.4 Marking

The marking shall be clearly identifiable by persons with normal or corrected sight without further magnification. Each hand tool and/or tool component shall be legibly and permanently marked with the following items of marking:

- on the insulating material or on the metal part:
  - marking of the origin (manufacturer's name or trade mark);
- on the insulating material:
  - model/type reference;
  - year of manufacture (at least the last two digits of the year);
  - symbol IEC 60417-5216:2002-10 – Suitable for live working; double triangle (see Annex B);

    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.
  - indication 1 000 V (i.e. the electrical working limit for alternating current), immediately adjacent to the symbol double triangle (see Figure 1 for an example);

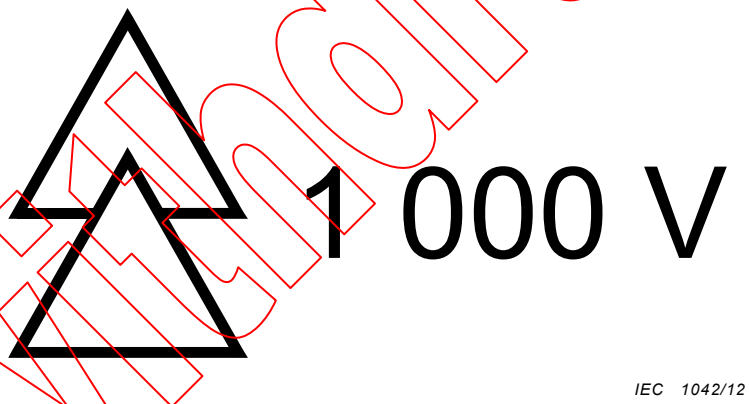

Figure 1 – Marking of the electrical working limit adjacent to the symbol double triangle

  - number of the relevant IEC standard immediately adjacent to the symbol double triangle, (IEC 60900);
  - for hand tools designed for use at extremely low temperature: letter "C" (see 4.2.2);
  - additional marking for hand tools capable of being assembled and designed to be interchangeable between different manufacturers (see 4.3.1.3.2);
  - additional marking where specified by the customer (for example ownership mark).

The hand 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 hand tool is suitable for work at that voltage.

Other characteristics or information not needed at the work location, like the year of publication of the standard, shall be associated to the product item by other means, such as coded information (bar codes, microchips, etc.), or shall be associated to its packaging.

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The symbol double triangle shall be at least 3 mm high; the letter and the figures of the electrical working limit shall be at least 2 mm (see Figure 1).

4.1.5 Separating of covers

If hand 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 do not come off during normal use (see 5.7.4).

4.1.6 Instructions for correct adjustment and assembly

Where the manufacturer deems that instructions are necessary for correct adjustment or assembly, then the manufacturer shall provide these in accordance with the general provisions given in IEC 61477 (see also Annex C).

4.2 Requirements concerning insulating materials

4.2.1 General

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 hand tools shall not be impaired within the temperature range –20 °C to +70 °C.

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

Hand 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 Hand tools capable of being assembled

4.3.1.1 Retaining devices for hand tools capable of being assembled

Hand 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 5.8.4.

4.3.1.2 Insulation design for hand tools capable of being assembled

In the case of connecting parts of hand tools capable of being assembled, the insulation shall be applied in such a manner that if any part becomes detached during use by exceeding the retaining forces according to 5.8.4, no conductive part, which may still be live, can be inadvertently touched or cause a disruptive discharge.

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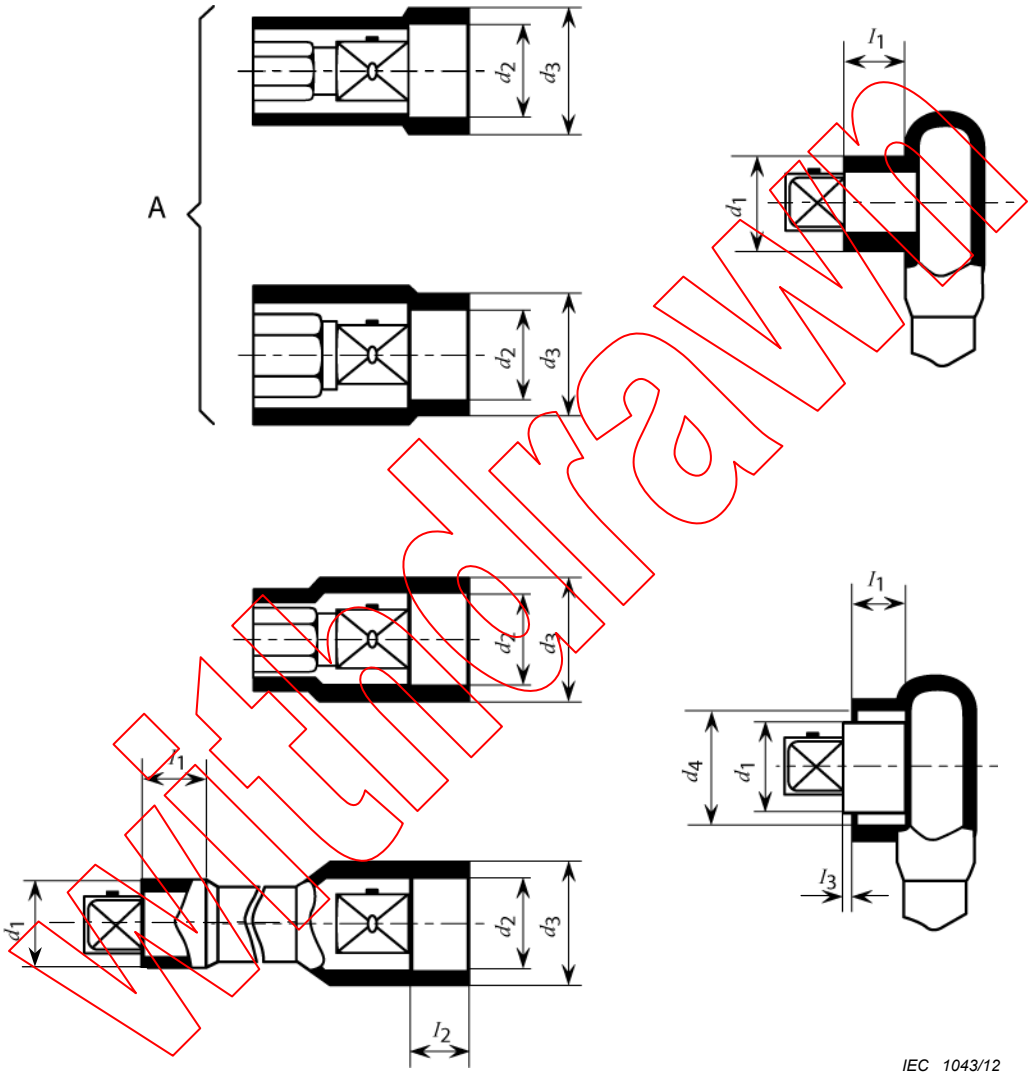
4.3.1.3 Hand tools capable of being assembled with square drives

4.3.1.3.1 General

Hand 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 5.8.4.2). To ensure compatibility of insulation between different manufacturers, these hand tools shall be designed with overlapping elements described in Figure 2. Their dimensions and tolerances shall be in accordance with Table 1.



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Key

A admitted shapes

Figure 2 – Description of the insulating overlapping element and different assembly configurations for hand tools capable of being assembled with square drives

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Table 1 – Dimensions and tolerances of the insulating overlapping element

Dimensions in millimetres

Nominal size of the square drive	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 2.							

4.3.1.3.2 Interchangeability of components made by different manufacturers

Hand 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 3. The dimension H shall be greater than or equal to 5 mm.

Dimensions in millimetres

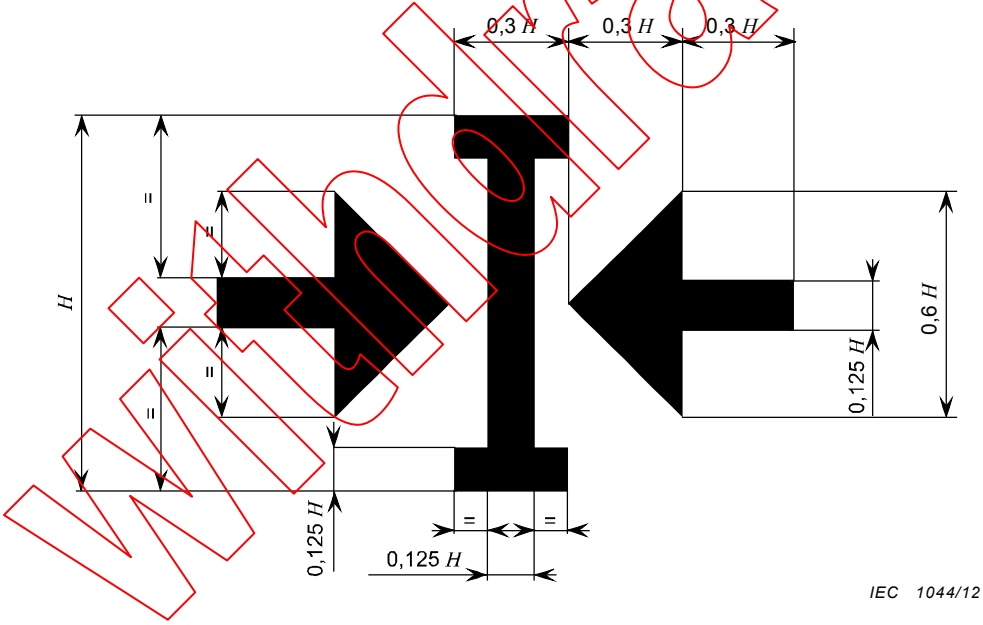

Figure 3 – Marking symbol for hand tools capable of being assembled and designed to be interchangeable between different manufacturers

The reliable function of locking systems used for those hand tools shall be tested by applying a separation test in accordance with 5.8.4 with a corresponding dummy.

For this kind of hand tools, instructions for correct assembly are mandatory. The manufacturer shall include the following information: “To assure that the complete assembly of insulated hand 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”.

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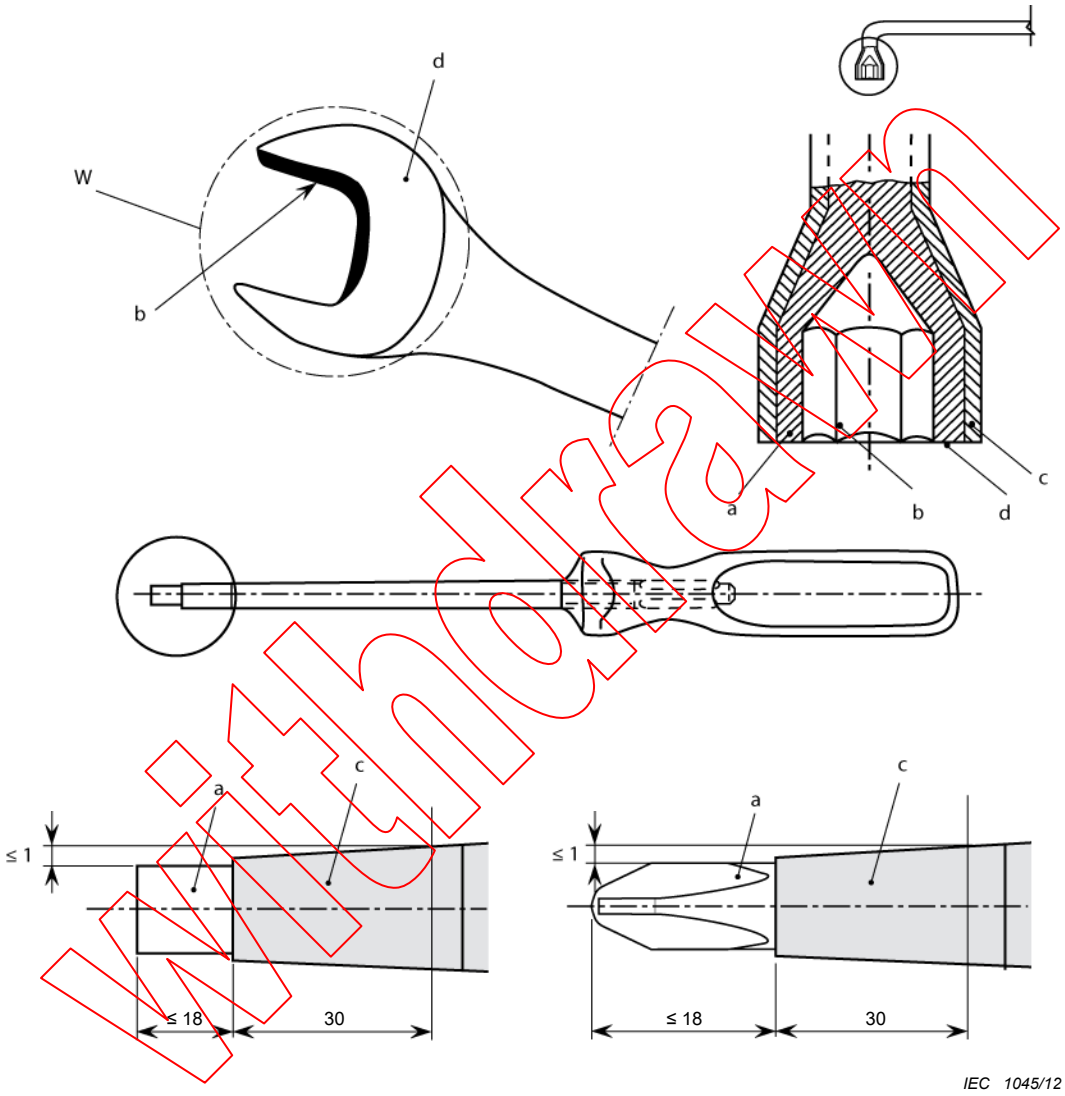
4.3.2 Screwdrivers

4.3.2.1 Uninsulated areas

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

Dimensions in millimetres



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Key

a	conductive part
b	working surface
c	insulation
d	contact area
W	working head

Figure 4 – Illustration of insulation of typical hand tools

4.3.2.2 Shape of shaft insulation

The shaft 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

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the width of the shaft at the tip or the width of the tip, whatever is the larger dimension. This area may be parallel or tapered towards the tip.

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

4.3.2.3 Screwdrivers with exchangeable working heads

Screwdrivers with exchangeable working heads are regarded as hand 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 Adjustable wrenches

The insulation of adjustable wrenches shall be applied as far as possible towards the working head.

The uninsulated area may be extended to the working head. If the working head remains uninsulated, a guard shall be applied so that the hand is prevented from slipping towards the uncovered conductive parts of the head (see an example in Figure 5).

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Dimensions in millimetres

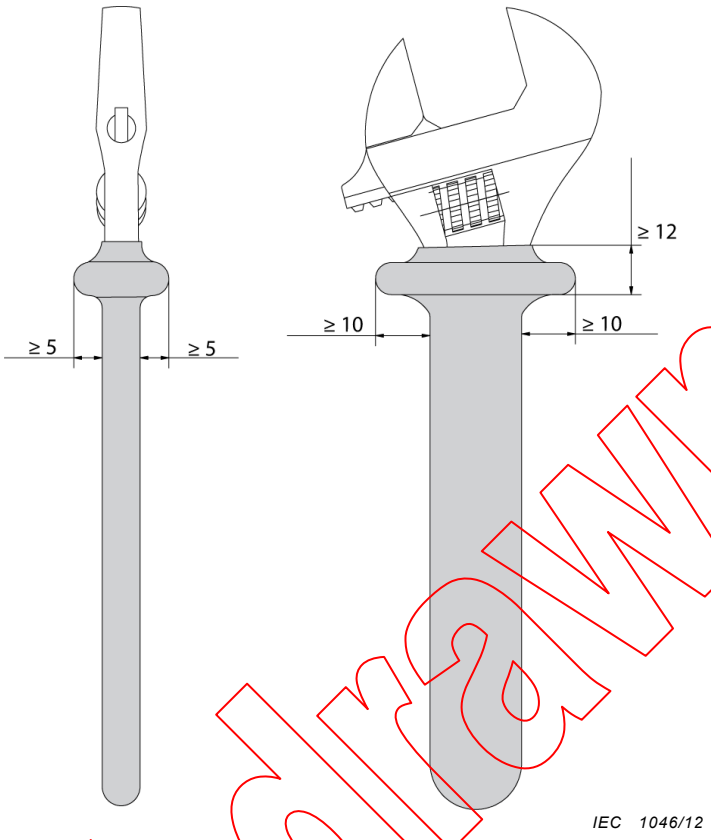

Figure 5 – Insulated adjustable wrench

Withdrawn

4.3.5 Pliers, strippers, cable scissors, cable-cutting hand 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 6 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 6 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 each guard and any non-insulated parts shall be 12 mm (see Figure 6). The insulation portion in front of the guard shall extend as far as possible towards the working head.

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Dimensions in millimetres

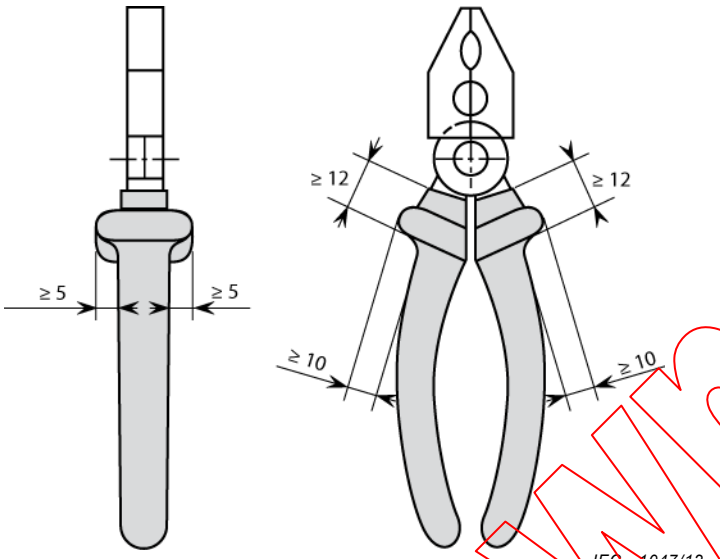

Figure 6 – Insulation of pliers

In the case of a slip joint, a guard of 5 mm shall be provided for the inner part of the handles. Refer to Figure 7 for further dimensioning.

Dimensions in millimetres

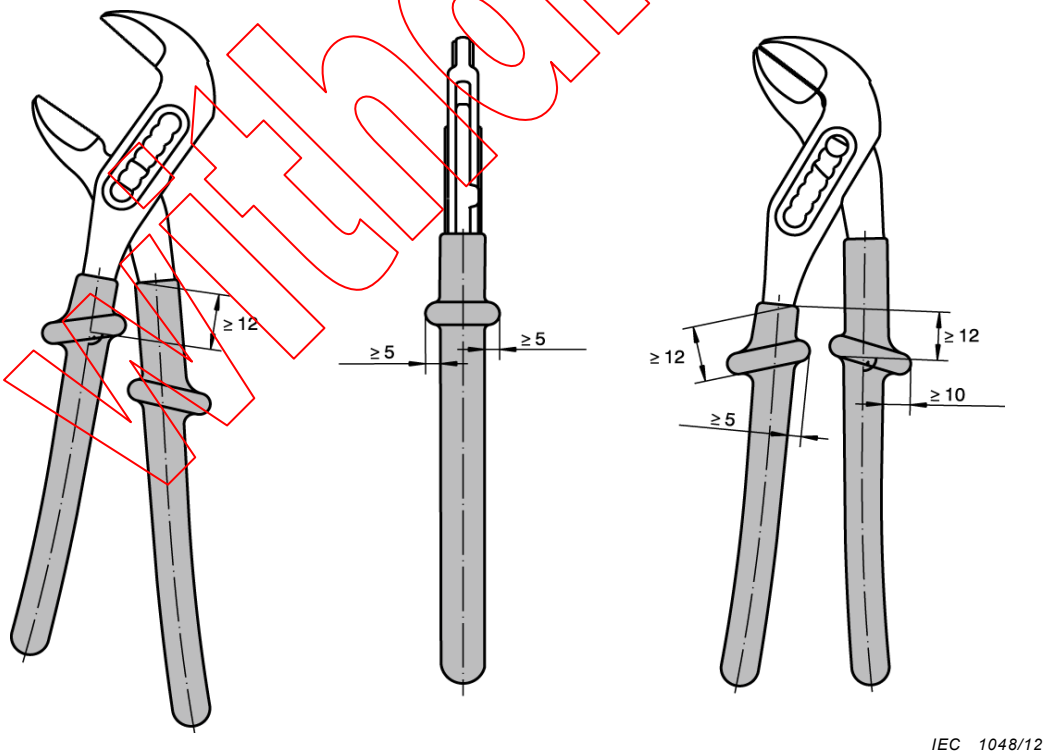

Figure 7 – Insulation of multiple slip joint pliers

Where there is a functional surface below the joint, an inner guard shall be provided (as used with multiple slip joint pliers). See Figure 8.

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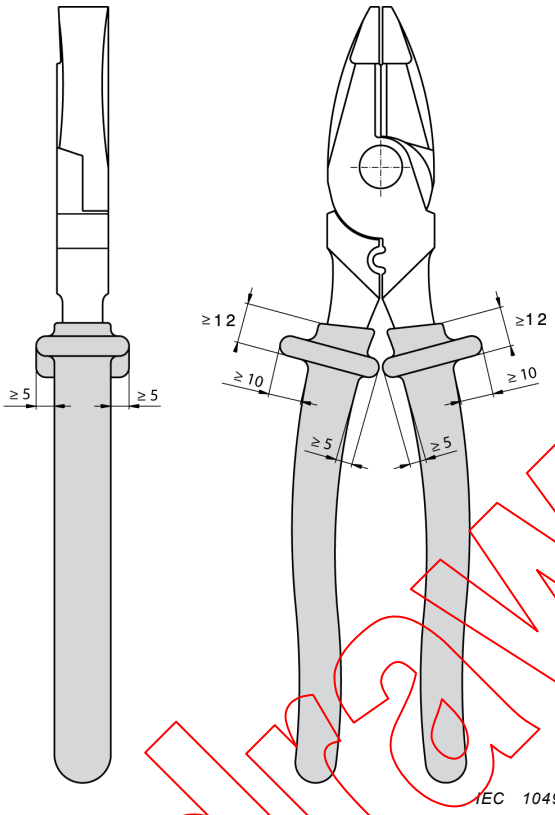

Figure 8 – Insulation of pliers with a functional area below the joint

Where the handles of the hand 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 9).

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

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Dimensions in millimetres

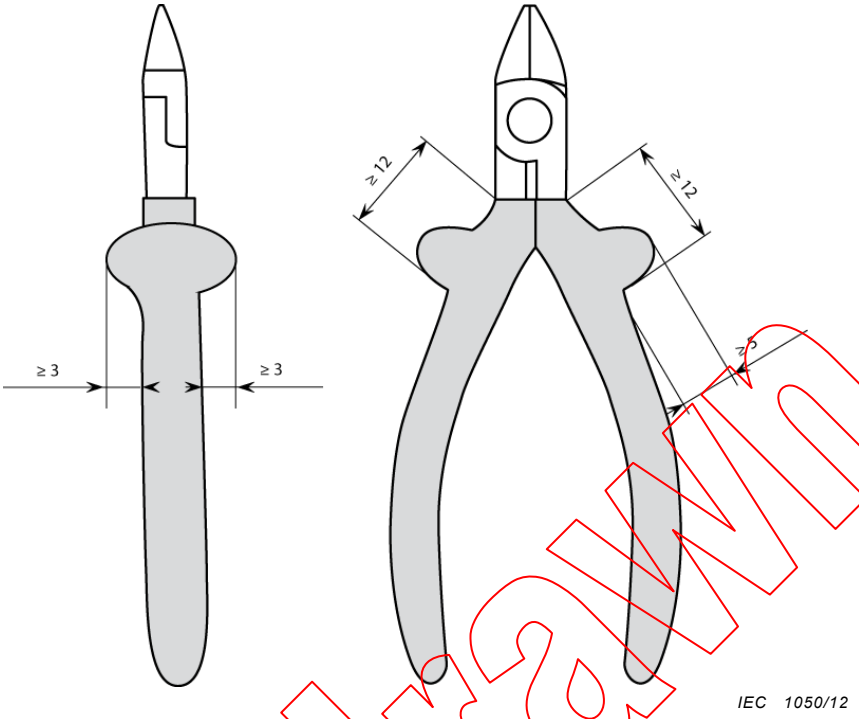

Figure 9 – Illustration of insulation of pliers and nippers for electronics

4.3.6 Scissors

A typical insulation of scissors is shown in Figure 10.

The shackles of the scissors shall have one of both designs presented in Figures 10a and 10b.

The maximum length of the uninsulated parts of scissors shall not exceed 100 mm.

The insulation portion in front of the guard shall extend as far as possible towards the working head. If the insulated length in front of the shackle is less than 50 mm, at least one guard is required.

Withdrawn

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Dimensions in millimetres

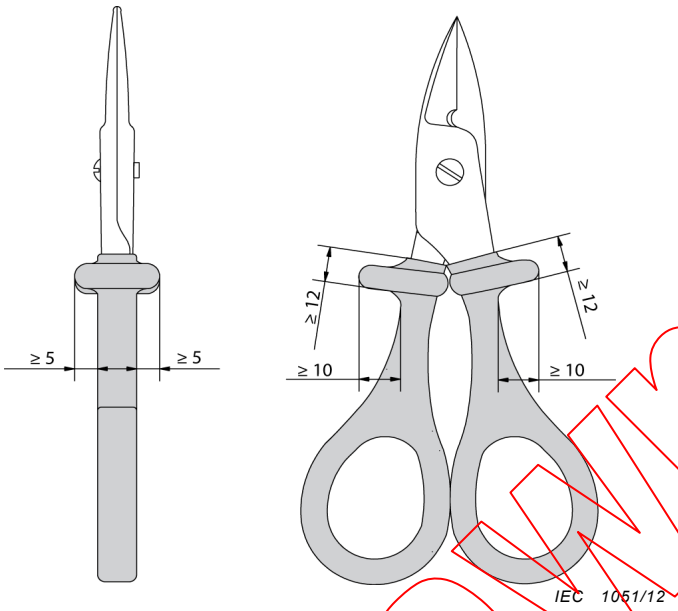

Figure 10a

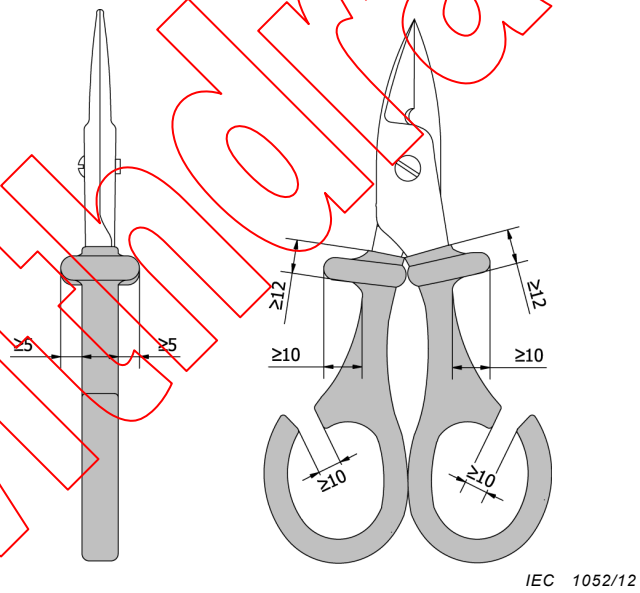

Figure 10b

Figure 10 – Insulation of scissors

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4.3.7 Knives

Figure 11 shows an example for the application of the insulation of knives. The dimensions of insulated knives shall be in accordance with Figure 11.

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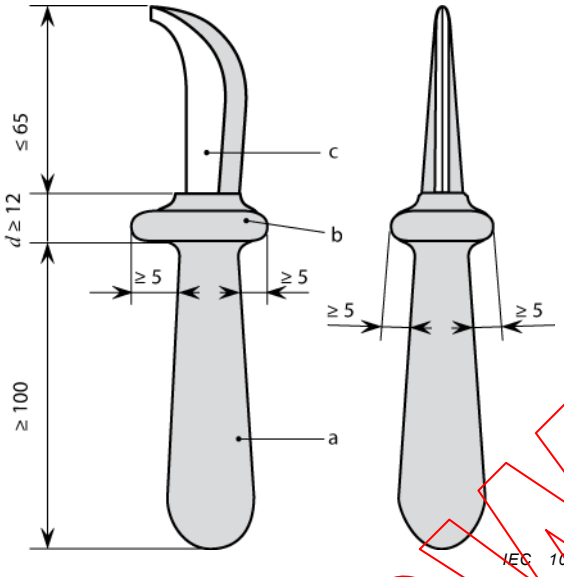
Dimensions in millimetres



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 11 – Insulation of knives

4.3.8 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 12).

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 12).

The uninsulated length u of the working head shall not exceed 20 mm (see Figure 12).

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.

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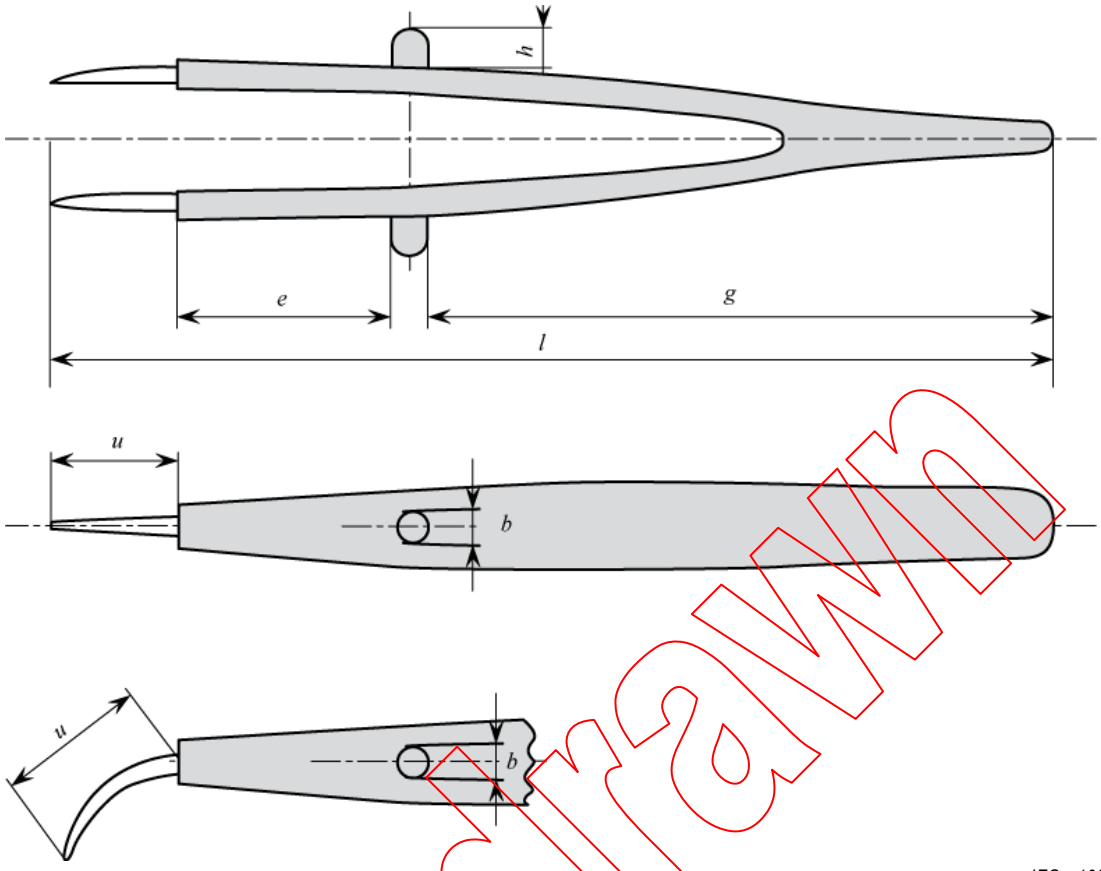

IEC 1054/12

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 12 – Example of insulation of the handles of tweezers

Withdrawn

5 Tests

5.1 General

The present standard provides testing provisions to demonstrate compliance of the product to the requirements of Clause 4. These testing provisions are primarily intended to be used as type tests for validation of the design input. Where relevant, alternative means (calculation, examination, tests, etc.), are specified within the test subclauses for the purpose of hand tools having completed the production phase.

The type tests specified in 5.2 to 5.10 shall be carried out on at least three hand tools of the same design and in the sequence specified in Annex D.

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

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

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Unless otherwise stated, the type 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 type test values required are permissible.

5.2 Visual check

The hand 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.

The compliance with the relevant complementary requirements of the following subclauses shall be checked by visual inspection:

- subclause 4.3.1.2, in the case of connecting parts of hand tools capable of being assembled;
- subclause 4.3.1.3.2 for instructions for use in the case of hand tools capable of being assembled and designed to be interchangeable between different manufacturers;
- subclause 4.3.2.4 for the type of material of the screw retaining devices of screwdrivers;
- subclause 4.3.3 for uninsulated areas of wrenches.

5.3 Dimensional check

The dimensional requirements of 4.3 shall be checked. The dimensions of certain elements of marking shall be checked according to 4.1.4.

5.4 Impact tests

5.4.1 Type test

5.4.1.1 General

The test shall be carried out according to one of the two methods shown in Figures 13 and 14. In any doubt, method "B" applies (see Figure 14).

In case of hand tools capable of being assembled, the tool components shall be tested separately.

The hammer used in the apparatus of Figure 13 and the hammer and intermediate piece used in apparatus of Figure 14 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 hand tool drops on a flat surface.

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

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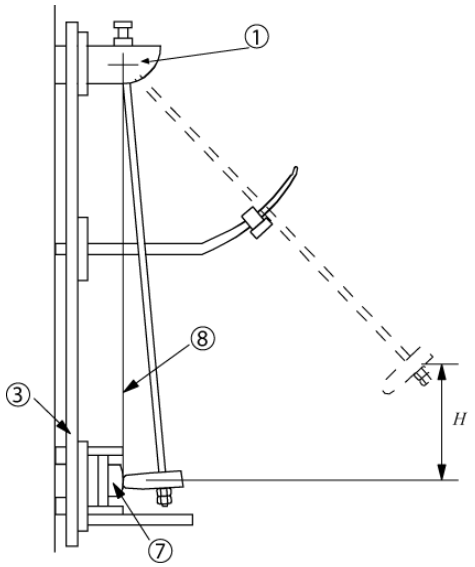
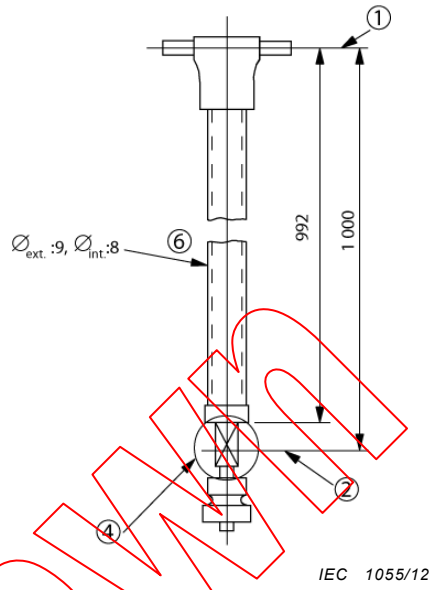
Dimensions in millimetres

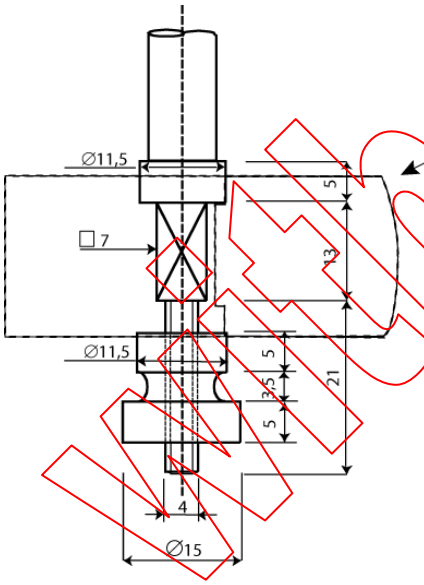


Side view

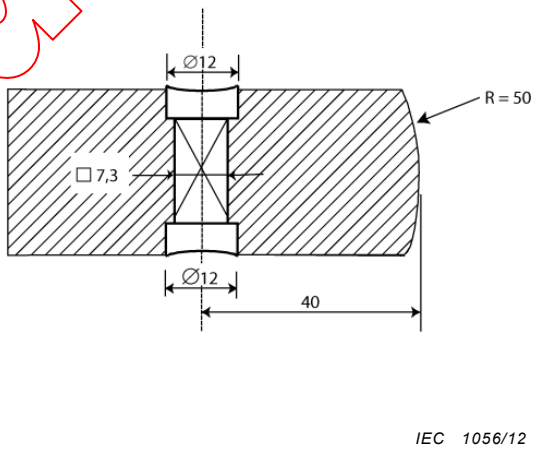


Front view

Dimensions in millimetres



Detail of the assembly of hammer



Detail of hammer head

Key

1	axis of swing adjustable	5	hammer head – Rockwell hardness of material between 20 HRC and 46 HRC
2	axe of hammer	6	steel tube
H	fall height	7	test piece
3	frame	8	vertical plane through axis of pendulum
4	hammer		

Figure 13 – Example of test arrangement for the impact test – Method A

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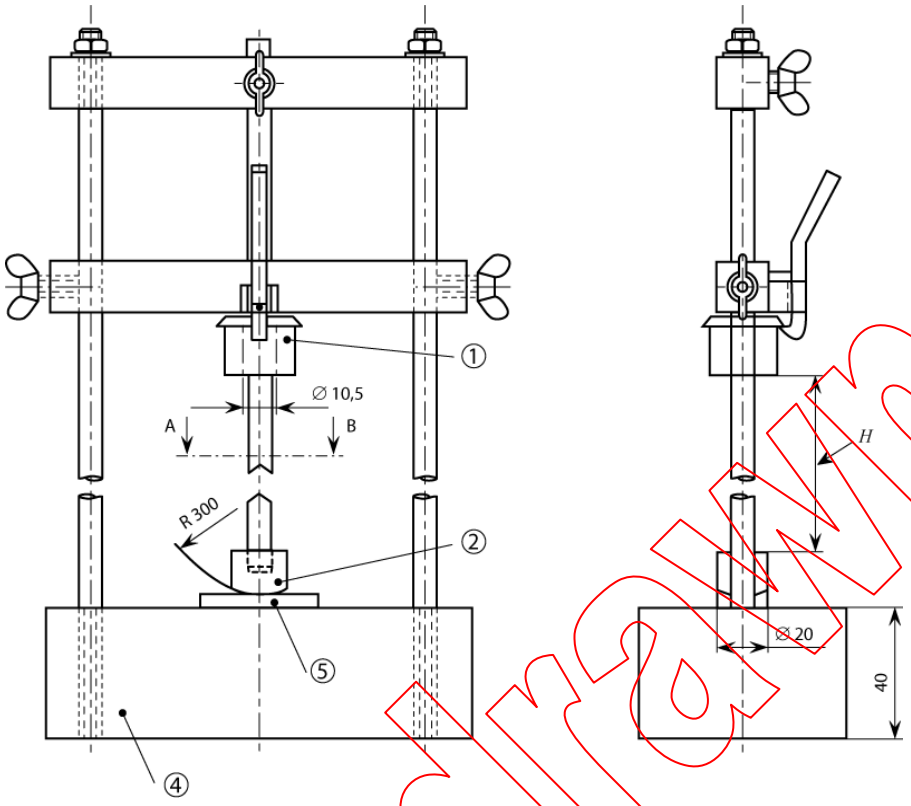
Dimensions in millimetres



Key

H	fall height
1	hammer
2	steel intermediate piece 100 g
3	slightly rounded edges
4	steel part 10 kg
5	test piece

Figure 14 – Example of test arrangement for the impact test – Method B

5.4.1.2 Ambient temperature impact test

The hand 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 hand tool to be tested shall be equal to that of this tool falling on a hard surface from a height of 2 m:

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

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where

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

5.4.1.3 Low temperature impact test

Hand 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 hand 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 hand tool tested, in newtons;
P is the weight of the hammer, in newtons.

5.4.1.4 Extreme low temperature impact test

Hand 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 5.4.1.3.

5.4.2 Alternative means in case of insulated and insulating hand tools having completed the production phase

For conformity evaluation of insulated and insulating hand tools having completed the production phase, the manufacturer shall prove that he has followed the same documented production procedure as per the type tested device.

The manufacturer shall document components and procedures that could affect the impact resistance.

In any doubt, a sampling test in accordance with IEC 61318, using the test method defined for the type test, applies.

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** (for type test only)

5.5.2.1 General

Before testing (according to 5.5.3 or 5.5.4), the hand tools shall be conditioned in accordance with one of the two possibilities described in 5.5.2.2 and 5.5.2.3.

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5.5.2.2 Water bath

The hand 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. The water shall have a minimum conductivity of 100 μS/cm. After this conditioning, the hand tools shall be wiped dry and submitted to the dielectric test.

5.5.2.3 Wet chamber

The hand tools shall be stored at a relative humidity of (93 ± 2)% at a temperature of 23 °C ± 5 °C for 48 h. Hand tools capable of being assembled shall not be assembled prior to conditioning.

NOTE This humidity conditioning may be obtained by storing the hand 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 hand tools

5.5.3.1 Type test

5.5.3.1.1 General

The hand 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 water shall have a minimum conductivity of 100 μS/cm. The conductive part shall be above the water level (see Figure 15).

Pliers and similar hand 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 15).

For hand 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 hand 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 E gives examples of calculation of the unwinded length of coating and the limits of acceptable leakage current.

Hand tools capable of being assembled shall be tested in all variations of the assembly that are specified by the manufacturer. For tools capable of being assembled with square drives, dummies may be used for the electrical test (see 5.5.3.1.2). Hand tools with retaining devices shall be tested on both end positions, if applicable.

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

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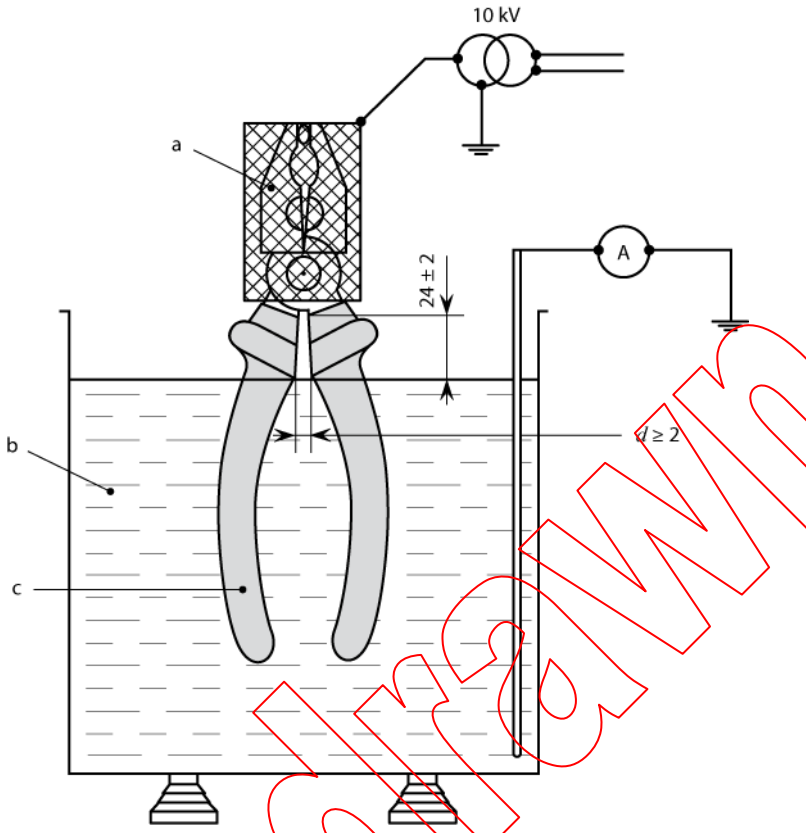
Dimensions in millimetres



Key

a conductive working head
b tap water bath
c insulated part of the hand tool
d gap to be maintained between the two inner sides of the legs
A ammeter

Figure 15 – Dielectric testing arrangement for insulated hand tools

5.5.3.1.2 Tests of hand tools capable of being assembled with square drives (see 4.3.1.3.1)

In case of hand 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 16. The dimensions and tolerances of the dummies shall be in accordance with Table 2.

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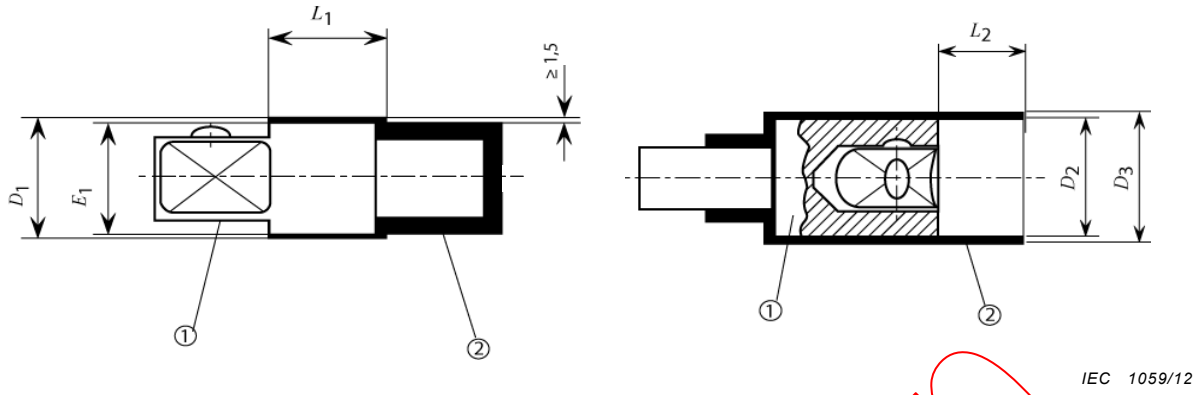
Dimensions in millimetres



Dummy part 1 to be used with female hand tool ends

Dummy part 2 to be used with male hand tool ends

Key

1 conductive part

2 insulation

Figure 16 – Description of dummies for dielectric tests for hand tools capable of being assembled with square drives

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 16.						

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 as passed if no electrical puncture, sparkover or flashover occurs during the test period, and if the limits of leakage current are not exceeded.

5.5.3.2 Alternative means in case of insulated hand tools having completed the production phase

For conformity evaluation of hand tools having completed the production phase the test of 5.5.3.1 shall be performed but

– 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 is not carried out.

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5.5.4 Dielectric testing of insulating hand tools

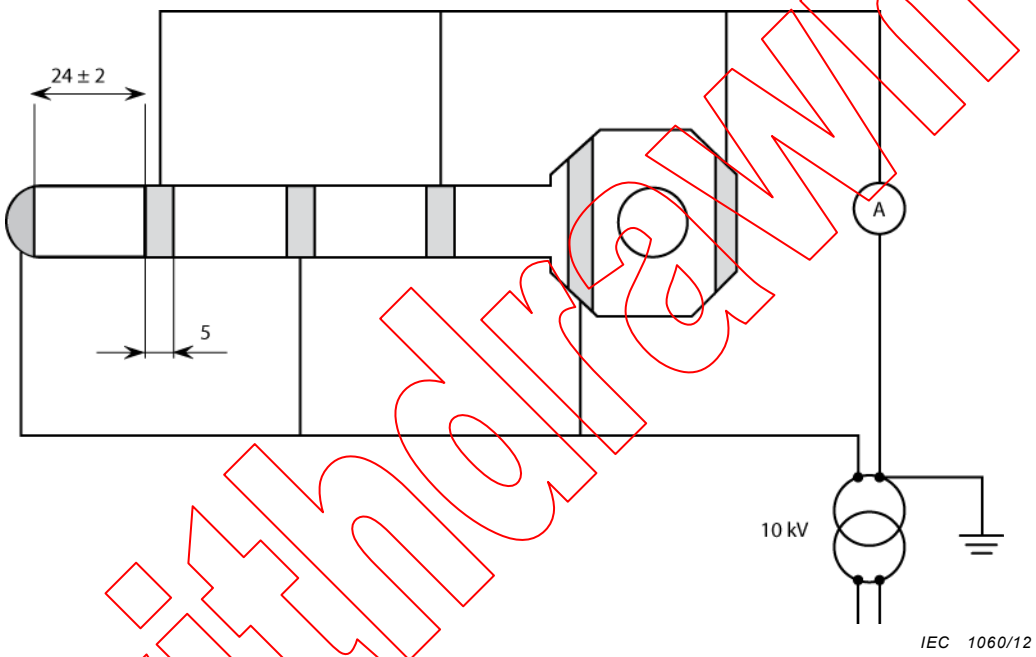
5.5.4.1 Type test

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 17). 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.

Dimensions in millimetres



Key

A ammeter

Figure 17 – Dielectric testing arrangement for insulating hand tools

The test shall be considered as passed 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.

5.5.4.2 Alternative means in case of insulating hand tools having completed the production phase

For conformity evaluation of insulating hand tools having completed the production phase, the manufacturer shall prove that he has followed the same documented manufacturing procedure as per the type tested device.

The manufacturer shall document components and procedures that could affect the dielectric performance.

In any doubt, a sampling test in accordance with IEC 61318, using the test method defined for the type test, applies.

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5.6 **Indentation test** (for insulated hand tools)

5.6.1 Type test

All parts of the insulating coating of insulated hand tools, electrically tested as indicated in the relevant subclauses of 5.5 shall pass this test. The test shall be performed on the most vulnerable part(s) for screwdrivers with insulated shaft, and for other hand 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 18a. 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 18b).

The hand 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/70 °C/<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 hand tool for 3 min, using the code 18 °C - 28 °C/45 % - 75 % of IEC 60212.

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

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