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Second edition
2004-01

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60900 has been prepared by IEC technical committee 78: Live working. This second edition

– cancels and replaces the first edition, published in 1987, and its two amendments published in 1995 and in 2002;
– 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 text of this standard is based on the following documents:

FDIS	Report on voting
78/547/FDIS	78/554/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 2008. At this date, the publication will be

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- withdrawn;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

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.