SLOVENSKI STANDARD
SIST EN 60900:2001

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Hand tools for live working up to 1 kV a.c. and 1,5 kV d.c.

Hand tools for live working up to 1 kV a.c. and 1,5 kV d.c.

Handwerkzeuge zum Arbeiten an unter Spannung stehenden Teilen bis AC 1 kV und DC 1,5 kV

Outils à main pour travaux sous tension jusqu'à 1 kV en courant alternatif et 1,5 kV en courant continu

Ta slovenski standard je istoveten z: **EN 60900:1993**

ICS:

13.260	Varstvo pred električnim udarom. Delo pod napetostjo	Protection against electric shock. Live working

SIST EN 60900:2001 **en**

EUROPEAN STANDARD
NORME EUROPÉENNE
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EN 60900 + A11
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English version

Hand tools for live working up to 1 kV a.c. and 1,5 kV d.c.

(includes amendments A1:1995, A2:2002 and A11:1997)
(IEC 900:1987, modified + A1:1995 + A2:2002, modified)

Outils à main pour travaux sous tension jusqu'à 1 kV en courant alternatif et 1,5 kV en courant continu
(inclut les amendements A1:1995, A2:2002 et A11:1997)
(CEI 900:1987, modifiée + A1:1995, + A2:2002 modifiée)

Handwerkzeuge zum Arbeiten an unter Spannung stehenden Teilen bis 1 kV a.c. und 1,5 kV d.c.
(enthält Änderungen A1:1995, A2:2002 und A11:1997)
(IEC 900:1987, modifiziert + A1:1995, + A2:2002 modifiziert)

This European Standard was approved by CENELEC on 1993-07-06. Amendment A1 was approved by CENELEC on 1995-09-20; amendment A11 was approved by CENELEC on 1996-12-09 and amendment A2 was approved by CENELEC on 2002-07-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Ref. No. EN 60900:1993 + A1:1995 + A2:2002 + A11:1997 E

Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 900:1987 could be accepted without textual changes, has shown that some common modifications were necessary for the acceptance as European Standard.

The reference document, together with the common modifications prepared by the CENELEC Technical Committee TC 78, was submitted to the CENELEC members for formal vote.

The text of the draft was approved by CENELEC as EN 60900 on 1993-07-06.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1994-08-01
- latest date of withdrawal of conflicting national standards (dow) 1995-08-01

For products which have complied with the relevant national standard before 1995-08-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1999-08-01.

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given only for information. In this standard, Annex A, Annex B and Annex ZB are informative, Annex ZA and Annex ZC are normative.

Foreword to amendment A1

The text of document 78/163/DIS, future amendment 1 to IEC 900:1987, prepared by IEC TC 78, Tools for live working, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 60900:1993 on 1995-09-20.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-07-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1996-07-01

As a consequence of endorsing amendment 1:1995 to IEC 900:1987, the common modifications and Annex ZA and Annex ZB in EN 60900:1993 are withdrawn and replaced by similar IEC text. Hence, EN 60900:1993 + A1:1995 is now identical to IEC 900:1987 + A1:1995.

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given for information only. In this standard, Annex C and Annex ZC are normative and Annex A, Annex B and Annex D are informative. Annex ZC has been added by CENELEC, it replaces Annex ZC of EN 60900.

Foreword to amendment A11

This amendment was prepared by the Technical Committee CENELEC TC 78, Tools and equipment for live working.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A11 to EN 60900:1993 on 1996-12-09.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-12-01
- latest date by which national standards conflicting with the amendment have to be withdrawn (dow) 1997-12-01

This amendment supplements or modifies the text of EN 60900-1993 and its amendment A1:1995.

This amendment to EN 60900 answers the following two questions:

1 — How to solve the insulation compatibility of tools capable to be assembled produced by different manufacturers.

2 — In case of "micro tools", what are the guard dimensions?

Foreword to amendment A2

The text of document 78/429/FDIS, future amendment 2 to IEC 60900:1987 to amendment A2 prepared by IEC TC 78, Live working, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A2 to EN 60900:1993 on 2002-07-01.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2003-04-01
- latest date by which national standards conflicting with the amendment have to be withdrawn (dow) 2005-07-01

Annexes designated "normative" are part of the body of the standard.

In this standard Annex ZA is normative.

Annex ZA has been added by CENELEC.

Contents

1 Scope

This 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.

Not included are:

— tools and equipment and material supplied from an external energy source;

— insulating rods and poles, used for working at a distance, which are covered by IEC 855.

2 Nomenclature and definitions

2.1
hand tools
for the nomenclature, refer to applicable ISO Standards such as ISO 1703, ISO 5742 and ISO 8979

2.2
insulated hand tools
hand tools covered with insulating material in order to protect the user from electric shock and to minimize the risk of short-circuits between two parts at different potentials

2.3
insulating hand tools
hand tools made predominantly of insulating material except for metal inserts,

— at the working head or active part, or

— used for reinforcement, but with no exposed metal parts,

in either case to protect the user from electric shocks as well as to prevent short-circuit between exposed parts at different potentials

2.4 Definition of tests

The following terms are defined in accordance with Chapter 151 of the International Electrotechnical Vocabulary (IEV) [IEC Publication 50 (151)].

2.4.1
type test
a test of one or more devices made to a certain design to show that the design meets certain specifications (IEV 151-04-15)

2.4.2
routine test
a test to which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria (IEV 151-04-16)

2.4.3
sampling test
a test on a number of devices taken at random from a batch (IEV 151-04-17)

2.4.4
acceptance test
a contractual test to prove to the customer that the device meets certain conditions of its specification (IEV 151-04-20)

2.5
other definitions
for the definitions of general terms in this standard, reference should be made to IEC Publication 50 or to special definitions laid down in IEC Publication 743

2.6
formation of lots or batches
the product is assembled into identifiable lots, sub-lots, batches, or in such other manner as may be prescribed (see **6.2** of ISO 2859-1). Each lot or batch, as far as practicable, consists of units of product of a single type, grade, class, size and composition, manufactured under essentially the same conditions and essentially the same time (see IEC 1318)

3 Requirements

3.1 General requirements

3.1.1 Insulated and insulating hand tools shall be manufactured and dimensioned in such a way that they do not constitute a danger for the user or the installation if they are properly used.

3.1.2 The mechanical specifications for insulated hand tools and those for insulating hand tools having the same function shall comply with the corresponding CEN Standards where these exist or otherwise with ISO Standards or where neither a CEN nor an ISO Standard exists, with a Standard specified by the customer (e.g. national standard...). The mechanical specifications of the working parts of the tools shall be maintained even after application of an insulating layer.

Insulating hand tools specially designed for live working in an environment of live parts at different potentials (boxes with electrical equipment, live working on underground cables, etc.), that are generally used to hold or move live conductors or to cut wires of small section, must have adequate mechanical properties to avoid the risk of breaking and the possible corresponding electrical consequences. These tools shall be checked for compliance with Sub-clause 4.8.

3.1.3 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 conditioning 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 slipping.

3.1.4 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 (–40 °C) shall be designated "Category C" and shall be designed for this purpose.

3.1.5 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.

3.1.6 Tools capable of being assembled shall have suitable retaining devices to prevent unintentional separation of the assembly.

3.1.7 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.

3.1.8 Tools capable of being assembled and designed to ensure compatibility of insulation between different manufacturers shall have square drives and square sockets in accordance with ISO 1174. These tools shall be designed with insulating overlapping elements described in Figure 15. Their dimensions and tolerances shall be in accordance with the following Table 1.

Table 1 — Dimensions and tolerances of the insulating overlapping element

Dimensions in millimetres

Nominal size	l1 min.	$l2\ ^{+2}_{0}$	$l3\ ^{+0,5}_{-0,5}$	$d1\ ^{0}_{-1,5}$	$d2\ ^{+1,5}_{0}$	$d3\ ^{0}_{-1,5}$	$d4\ ^{+1,5}_{0}$
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
l1, l2, l3, d1, d2, d3 and d4 are described in Figure 15.							

NOTE There are considerable difficulties in developing a unified standard for the mechanical joining systems for components and tools from different manufacturers. Users are strongly advised not to mix insulated tools and component parts from different manufacturers. Only in this way can the mechanical integrity of the joining systems be ensured.

3.2 Additional requirements

3.2.1 *Screwdrivers and wrenches*

3.2.1.1 The following uninsulated areas and lengths on the working head are permissible (Figure 1):

— screwdrivers for slotted-head screws: maximum length of 15 mm;

— other types of screwdrivers: (Philips-end, square, hexagonal), maximum length 18 mm;

NOTE For special uses, at the request of the customer, length may be reduced.

— 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.

3.2.1.2 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 1, 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.

3.2.2 *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 metal parts of the head (see Figure 2a, as an example).

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

For pliers, the minimum dimensions of the guard shall be (see Figure 2a):

— 10 mm on the left and on the right of the pliers held on a flat surface;

— 5 mm on the upper and on 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 of the guard shall extend as far as possible towards the working head (see Figure 2a).

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

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 of the guard shall extend as far as possible towards the working head (see Figure 16).

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

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

3.2.3 *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 2b, letter b).

The uninsulated part of the knife blade shall be not longer than 65 mm (see Figure 2b, letter c).

3.2.4 *Tweezers* (see Figure 14)

The total length l shall be 130 mm minimum and 200 mm maximum. The length of the handle g shall be 80 mm minimum.

Both handles of the tweezers shall have a guard towards the working head. The guard shall not be moveable. Its height h and width b shall be sufficient (5 mm minimum) to avoid any slipping of the fingers during the work towards the uninsulated working head u.

On both handles, the insulated part between the guard and the working head e shall be 12 mm minimum and 35 mm maximum.

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

The uninsulated length u of the working head shall not exceed a length of 20 mm.

Insulating tweezers shall not have exposed conductive parts.

3.2.5 *Marking*

Each tool and/or tool component shall be legibly and permanently marked with the following inscriptions:

a) On the insulating material layer or on the metal part:

— marking of the origin (manufacturer's name or trade mark).

b) On the insulating material layer:

— model/type reference;

— year of manufacture (at least the last two digits of the year);

— symbol IEC-60417-5216 — Suitable for live working; double triangle, symbol with indication 1 000 V (i.e. the electrical working limit for alternating current). The symbol shall be at least 3 mm high; the letters and the figures shall be at least 2 mm high (see Figure 3);

— number of the relevant IEC standard immediately adjacent to the symbol;

— for tools designed for use at extremely low temperature (–40 °C): letter "C".

NOTE In case of lack of room for all the markings on the insulating material layer, the model/type reference may be moved to the packaging.

c) Text deleted

d) Additional marking where specified by the customer (e.g. ownership mark).

The tools shall bear no voltage markings 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.

3.2.6 *Instructions for use*

In the case of tools which require assembly, the proper method shall be stated in the instructions for use.

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

4 Type tests

4.1 General test specifications

For tests to be carried out according to IEC 60, the test voltage shall be increased and reduced a uniform rate of approximately 1 000 V/s.

Compliance with the specifications in Clause **3** shall be verified by means of the following type tests.

The tests specified in **4.2** to **4.10** shall be carried out on at least three tools of the same batch (see **2.8** of IEC 1318) 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 batch. 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. This also applies to any other tools from the batch unless the test is non-destructive. In this case, all tools shall be tested.

Unless otherwise stated, the test shall be carried out after a minimum storage time of 16 hours 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.

4.2 Visual and dimensional check

4.2.1 *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 Sub-clause **3.2.5.**

4.2.2 *Dimensional check*

The dimensions shall be checked according to Clause **3.**

4.3 Impact test

The test shall be carried out according to one of the two alternatives shown in Figure 4a and Figure 4b. The hardness of the hammer shall be at least 20 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 is 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.

4.3.1 *Ambient temperature test*

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

The fall height 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 from a height of 2 m onto a hard surface:

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

where

H is the fall height of the hammer, in metres;

F is the weight of the tool tested, in newtons;

P is the weight of the hammer, in newtons.

4.3.2 *Low temperature test*

Tools, excluding those of category C, shall be conditioned by placement in a cooling chamber for 2 h at –25 °C ± 3 °C.

The impact test shall take place 120 s after removal from the cooling chamber. The ambient temperature shall be 23 °C ± 5 °C.

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

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

where

H is the fall height of the hammer, in metres;

F is the weight of the tool tested, in newtons;

P is the weight of the hammer, in newtons.

4.3.3 ***Extreme low temperature test***

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

The impact test shall be carried out according to **4.3.2**.

4.4 Dielectric test

4.4.1 ***Conditioning***

Before testing, the tools shall be conditioned by total immersion in a bath of tap water at room temperature as specified in **4.1** (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.

In the case of tools capable of being assembled the water immersion shall be replaced by a storage at a relative humidity between 91 % and 95 % at a temperature of 23 °C ± 5 °C for 48 h. Tools shall not be assembled prior to conditioning.

NOTE This humidity may be obtained by storage in a closed chamber which contains a saturated solution of sodium sulphate decahydrate Na_2SO_4 $10H_2O$ (Glauber's salt) having a large exposed surface.

4.4.2 ***Insulated tools***

The tool shall be immersed with its insulated part in a bath of tap water up to a level of 24 ± 2 mm from the nearest non-insulated part. The conductive part shall be above the water level (see Figure 5).

Pliers and similar tools shall be tested in such a position that the gap d between the two inner sides of the insulated legs is 2 mm to 3 mm, or the minimum possible by the tool's construction but not less than 2 mm (see Figure 5).

For tools capable of being assembled, 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 Publication 60, 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:

$$I = 5\,L$$

where

I (mA) is the leakage current rounded to the upper value in milliamperes

L (m) is the developed length of coating (rounded to the lower value in centimetres).

NOTE Annex A gives examples of calculation of the developed 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.

In case of tools capable of being assembled and designed to ensure compatibility of insulation between different manufacturers, the tools shall be tested in separate parts. The parts shall be assembled with dummies described in Figure 17. Their dimensions and tolerances shall be in accordance with the following Table 2.

Table 2 — Dimensions and tolerances for dummies to be used for electrical tests

Dimensions in millimetres

Nominal size	L1 ± 0,1	L2 ± 0,1	E1 ± 0,05	D1 ± 0,05	D2 ± 0,05	D3 ± 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
L1, L2, E1, D1, D2 and D3 are described in Figure 17.						

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

4.4.3 ***Insulating tools***

Tools having a metallic working head shall be tested according to **4.4.2**.

Tools having no exposed metallic 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 6), in accordance with IEC 60. 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 is 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 spaces between the electrodes.

4.5 Indentation test (for insulated tools)

All parts of the insulating coating, electrically tested as indicated in Sub-clause **4.4**, 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 ≥ 10 mm, the test shall be made with a test device according to Figure 7a in a heating chamber with natural ventilation. 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 7b).

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 Publication 212. 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 Publication 60, between the testing device and the metal part of the tool for 3 min, using the code 18–28C/45–75 % of IEC Publication 212.

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

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

4.6.1 ***Conditioning***

The tools shall be conditioned before the tests in a heating chamber with natural ventilation at a temperature of 70 ± 2 °C for 168 h.

The following tests shall be carried out at ambient temperature between the third and fifth minute after removal from the heating chamber, using code 18–28C/45–75 % of IEC Publication 212.