SLOVENSKI STANDARD

SIST EN 60999-1:2000

01-september-2000

Povezovalne naprave - Varnostne zahteve za vijaļ ne in brezvijaļ ne pritrdilne enote za elektriļ ne bakrene vodnike - 1. del: Sploġne in posebne zahteve za vodnike od 0,2 mm2 do vkljuļ no 35 mm2 (IEC 60999-1:1990, spremenjen)

Connecting devices - Safety requirements for screw-type and screwless-type clamping units for electrical copper conductors - Part 1: General requirements and particular requirements for conductors from 0, 5 mm<(hoch)2> up to 35 mm<(hoch)2> (included) (IEC 60999-1:1990, modified)

Verbindungsmaterial - Sicherheitsanforderungen für Schraubklemmstellen und schraublose Klemmstellen für elektrische Kupferleiter - Teil 1: Allgemeine Anforderungen und besondere Anforderungen für Leiter von 0, 5 mm<(hoch)2> bis 35 mm<(hoch)2> (einschließlich) (IEC 60999-1:1990, modifiziert)

Dispositifs de connexion - Prescriptions de s®curit® pour organes de serrage Ţ vis et sans vis pour conducteurs ®lectriques en cuivre - Partie 1: Prescriptions particulir res pour conducteurs de 0, 5 mm<(hoch)2> Ţ 35 mm<(hoch)2> (inclus) (CEI 60999-1:1990, modifi®e)

Ta slovenski standard je istoveten z: **EN 60999-1:1993**

ICS:

29.120.20

SIST EN 60999-1:2000 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60999

August 1993

UDC 621.315.684:621.315.55-034.3

Descriptors: Low voltage equipment, home electrical installations, connecting equipment, screwless type clamping units, screw-type clamping units, characteristics, tests

English version

Connecting devices — Safety requirements for screw-type and screwless-type clamping units for electrical copper conductors

(IEC 999:1990, modified)

Dispositifs de connexion
Prescriptions de sécurité pour organes de serrage à vis et sans vis pour conducteurs électriques en cuivre
(CEI 999:1990, modifiée)

Verbindungsmaterial
Sicherheitsanforderungen für Schraubklemmstellen und schraublose Klemmstellen für elektrische Kupferleiter
(IEC 999:1990, modifiziert)

This European Standard was approved by CENELEC on 9 March 1993. 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.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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

Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 999:1990 could be accepted without textual changes, has shown that some common modifications were necessary for the acceptance as a European Standard.

The reference document, together with the common modifications prepared by the CENELEC Reporting Secretariat SR 23F, was submitted to the CENELEC members for formal vote in August 1992.

The text of the draft was approved by CENELEC on 9 March 1993. The following dates were fixed:

— latest date of publication of an identical national standard (dop) 1994-03-01

— latest date of withdrawal of conflicting standards (dow) 1994-03-01

For products which have complied with the relevant national standard before 1994-03-01 as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1999-03-01.

Appendices and CENELEC annexes designated "normative" are part of the body of the standard. In this standard, Appendix B and Appendix C and Annex ZA are normative. Where reference is made to other international or harmonized standards, the edition of that standard quoted in Annex ZA is applicable.

NOTE In this document, the following print types are used:
— requirements proper: in roman type;
— *test specifications: in italic type;*
— explanatory matter: in smaller roman type.

Contents

1 Scope

This standard applies to screw-type and screwless-type clamping units for connecting devices, either as separate entities or as integral parts of equipment, for the connection of electrical copper conductors (complying with HD 383), rigid (solid or stranded) and/or flexible, having a cross-sectional area of 0.5 mm^2 up to and including 35 mm^2 with a rated voltage not exceeding 1 000 V a.c. with a frequency up to and including 1 000 Hz, and 1 500 V d.c.

It applies to clamping units primarily suitable for connecting unprepared conductors.

This standard does not apply to clamping units:

a) for connection by crimping or soldering;

b) for data and signalling circuits;

c) for flat quick-connect terminations, insulation-piercing connecting devices and twist-on connecting devices, for which separate parts are under consideration.

d) designed to receive prepared conductors (soldering, eyelet, lug etc.) nor to terminals designed to be assembled together with apparatus being subjected to strong vibrations.

2 Definitions

2.1 Clamping unit denotes the part(s) of the terminal necessary for the mechanical clamping and the electrical connection of the conductor(s), including the parts which are necessary to ensure the correct contact pressure.

2.2 Terminal denotes the conductive part of one pole, composed of one or more clamping unit(s) and insulation if necessary.

2.3 Connecting device denotes a device for the electrical connection of one (or more) conductor(s), comprising one (or more) terminal(s), either fixed to a base or forming an integral part of the equipment.

2.4 Screw-type clamping unit denotes a clamping unit for the connection and subsequent disconnection of one conductor or the interconnection and subsequent disconnection of two or more conductors, the connection being made, directly or indirectly, by means of screws or nuts of any kind.

2.5 Pillar clamping unit denotes a screw-type clamping unit in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of a screw or screws. The clamping pressure may be applied directly by the shank of the screw or through an intermediate part to which pressure is applied by the shank of the screw.

Examples of pillar clamping units are given in Figure 2.

2.6 Screw clamping unit denotes a screw-type clamping unit in which the conductor is clamped under the head of a screw. The clamping pressure may be applied directly by the head of the screw or through an intermediate part such as a washer, clamping plate or anti-spread device.

Examples of screw clamping units are given in Figure 3.

2.7 Stud clamping unit denotes a screw-type clamping unit in which the conductor is clamped under a nut. The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part such as a washer, clamping plate or anti-spread device.

Examples of stud clamping units are given in Figure 3.

2.8 Saddle clamping unit denotes a screw-type clamping unit in which the conductor is clamped under a saddle by means of two or more screws or nuts.

Examples of saddle clamping units are given in Figure 4.

2.9 Mantle clamping unit denotes a screw-type clamping unit in which the conductor is clamped against the base of a slot in a threaded stud by means of a nut, by a suitably shaped washer under the nut, by a central peg if the nut is a cap nut, or by an equally effective means for transmitting the pressure from the nut to the conductor within the slot.

Examples of mantle clamping units are given in Figure 5.

2.10 Screwless-type clamping unit denotes a clamping unit for the connection and subsequent disconnection of one conductor or the interconnection and subsequent disconnection of two or more conductors, the connection being made, directly or indirectly, by means other than screws.

2.10.1 Universal clamping unit (for all types of conductors).

2.10.2 Non-universal clamping unit (for certain types of conductors only).

For example:

— push-wire clamping unit (for solid conductors only);

— push-wire clamping unit (for rigid (solid and stranded) conductors only).

Examples of screwless-type clamping units are given in Figure 6.

2.11 Rated connecting capacity denotes the cross-sectional area of the largest rigid conductor that can be connected, as stated by the manufacturer of the clamping unit.

2.12 Ambient temperature denotes the temperature of the air surrounding the clamping unit together with its enclosure, if any.

2.13 Temperature rise denotes the difference between the temperature of the part under test, together with its enclosure, if any, measured under load according to the test specification and the ambient temperature.

2.14 Unprepared conductor denotes a conductor which has been cut and the insulation of which has been removed for insertion into a clamping unit.

A conductor the shape of which is arranged for introduction into a clamping unit or the strands of which are twisted to consolidate the end, is considered to be an unprepared conductor.

2.15 Prepared conductor denotes a conductor the stripped end of which is fitted with an eyelet, a terminal end, a cable lug, etc.

3 General

Clamping units shall be so designed and constructed that, in normal use, their performance is reliable and without danger to the user or the surroundings.

Compliance is checked by carrying out all the tests specified.

4 General notes on tests

4.1 *Tests according to this standard are intended to be type tests. They are carried out as tests of the product standard to be specified by the relevant Technical Committee.*

4.2 *Unless otherwise specified, the specimens are tested in the condition in which they are delivered and installed as in normal use. Tests are made at an ambient temperature of (20 ± 5) °C.*

4.3 *The tests of Clause 8 are carried out in the order of the sub-clauses.*

4.4 *Unless otherwise specified, a set consisting of a minimum of three specimens is subjected to all the tests.*

4.5 *Clamping units are deemed not to comply with this standard if more than one sample fails one of the tests. If one sample fails in a test, that test and the preceding ones which may have influenced the results of that test are repeated on another set of three samples, all of which shall then comply with the repeated tests.*

4.6 *A supplementary set of three samples, which may be necessary for the repetition of a test, may be supplied at the same time as the first set.*

Sub-clauses **4.5** and **4.6** are under revision by Technical Committee No. 23 as the present text is unacceptable to some countries.

5 Main characteristics

The standard rated connecting capacities of a clamping unit are: 0.5 mm^2, 0.75 mm^2, 1 mm^2, 1.5 mm^2, 2.5 mm^2, 4 mm^2, 6 mm^2, 10 mm^2, 16 mm^2, 25 mm^2, and 35 mm^2.

6 Connection of conductors

6.1 In general, clamping units are suitable to accept one conductor only. Certain types may also be used for two or more conductors of the same or of different nominal cross-sectional areas or compositions.

Clamping units shall accept unprepared conductors.

6.2 Each clamping unit, if not otherwise stated in the relevant product standard, shall, in addition to its rated connecting capacity, accept at least the two successive smaller cross-sectional areas (e.g. a clamping unit having the rated connecting capacity of 1 mm^2 shall clamp reliably a conductor of the same type of 0.5 mm^2, 0.75 mm^2 or 1 mm^2).

6.3 The relationship between the rated connecting capacity of clamping units and connectable conductors as well as data on the diameters of conductors are given in Table I.

Table I — Rated connecting capacity and connectable conductors

Rated connecting capacity	Connectable conductors and their theoretical diameters				
	Metric				
	Rigid			Flexible	
		solid	stranded		
mm^2	mm^2	Ømm	Ømm	mm^2	Ømm
0.5	0.5	0.9	1.1	0.5	1.1
0.75	0.75	1.0	1.2	0.75	1.3
1.0	1.0	1.2	1.4	1.0	1.5
1.5	1.5	1.5	1.7	1.5	1.8
2.5	2.5	1.9	2.2	2.5	2.3[a]
4.0	4.0	2.4	2.7	4.0	2.9[a]
6.0	6.0	2.9	3.3	4.0	2.9[a]
10.0	10.0	3.7	4.2	6.0	3.9
16.0	16.0	4.6	5.3	10.0	5.1
25.0	25.0	—	6.6	16.0	6.3
35.0	35.0	—	7.9	25.0	7.8

[a] Dimensions for Class 5 flexible conductors only, according to HD 383.

Diameters of the largest rigid and flexible conductors are based on Table I of IEC Publication 228A.

6.4 Screw-type clamping units, unless otherwise specified by the manufacturer, shall accept rigid and flexible conductors as indicated in Table I, in which case no markings are necessary.

If a screw-type clamping unit according to the manufacturer's specification can accept only one type of conductor (e.g. rigid or flexible), this shall be either clearly marked on the end product, for connecting purposes, by the letter "r" or "f", or indicated on the smallest package unit or in technical information and/or catalogues.

Compliance is checked by inspection and by the tests of Sub-clauses 8.1 and 8.6.

6.5 Screwless-type clamping units, unless otherwise specified by the manufacturer, shall accept rigid and flexible conductors as indicated in Table I, in which case no markings are necessary.

If a screwless-type clamping unit according to the manufacturer's specification can accept only solid conductors, this shall be either clearly marked on the end product, for connecting purposes, by the letter "s" or "sol", or indicated on the smallest package unit or in technical information and/or catalogues.

If a screwless-type clamping unit according to the manufacturer's specification can accept only rigid (solid and stranded) conductors, this shall be either clearly marked on the end product, for connecting purposes, by the letter "r", or indicated on the smallest package unit or in technical information and/or catalogues.

See Sub-clause **2.10**.

Compliance is checked by inspection and by the test of Sub-clause 8.1.

6.6 On screwless-type clamping units, the connection or disconnection of conductors shall be made as follows:

— on universal clamping units by the use of a general purpose tool or a convenient device, integral with the clamping unit to open it for the insertion or withdrawal of the conductors;

— on push-wire clamping units by simple insertion. For the disconnection of the conductors an operation other than a pull on the conductor shall be necessary.

The use of a general purpose tool or of a convenient device, integral with the clamping unit is allowed in order to "open" it and to assist the insertion or the withdrawal of the conductor.

Compliance is checked by inspection and by the test of Sub-clause 8.3.

7 Constructional requirements

7.1 Parts of terminals mainly intended for carrying current, shall be of:

— copper, or

— an alloy containing at least 58 % copper for parts that are worked cold or at least 50 % copper for other parts, or

— other metal with surface protection offering a resistance to corrosion not less than that of copper and having mechanical properties at least equivalent.

Compliance is checked by inspection and by the relevant test specified in the relevant product standard (the test of HD 323 is recommended).

7.2 Clamping units shall be so designed and constructed that contact pressure shall not be transmitted via insulating material other than ceramic or pure mica, unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

The possibility of using material other than metal as compensation for any possible deformation, for example shrinkage, is under consideration.

Compliance is checked by tests under consideration, such as a test for the efficiency of resiliency.

7.3 Earthing clamping units shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor, or any other metal that is in contact with these parts.

The body of the earthing clamping unit shall be of brass or other metal no less resistant to corrosion, unless it is a part of the metal frame or enclosure; in this case the screw or nut shall be of brass or another metal no less resistant to corrosion.

If the body of the earthing clamping unit is a part of a frame or enclosure of aluminium or an aluminium alloy, precautions shall be taken to avoid the risk of corrosion resulting from contact between copper and aluminium or its alloys.

Precautions shall be taken to ensure that the surface of the metal frame or enclosure is clean when the conductor is clamped against it.

Compliance is checked by inspection.

Plated steel withstanding the corrosion test is considered as a metal no less resistant to corrosion than brass.

A test for checking the resistance to corrosion is under consideration.

7.4 Screws and nuts for clamping the conductor shall not serve to fix any other component, although they may hold the clamping unit in place or prevent it from turning.

Compliance is checked by inspection.

Screws shall not be of metal which is soft or liable to creep, such as zinc or aluminium.

The use of aluminium alloy screws requires additional tests, which are under consideration.

7.5 Screws or nuts of earthing clamping units identified as such shall be adequately locked against accidental loosening and it shall not be possible to loosen them without the aid of a tool.

In general clamping units shown in the Figure 2 to Figure 5 meet this requirement, provided they comply with the tests of this standard.

It may be necessary to incorporate a resilient part (e.g. a pressure plate), if the end product is intended to be subjected to vibration or temperature cycling.

7.6 For screwless-type clamping units, the insertion and disconnection of the conductors shall be made in accordance with the manufacturer's instructions. Such instructions need to be considered by the relevant product committees as part of their marking requirements.

Disconnection of a conductor shall require an operation, other than a pull on the conductor, such that it can, in normal use, be effected manually, with or without the help of a tool.

Openings for the use of a tool intended to assist the insertion or disconnection of the conductors shall be clearly distinguishable from the openings intended for the conductors.

Compliance is checked by inspection.

7.7 Screwless-type clamping units intended to be used for the interconnection of two or more conductors shall be so designed and constructed that:

— each conductor is clamped individually;

— during connection or disconnection, the conductors can be connected or disconnected either simultaneously or separately.

It shall be possible to clamp securely any number of conductors, up to the maximum provided for.

*Compliance is checked by inspection and by the tests of Sub-clause **8.4**.*

7.8 Screwless type clamping units shall be so designed and constructed that inadequate insertion of the conductor is avoided.

For the purpose of this requirement, an appropriate marking, indicating the length of insulation to be removed before insertion of the conductor into the clamping unit, shall be indicated on the product or on the smallest package unit, or in technical information and/or in catalogues.

Compliance is checked by inspection.

7.9 Clamping units shall have adequate mechanical strength.

*Compliance is checked for screw-type clamping units by the tests of Sub-clauses **8.5** and **8.6**, and for screwless type clamping units by the tests of Sub-clauses **8.3** and **8.5**.*

7.10 Clamping units shall be so designed and constructed that they clamp the conductor without undue damage to the conductor.

*Compliance is checked by inspection, after the test of Sub-clause **8.4**.*

7.11 Clamping units shall be so designed and constructed that they clamp the conductor reliably and between metal surfaces.

*Compliance is checked by inspection, during the test of Sub-clause **8.5**.*

Tests for clamping units where the conductor is not clamped between metal surfaces are under consideration.

7.12 Clamping units shall be so designed and constructed that neither a rigid wire of a stranded conductor, nor a wire of a flexible conductor, can slip out.

*Compliance is checked by the test of Sub-clause **8.2**.*

7.13 Clamping units shall be so designed and constructed that the temperature rise in normal use does not exceed a value appropriate to the materials used in the clamping unit and to the materials with which it is in contact.

*Compliance is checked by the test of Sub-clause **8.7**.*

7.14 Screwless-type clamping units shall be so designed and constructed that during normal use their electrical performances are reliable, so as not to affect their further use.

*Compliance is checked by the tests of Sub-clauses **8.8**, **8.9** and **8.10**.*

7.15 Clamping units shall be so designed and constructed as to permit the insertion of the conductors according to Sub-clauses **6.2** and **6.4** (screw-type), and **6.2** and **6.5** (screwless-type).

*Compliance is checked by the test of Sub-clause **8.1**.*

7.16 Care shall be taken in order to prevent clamping units being subjected to strains imposed by connected conductors forming part of cables or cords (e.g. cables or cords of portable equipment).

Relevant product standards shall require a strain relief and the relevant suitable tests.

8 Tests

8.1 *The insertion of the largest conductor is checked by the test according to Appendix B, or by the insertion of the largest conductor after the insulation has been removed and the ends of the rigid stranded and of the flexible conductors have been reshaped.*

The stripped end of the conductor shall be able to enter completely within the clamping unit aperture., without use of undue force.

8.2 *Three new clamping units are fitted with new conductors of the type and of the rated connecting capacity according to Table I of Sub-clause **6.3** and whose core composition complies with the table in Appendix C.*

Before insertion into the clamping unit, wires of stranded rigid conductors and flexible conductors may be reshaped.

The use of a tool is permitted.

It shall be possible to fit the conductor into the clamping unit without use of undue force.

The conductor is inserted into the clamping unit until it just protrudes from the far side of the clamping unit if possible, and in the position most likely to allow the wire to escape.

*The clamping screws, if any, are then tightened with a torque as shown in Sub-clause **8.6**.*

After the test, no wire of the conductor shall have escaped outside the clamping unit thus reducing creepage distances and clearances required by the relevant product standard.

8.3 *Screwless-type clamping units according to Sub-clauses **6.5** and **6.6** are tested with conductors having the largest diameter:*

- *— solid only;*
- *— rigid (solid and stranded) only;*
- *— rigid (solid and stranded) and flexible.*

Five insertions and disconnections are made with each type of conductor for which the clamping unit is intended to be used.

New conductors are used each time, except for the fifth time, when the conductor used for the fourth insertion is clamped at the same place. For each insertion, the conductors are either pushed as far as possible into the clamping unit or are inserted so that adequate connection is obvious. After each insertion the conductor is twisted through 90° and subsequently disconnected. After these tests, the clamping units shall not be damaged in such a way as to impair their further use.

8.4 *For checking the requirement of Sub-clause **7.10** (clamping the conductor without undue damage to the conductor) three new clamping units are fitted with new conductors of the type and of the minimum and maximum cross-sectional areas according to Sub-clauses **6.2** and **6.4** (screw-type) or **6.2** and **6.5** (screwless-type) in the equipment shown in Figure 1.*

- *— firstly with conductors of the minimum cross-sectional area;*
- *— secondly with conductors of the maximum cross-sectional area.*

The length of the test conductor shall be 75 mm longer than the height (H) specified in Table II.

*The test conductor is then connected to the clamping unit, the clamping screws or nuts, if any, are tightened with the torque according to Sub-clause **8.6**.*

Each of the conductors is subjected to the following test:

The end of one conductor is passed through an appropriate sized bushing in a platen positioned at a height (H) below the equipment as given in Table II. The bushing is positioned in a horizontal plane such that its centre line describes a circle of 75 mm diameter, concentric with the centre of the clamping unit in the horizontal (plane); the platen is then rotated at a rate of (10 ± 2) r.p.m.

The distance between the mouth of the clamping unit and the upper surface of the bushing shall be within ± 15 mm of the height in Table II. The bushing may be lubricated to prevent binding, twisting or rotation of the insulated conductor.

A mass as specified in Table II is suspended from the end of the conductor. The duration of the test is 15 min.

During the test, the conductor shall neither slip out of the clamping unit nor break near the clamping unit, nor shall the conductor be damaged in such a way as to render it unfit for further use.

Table II

Conductor cross-sectional area		Diameter of bushing hole[b]	Height H[a]	Mass for conductor
mm^2	AWG	mm	mm	kg
0.5 0.75	20 18	6.5 6.5	260 260	0.3 0.4
1.0 1.5	— 16	6.5 6.5	260 260	0.4 0.4
2.5 4.0	14 12	9.5 9.5	280 280	0.7 0.9
6.0 10.0	10 8	9.5 9.5	280 280	1.4 2.0
16.0 25.0	6 4	13.0 13.0	300 300	2.9 4.5
— 35.0	3 2	14.5 14.5	320 320	5.9 6.8

[a] Tolerance for height H ± 15 mm

[b] If the bushing hole diameter is not large enough to accommodate the conductor without binding, a bushing having the next larger hole size may be used.

8.5 *For the pull test, three new clamping units are fitted with new conductors of the type and of the minimum and maximum cross-sectional areas according to Sub-clauses **6.2** and **6.4** (screw-type) or **6.2** and **6.5** (screwless-type).*

*Screws, if any, are tightened with a torque according to Sub-clause **8.6**.*

If the screw has a hexagonal head with a slot, the torque applied is equal to that shown in column III of Table IV or higher, as stated by the manufacturer.

Each conductor is then subjected to a pull of the value shown in the following Table III, the pull being applied without jerks, for 1 min, in the direction of the axis of the conductor.

During the test the conductor shall not slip out of the clamping unit.

8.6 *The test is carried out on screw-type clamping units with copper conductors, in accordance with Sub-clause **6.2**, the smallest and largest diameter conductors being placed alternatively in the same clamping unit.*

Screws and nuts are tightened and loosened five times by means of a suitable test screwdriver or spanner, the torque applied when tightening being equal to that shown in the appropriate column of the following Table IV or in the appropriate Table V to Table VIII, whichever is the higher.

A new conductor end is used each time the screw or nut is loosened.

Greater values of torque may be used if the manufacturer so states and provides the relevant information.

Column I applies to screws without heads if the screw, when tightened, does not protrude from the hole and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Column II applies to nuts of mantle clamping units which are tightened by means of a screwdriver.

Column III applies to other screws of clamping units which are tightened by means of a screwdriver.

Column IV applies to screws and nuts, other than nuts of mantle clamping units, which are tightened by means other than a screw-driver.

Column V applies to nuts of mantle clamping units, which are tightened by means other than a screwdriver.

Where a screw has a hexagonal head with a slot and the values in columns III and IV are different, the test is made twice, first on a set of three samples, applying to the hexagonal head the torque specified in column IV and then on another set of samples, applying the torque specified in column III by means of a screwdriver. If the values in columns III and IV are the same, only the test with the screwdriver is made.

Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength.

During the test the clamping unit shall not be damaged, for example, by the breakage of screws or damage to the head slots, threads, washers or stirrups, so as to prevent their further use.

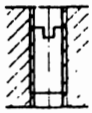
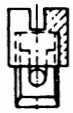
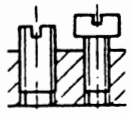
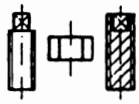
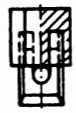
For mantle clamping units the specified nominal diameter is that of the slotted stud.

The shape of the blade of the test screwdriver must suit the head of the screws to be tested, The screws and nuts shall not be tightened in jerks.

Table III

Cross-sectional area (mm^2)	0.5	0.75	1.0	1.5	2.5	4	6	10	16	25	35
Pull force (N)	30	30	35	40	50	60	80	90	100	135	190

Table IV

Nominal diameter of thread mm	Torque (Nm)				
	I 	II 	III 	IV 	V 
Up to and including 2.8	0.2	—	0.4	0.4	—
Over 2.8 up to and including 3.0	0.25	—	0.5	0.5	—
Over 3.0 up to and including 3.2	0.3	—	0.6	0.6	—
Over 3.2 up to and including 3.6	0.4	—	0.8	0.8	—
Over 3.6 up to and including 4.1	0.7	1.2	1.2	1.2	1.2
Over 4.1 up to and including 4.7	0.8	1.2	1.8	1.8	1.8
Over 4.7 up to and including 5.3	0.8	1.4	2.0	2.0	2.0
Over 5.3 up to and including 6.0	1.2	1.8	2.5	3.0	3.0
Over 6.0 up to and including 8.0	2.5	2.5	3.5	6.0	4.0
Over 8.0 up to and including 10.0	—	3.5	4.0	10.0	6.0
Over 10.0 up to and including 12.0	—	4.0	—	—	8.0
Over 12.0 up to and including 15.0	—	5.0	—	—	10.0
Torque values in this table will be the subject of further study.					

8.7 *During the temperature rise test on the end product, clamping units are connected with the conductor having the appropriate cross-sectional area and type and under the conditions stated in the relevant product standard; the screws or nuts, if any, are tightened with a torque equal to two thirds of that specified in Sub-clause* ***8.6****.*

8.8 *The electrical performance of screwless-type clamping units is verified by the following test, which is made on ten new samples of each design which have not been used for any other test. In the case of clamping units forming part of an equipment, these may be submitted separately.*

The test is made with new copper conductors having a cross-sectional area according to Sub-clauses ***6.2*** *and* ***6.5****:*

— solid for clamping units which can accept solid conductors only;

— rigid (solid/stranded) for clamping units which can accept these two types of conductors;

— rigid (solid/stranded) and flexible for clamping units which can accept all types of conductors.

A conductor having the smallest cross-sectional area is connected, as in normal use, to each of five clamping units and a conductor having the largest cross-sectional area is connected, as in normal use, to each of the five other clamping units.

The clamping units are loaded for 1 h with an a.c. equal to the test current defined in the relevant product standard.

Immediately after this period and with the same current flowing, the voltage drop across each clamping unit is measured.

In no case shall the voltage drop exceed 15 mV.

The measurements shall be made as near as possible to the area of contact on the clamping unit.

If the measuring points cannot be positioned closely to the point of contact, the voltage drop within the part of the conductor between the ideal and the actual measuring points shall be deducted from the voltage drop measured.

It is recommended that, if possible, the samples, if submitted separately, be fixed to a common support and connected in series. Similarly, parts of the equipment on which clamping units are mounted shall be fixed to a common support.

In the case of connections in series, the linking conductors shall form a loop unless the clamping units are so positioned that the thermal expansion of the linking conductor has no effect on the terminals.

Care shall be taken during the test, including the measurement, that the conductors are not moved in the clamping units.