SLOVENSKI STANDARD
SIST EN 60352-6:2002

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Solderless connections - Part 6: Insulation piercing connections - General requirements, test methods and practical guidance (IEC 60352-6:1997)

Solderless connections -- Part 6: Insulation piercing connections - General requirements, test methods and practical guidance

Lötfreie Verbindungen -- Teil 6: Durchdringverbindungen - Allgemeine Anforderungen, Prüfverfahren und Anwendungshinweise

Connexions sans soudure -- Partie 6: Connexions à percement d'isolant - Règles générales, méthodes d'essai et guide pratique

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Part 6: Insulation piercing connections
General requirements, test methods and practical guidance

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 48B/596/FDIS, future edition 1 of IEC 60352-6, prepared by SC 48B, Connectors, of IEC TC 48, Electromechanical components and mechanical structures for electronic equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60352-6 on 1997-10-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1998-07-01

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.

Endorsement notice

The text of the International Standard IEC 60352-6:1997 was approved by CENELEC as a European Standard without any modification.

Contents

Introduction

This part of IEC 60352 includes requirements, tests and practical guidance information.

Two test schedules are provided.

The qualification test schedule applies to insulation piercing connections which conform to all requirements of clause 4.

These requirements are derived from experience with successful applications of such insulation piercing connections.

The application test schedule applies to insulation piercing connections which are part of a component and are already qualified.

1 Scope and object

This part of IEC 60352 is applicable to insulation piercing connections made with stranded wires and tinsel-wire, flat conductors and flat flexible circuitries for use in telecommunication equipment and in electronic devices employing similar techniques.

Information on materials and data from industrial experience is included in addition to the test procedures to provide electrically stable connections under prescribed environmental conditions.

The object of this standard is to

— determine the suitability of insulation piercing connections under specified mechanical, electrical, and atmospheric conditions;

— provide a means of comparing test results, when the tools used to make the connections are of different designs or manufacture.

There are different designs and materials for insulation piercing terminations in use. For this reason only fundamental parameters of the termination, the performance requirements of the conductor and the complete connection are specified in this standard.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60352. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 60352 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(581):1978, *International Electrotechnical Vocabulary (IEV) — Chapter 581: Electromechanical components for electronic equipment.*

IEC 60068-1:1988, *Environmental testing — Part 1: General and guidance Amendment 1 (1992).*

IEC 60512-1:1994, *Electromechanical components for electronic equipment — Basic testing procedures and measuring methods — Part 1: General.*

IEC 60512-2:1985, *Electromechanical components for electronic equipment — Basic testing procedures and measuring methods — Part 2: General examination, electrical continuity and contact resistance tests, insulation tests and voltage stress tests Amendment 1 (1994).*

IEC 60512-4:1976, *Electromechanical components for electronic equipment; basic testing procedures and measuring methods — Part 4: Dynamic stress tests.*

IEC 60512-5:1992, *Electromechanical components for electronic equipment; basic testing procedures and measuring methods — Part 5: Impact tests (free components), static load tests (fixed components), endurance tests and overload tests.*

IEC 60512-6:1984, *Electromechanical components for electronic equipment; basic testing procedures and measuring methods — Part 6: Climatic tests and soldering tests.*

IEC 60512-11-1:1995, *Electromechanical components for electronic equipment — Basic testing procedures and measuring methods — Part 11: Climatic tests — Section 1: Test 11 a — Climatic sequence.*

IEC 60512-11-7:1996, *Electromechanical components for electronic equipment — Basic testing procedures and measuring methods — Part 11: Climatic tests — Section 7: Test 11 g: Flowing mixed gas corrosion test.*

IEC 60512-16-20:1996, *Electromechanical components for electronic equipment — Basic testing procedures and measuring methods — Part 16: Mechanical tests on contacts and terminations — Section 20: Test 16t: Mechanical strength (wired termination of solderless connections).*

IEC 60603-7:1996, *Connectors for frequencies below 3 MHz for use with printed boards — Part 7: Detail specification for connectors, 8-way, including fixed and free connectors with common mating features, with assessed quality.*

3 Definitions

For the purposes of this part of IEC 60352, the terms and definitions of IEC 60050(581) and IEC 60512-1 and the following additional terms and definitions apply.

3.1 insulation piercing connection

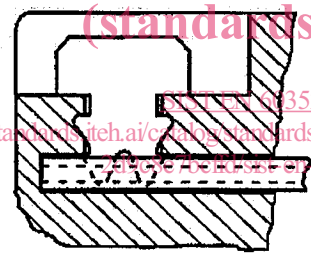
A solderless connection made by suitable piercing elements, which pierce the insulation and provide contact by deforming or penetrating the conductor. [IEV 581-03-42]

3.1.1
integrated insulation piercing connection with stranded conductor or tinsel-wire

an integrated insulation piercing connection which is part of a multipole connector

for example, for the free connector (see note) the piercing zone and its housing are integral parts of the connection (see Figure 1)

usually all insulation piercing connections of the connector are made in one step



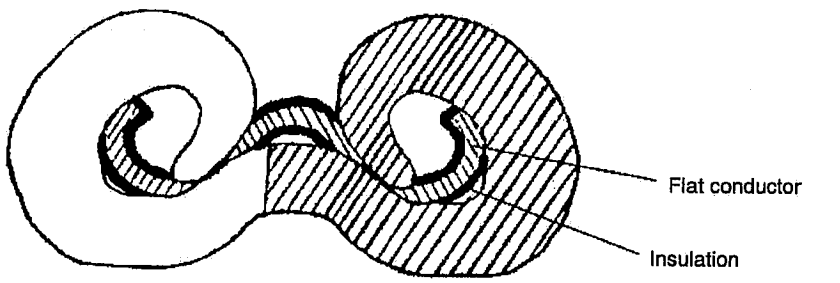
IEC 1086/97

Figure 1 — Example of an integrated insulation piercing connection (one connection shown)

NOTE An example for the application is the free connector according to IEC 60603-7.

3.1.2
insulation piercing connection with flat conductors or flat flexible circuitries

an insulation piercing connection formed by lances which pierce and penetrate the flat conductor (see Figure 2)

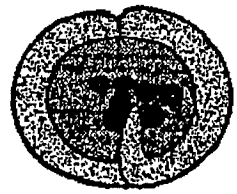


IEC 1087/97

Figure 2 — Example of an insulation piercing connection with flat conductor

3.1.3
insulation piercing barrel connection with stranded conductors or tinsel-wires of discrete wires

an insulation piercing connection made by lances in a barrel which pierce the insulation, and make contact with the conductor strands (see Figure 3)



IEC 1088/97

Figure 3 — Example of an insulation piercing connection in a barrel with stranded wires

3.2
insulation piercing termination

a termination to accept different types of insulated conductors for the purpose of establishing an insulation piercing connection [IEV 581-03-63]

3.3
insulation piercing zone

that portion of the contact designed and intended to effect the piercing of the insulation and provide contact with the conductor (see **6.3.1**) [IEV 581-03-53]

4 Requirements

4.1 Workmanship

The connections shall be processed in a careful and workmanlike manner, in accordance with good current practice.

4.2 Tools

Tools shall be used and inspected according to the instructions given by the manufacturer(s) of the tool and/or the connector.

The tools shall be able to make uniformly reliable insulation piercing connections during their lifetime.

The tools shall be designed to operate in such a manner that unacceptable damage to the insulation piercing termination and/or conductors is avoided.

Hand tools shall be provided with a full cycle mechanism.

Automatic tools shall be provided with a full cycle mechanism or equivalent safeguard.

Tools are evaluated by testing insulation piercing connections made with the tools to be evaluated.

4.3 Insulation piercing terminations

4.3.1 *Materials*

— Metallic parts

Suitable grades of copper or copper alloy such as copper-tin (bronze), copper-zinc (brass) or beryllium copper shall be used.

— Insulating parts

For insulation piercing connections according to **3.1.1** the component housing material shall be polycarbonate or similar plastic material.

For insulation piercing connections according to **3.1.3** the wire insulation shall be PVC or another material appropriate for this connecting technique.

4.3.2 *Dimensions*

The quality of an insulation piercing connection depends on the dimensions of the insulation piercing termination. The dimensions shall be suitable for stranded wires including tinsel-wires, insulated flat conductors or flat flexible circuitries, as specified in **4.4**.

4.3.3 *Surface finishes*

The contact area of the termination shall be unplated or plated with tin or tin-lead or silver, gold, palladium or their alloys.

The surface shall be free of contamination or corrosion which degrades performance.

4.3.4 *Design features*

Insulation piercing terminations shall be designed such that lances, peaks or sharp edges of the insulation piercing zones penetrate the insulation of insulated conductor(s) and establish a connection by penetration or controlled deformation of the conductor(s). The insulation piercing zones and termination body shall deform around the conductor(s) to maintain the connection.

For insulation piercing connections according to **3.1.1** the guiding function of the component housing for the inserted insulated wires is important.

4.4 Insulated conductors

Wires with stranded wires, tinsel-wires, flat conductors or flat flexible circuitries shall be used.

4.4.1 *Materials*

The conductors used shall be annealed copper.

4.4.2 *Dimensions*

4.4.2.1 *Dimensions for insulated conductors used for insulation piercing connections according to* ***3.1.1***

Specified in the detail specification.

4.4.2.2 *Dimensions for insulated conductors used for insulation piercing connections according to* ***3.1.2***

Specified in the detail specification.

4.4.2.3 *Dimensions for insulated conductors used for insulation piercing connections according to* ***3.1.3***

Specified in the detail specification.

4.4.3 *Surface finishes*

Conductors shall be unplated or plated with tin, tin-lead or silver.

The conductor surface shall be free of contamination or corrosion which degrades performance.

4.4.4 *Insulation*

The specification for the components using the insulation piercing termination shall specify

— the insulation thickness of the wires, and

— the outer diameters or the outer dimensions of the wires that shall be accommodated.

The insulation material shall have properties compatible with the insulation piercing process, i.e. the insulation material shall be capable of being readily pierced by the piercing zones. In case of stranded conductors or tinsel-wires the insulation shall additionally be capable of keeping the strands in place so that they are not unduly moved when making the connection.

For flat cables the insulation between the conductors, including any additional insulation forming the cable, shall additionally be capable of being readily pierced by the piercing zones.

4.5 Insulation piercing connections

a) The combination of insulated conductors, termination and connection tools shall be compatible.

b) During the connection process the insulation piercing termination of the component shall

— pierce the insulation without detrimental effect;

— deform or pierce the conductor so as to produce an electrical connection without detrimental effect to the conductor, for example cracking.

c) The termination design shall control the relative position of the insulated conductor and the piercing zone.

d) A conductor shall be correctly located in the insulation piercing termination as specified by the detail specification. There shall be a sufficient distance between the termination and the conductor end. The minimum value of the distance depends on the conductor used and shall be as specified by the detail specification.

e) Where the termination is equipped with an insulation support or insulation grip, the insulation shall be correctly located in the support or grip.

5 Tests

5.1 Testing

5.1.1 *General*

As explained in the introduction, there are two test schedules which shall be applied according to the following conditions:

— insulation piercing connections which conform to all the requirements of clause **4** shall be tested and shall meet the requirements of the qualification test schedule of **5.3.2**;

— insulation piercing connections which are part of a component and are already qualified to all the requirements of clause **4** shall be tested in accordance with and meet the requirements of the application test schedule of **5.3.3**, which shall be included in the detail specification.

5.1.2 *Standard conditions for testing*

Unless otherwise specified, all tests shall be carried out under standard conditions for testing, as specified in IEC 60512-1.

The ambient temperature and the relative humidity at which the measurements are made shall be stated in the test report.

In case of dispute about the test results, the test shall be repeated at one of the referee conditions of IEC 60068-1.

5.1.3 *Preconditioning*

Where specified, the connections shall be preconditioned under standard conditions for testing for a period of 24 h, in accordance with IEC 60512-1.

5.1.4 *Recovery*

Where specified, the specimens shall be allowed to recover under standard conditions for testing for a period of 1 h to 2 h after conditioning.

5.1.5 *Mounting of the specimen*

a) When mounting is required in a test, the specimens shall be mounted using the normal mounting method, unless otherwise specified.

b) The test specimen shall consist of the component having one or a specific number of insulation piercing connections with one insulated wire inserted in each insulation piercing termination.

5.2 Test methods and test requirements

NOTE As far as test methods are described in this standard, it is intended that the description be replaced by a reference to the appropriate part of IEC 60512 as soon as the relevant test method is included in IEC 60512.

5.2.1 *General examination*

The tests shall be carried out in accordance with test 1a: Visual examination, and test 1b: Examination of dimension and mass, of IEC 60512-2. The visual examination test may be carried out with magnification up to five times.

All parts shall be examined to ensure that the applicable requirements of **4.3** to **4.5** have been met.

5.2.2 *Mechanical tests*

5.2.2.1 *Tensile strength*

The test shall be carried out in accordance with test 16t: Mechanical strength (wired terminations of solderless connections), of IEC 60512-16-20, Method A or Method B (as to be agreed between user and manufacturer).

Requirement:

The tensile strength of insulation piercing connections shall be not less than 20 N per wire, unless otherwise specified by the detail specification.

5.2.2.2 *Bending of the wire/cable*

The object of this test is to assess the ability of an insulation piercing connection to withstand the mechanical stress caused by bending the connected insulated wire/cable, in a specified manner.

The test specimen shall consist of

— multiple connections to a multipole component. Such specimens may include multiple single wires, wires in cable constructions or multiconductor flat cable according to **3.1.1** and **3.1.2** (see Figure 1 and Figure 2);

— a single wire connected to a single component according to **3.1.3** (see Figure 3).

The test specimen shall be securely held in such a position that the wire(s) or the flat conductor hangs along its (their) longitudinal axis in the connection. An axial load F shall be applied to the free end of the wire(s) or flat conductor, to keep it (them) straight.

The value of this load shall be

— 5 % to 10 % of the breaking strength of the wire where single wires are to be tested;

— 10 N to 50 N where flat conductors are to be tested. The applicable load depends on the number of wires in the conductor, the wire diameter, the type and/or material of the insulation and shall be specified by the detail specification. The load shall be evenly distributed over the whole conductor.

The wire shall then be bent perpendicular in both directions. A bending over the distances 1, 2 and 3 shall be considered to be one cycle and over the distances 4, 5 and 6 shall be considered to be a further cycle (see Figure 4). Unless otherwise specified by the detail specification the bending angle shall be 30°.

Bending of the wire/conductor shall be carried out using a suitable test arrangement, for example as indicated in Figure 4 or Figure 5.

Where single wires connected to a multipole component are to be tested, the wire bending test shall be carried out with a number of single wires (specimens) per component, the number to be specified by the detail specification.

The specimens shall be tested sequentially or simultaneously as specified by the detail specification.

The number of cycles shall be 10 unless otherwise specified by the detail specification.

Contact disturbance shall be monitored during the bending test in accordance with test 2e: Contact disturbance, of IEC 60512-2.

The limit of duration of contact disturbance shall be 1 µs unless otherwise specified by the detail specification.

5.2.2.3 *Vibration*

The test shall be carried out in accordance with test 6d: Vibration, of IEC 60512-4.

The test specimen shall be firmly held on a vibration table.

An example of a suitable test arrangement for testing a component containing insulation piercing connections is shown in Figure 6.

Contact disturbance shall be monitored during the vibration test in accordance with test 2e: Contact disturbance, of IEC 60512-2.

The limit of duration of contact disturbance shall be 1 µs unless otherwise specified by the detail specification.

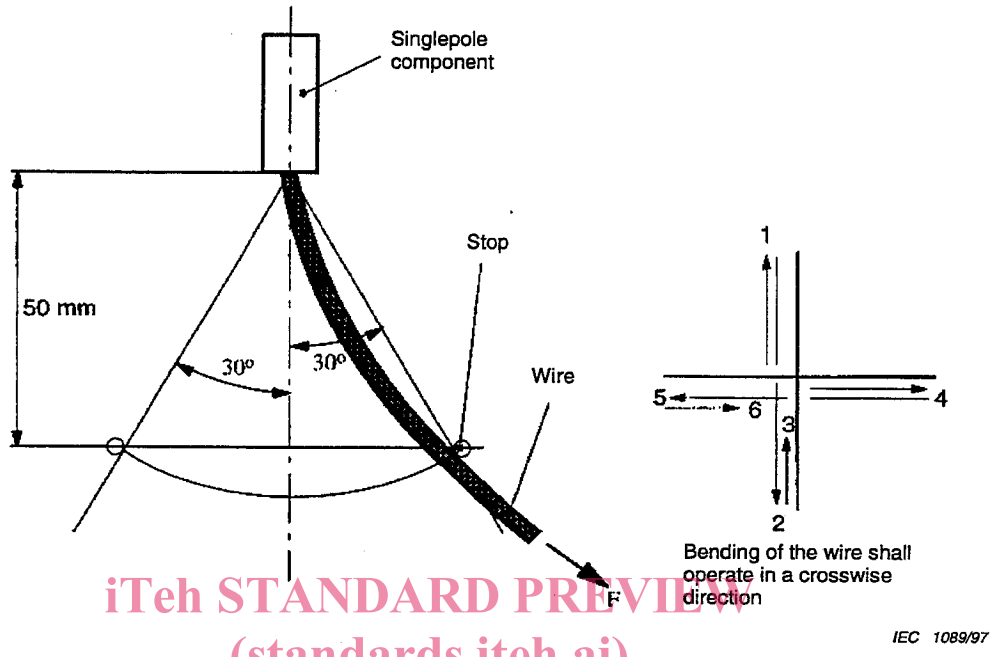


Figure 4 — Test arrangement, bending of single wire

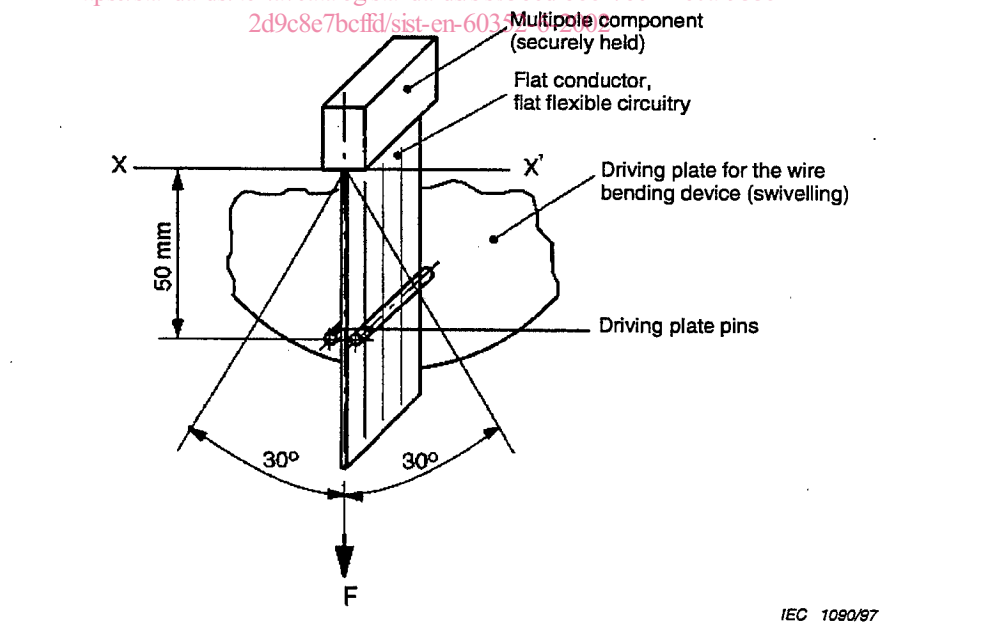


Figure 5 — Test arrangement, bending of flat conductor, flat flexible circuitry