

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Solderless connections -
Part 7: Spring clamp connections - General requirements, test methods and
practical guidance**

**Connexions sans soudure -
Partie 7: Connexions à ressort - Exigences générales, méthodes d'essai et guide
pratique**



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**Solderless connections -
Part 7: Spring clamp connections -
General requirements, test methods and practical guidance**

FOREWORD

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IEC 60352-7 has been prepared by subcommittee 48B: Electrical connectors, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment. It is an International Standard.

This third edition cancels and replaces the second edition published in 2020. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) Addition of definition 3.6 contact pressure via insulating material CoPI;
- b) Addition of definition 3.7 spring clamp connecting device with CoPI;
- c) Addition of a dedicated test group for spring clamp connections made with spring clamp terminations, which achieve contact pressure through insulating material (CoPI), which shall be tested according to Annex B in Subclause 6.1;

- d) Addition of test group “CoPI” in Clause 8;
- e) Addition of Annex B to detail tests for resiliency in metallic parts to compensate for any shrinkage or yielding of insulating material with regards to contact pressure transmitted through the insulating material (CoPI), referenced in the “Test group CoPI” added in both test schedules.

The text of this International Standard is based on the following documents:

Draft	Report on voting
48B/3177/FDIS	48B/3186/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60352 series, published under the general title *Solderless connections*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

This part of IEC 60352 covers spring clamp connections and includes requirements, tests and practical guidance information.

Two test schedules are provided.

- a) The basic test schedule applies to spring clamp connections which conform to all requirements of Clause 5. These requirements are derived from experience with successful applications of such spring clamp connections.
- b) The full test schedule applies to spring clamp connections which do not fully conform to all requirements of Clause 5, for example which are manufactured using materials or finishes not included in Clause 5.

This approach ensures cost and time effective performance verification using a limited basic test schedule for established spring clamp connections and an expanded full test schedule for spring clamp connections requiring more extensive performance validation.

In this third edition, a dedicated test group providing requirements and tests for spring clamp connections with contact pressure transmitted via insulating material (CoPI) has been added in both test schedules, referring to the new Annex B (normative). In such instance, this provides means to fulfil both the requirement of 6.6.3 of IEC 61984:2008 concerning the design of electrical connections of connectors, and the requirement of 8.2 of IEC 60999-1:1999 concerning the design of clamping units connecting devices.

The values given in this document are minimum values, which are harmonized with other IEC documents. Other standards or the manufacturer's specification can specify other values.

The test procedure for resiliency in metallic parts to compensate for any shrinkage or yielding of insulating material with regards to contact pressure transmitted via insulating material (CoPI) has been derived from IEC 60947-7-4:2019.

1 Scope

This part of IEC 60352 is applicable to spring clamp connections made with stripped wire of the following types and sizes according to IEC 60228 or IEC 60189-3, without further preparation (later described “unprepared”):

- solid conductors (e.g. class 1 of IEC 60228) of 0,32 mm to 3,7 mm nominal diameter (0,08 mm² to 10 mm² cross-section), or
 - stranded conductors (e.g. class 2 of IEC 60228) of 0,08 mm² to 10 mm² cross-section, or
 - flexible conductors (e.g. class 5 or 6 of IEC 60228) of 0,08 mm² to 10 mm² cross-section,
- for use in electrical and electronic equipment and components.

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 document is to determine the suitability of spring clamp connections under specified mechanical, electrical and atmospheric conditions.

NOTE IEC Guide 109 advocates the need to minimize the impact of a product on the natural environment throughout the product life cycle. It is understood that some of the materials permitted in this document can have a negative environmental impact. As technological advances lead to acceptable alternatives for these materials, they will be eliminated from this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60050-581, *International Electrotechnical Vocabulary (IEV) - Part 581: Electromechanical components for electronic equipment*

IEC 60068-1, *Environmental testing - Part 1: General and guidance*

IEC 60189-3, *Low-frequency cables and wires with PVC insulation and PVC sheath - Part 3: Equipment wires with solid or stranded conductor, PVC insulated, in singles, pairs and triples*

IEC 60228, *Conductors of insulated cables*

IEC 60512-1, *Connectors for electrical and electronic equipment - Tests and measurements - Part 1: Generic specification*

IEC 60512-1-1, *Connectors for electronic equipment - Tests and measurements - Part 1-1: General examination - Test 1a: Visual examination*

IEC 60512-1-2, *Connectors for electronic equipment - Tests and measurements - Part 1-2: General examination - Test 1b: Examination of dimension and mass*

IEC 60512-2-1, *Connectors for electronic equipment - Tests and measurements - Part 2-1: Electrical continuity and contact resistance tests - Test 2a: Contact resistance - Millivolt level method*

IEC 60512-2-2:2003, *Connectors for electronic equipment - Tests and measurements - Part 2-2: Electrical continuity and contact resistance tests - Test 2b: Contact resistance - Specified test current method*

IEC 60512-2-5, *Connectors for electronic equipment - Tests and measurements - Part 2-5: Electrical continuity and contact resistance tests - Test 2e: Contact disturbance*

IEC 60512-6-4, *Connectors for electronic equipment - Tests and measurements - Part 6-4: Dynamic stress tests - Test 6d: Vibration (sinusoidal)*

IEC 60512-9-5, *Connectors for electrical and electronic equipment - Tests and measurements - Part 9-5: Endurance tests - Test 9e: Current loading, cyclic*

IEC 60512-11-1, *Connectors for electrical and electronic equipment - Tests and measurements - Part 11-1: Climatic tests - Test 11a - Climatic sequence*

IEC 60512-11-4, *Connectors for electronic equipment - Tests and measurements - Part 11-4: Climatic tests - Test 11d: Rapid change of temperature*

IEC 60512-11-7, *Connectors for electronic equipment - Tests and measurements - Part 11-7: Climatic tests - Test 11g: Flowing mixed gas corrosion test*

IEC 60512-11-9, *Connectors for electronic equipment - Tests and measurements - Part 11-9: Climatic tests - Test 11i: Dry heat*

IEC 60512-11-10, *Connectors for electronic equipment - Tests and measurements - Part 11-10: Climatic tests - Test 11j: Cold*

IEC 60512-16-20, *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)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-581, IEC 60512-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

spring clamp termination

part of the contact or terminal to which one single conductor only is connected by means of a spring

3.1.1

universal spring clamp termination

spring clamp termination intended to accept solid, stranded and flexible unprepared conductors

Note 1 to entry: For the meaning of solid, stranded and flexible, see IEC 60228 where conductors are classified as class 1 (solid conductors), class 2 (stranded conductors), class 5 (flexible conductors) and class 6 (flexible conductors which are more flexible than class 5).

3.1.2

non-universal spring clamp termination

spring clamp termination intended to accept conductors of one class only, for example solid conductors only, or conductors of two classes only, for example solid and stranded but not flexible

Note 1 to entry: For the meaning of solid, stranded and flexible, see IEC 60228 where conductors are classified as class 1 (solid conductors), class 2 (stranded conductors), class 5 (flexible conductors) and class 6 (flexible conductors which are more flexible than class 5).

3.1.3

push-in spring clamp termination

spring clamp termination in which the connection is made by pushing in a solid or stranded conductor without the aid of a tool or of an actuating element

Note 1 to entry: For the meaning of solid and stranded, see IEC 60228 where solid conductors are classified as class 1, stranded conductors are classified as class 2.

Note 2 to entry: Flexible conductor ends can become solid by e.g. ultrasonic welding according to IEC 60352-9.

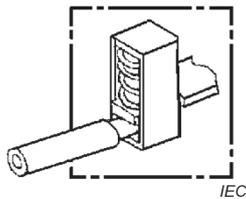
3.2

spring clamp connection

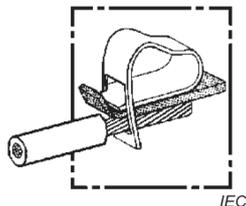
solderless connection achieved by clamping a conductor with a spring clamp termination

Note 1 to entry: See Figure 1.

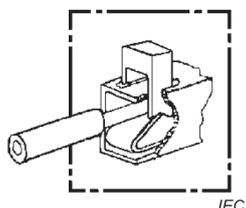
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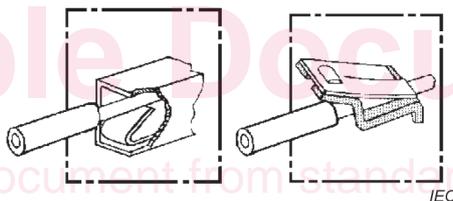
a) Spring clamp connection, operated without a tool



b) Spring clamp connection, operated with a tool



c) Spring clamp connection, operated with an actuating element



d) Spring clamp connections, with a push-in spring clamp termination, with solid wires

Figure 1 – Examples of spring clamp connections

3.3

spring clamp terminal

terminal designed to accept a conductor for the purpose of establishing a spring clamp connection

Note 1 to entry: See Figure 2.

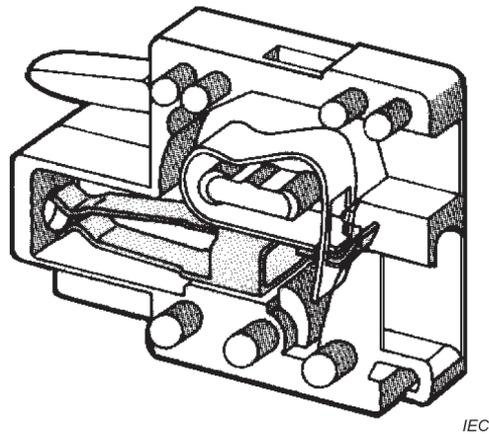


Figure 2 – Example of a spring clamp terminal

**3.4
spring clamp connecting device**

device for the electrical connection of one or more conductors comprising one or more spring clamp terminations and, if necessary, either insulation or auxiliary parts, or both

**3.5
actuating element**

part of a spring clamp termination or terminal to which an external force is to be applied

Note 1 to entry: Movement of the actuating element provides a means for activating or deactivating the spring.

**3.6
contact pressure via insulating material**

CoPI

contact pressure due to contact force transmitted through insulating material

**3.7
spring clamp connecting device with CoPI**

spring clamp connecting device where the electrical connection of one or more conductors depends on contact pressure transmitted via insulating material with sufficient resiliency in the metallic parts to assure necessary contact pressure

Note 1 to entry: See Figure 3.

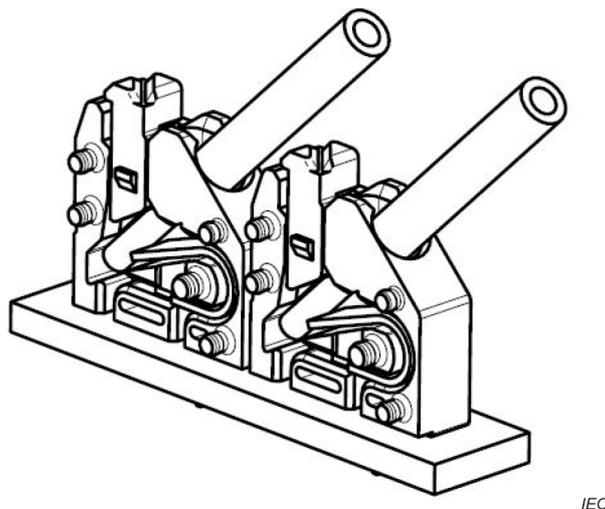


Figure 3 – Example of a spring clamp connecting device with CoPI

4 Requirements

4.1 Quality of work

The connection shall be processed in a careful and professional manner, in accordance with good current practice. Annex A (informative) provides practical guidance and can constitute a benchmark for the assessment of the quality of work.

NOTE Some industry sectors (e.g. automotive, aerospace, marine, nuclear, military) use standards for the quality of work which can be considered upon agreement between manufacturer and user.

4.2 Tools

Tools, if necessary, shall be used and inspected according to the instructions given by the manufacturer.

5 Pre-requisites for basic test schedule

5.1 Spring clamp terminations

5.1.1 Materials

- Materials for the current-carrying parts:
Suitable grades of copper or copper alloy shall be used.
- Materials for the spring clamp parts:
Suitable (according to manufacturer's instructions) grades of copper alloy or steel shall be used.

5.1.2 Surface finishes

The contact area of the current-carrying parts shall be plated with tin or tin-alloy.

The surface shall be free of detrimental contamination or corrosion.

5.1.3 Design features

Spring clamp terminations shall be designed so that the spring clamp parts establish a force to connect the conductors which ensures that the necessary contact pressure is maintained.

In a spring clamp connecting device, each conductor shall be clamped individually.

The openings for use of a tool intended to assist the insertion or withdrawal of the conductor shall be clearly distinguishable from the conductor's entry hole.

5.1.4 Dimensions

The suitability of a spring clamp connection depends on the dimensions of the termination together with the characteristics of the materials used.

The dimensions of the termination shall be chosen so as to be suitable for (i.e. able to accept) the cross-sectional area of the conductor or the range of conductors for which the termination is designed.

The suitability is verified by applying the test schedules given in Clause 8.

5.2 Wires

5.2.1 General

Wires with solid, stranded and flexible conductors according to IEC 60228 or IEC 60189-3 shall be used depending on the type of spring clamp terminations.

5.2.2 Materials

The conductor used shall be made of annealed copper.

5.2.3 Dimensions

Wires with the following dimensions shall be used:

- solid wires of 0,32 mm to 3,7 mm nominal diameter (0,08 mm² to 10 mm² cross-section), or
- stranded wires of 0,08 mm² to 10 mm² cross-section, or
- flexible wires of 0,08 mm² to 10 mm² cross-section.

5.2.4 Surface finishes

The conductor shall be unplated or plated with tin or tin-alloy.

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

5.2.5 Wire insulation

The insulation shall be capable of being readily stripped from the conductor without changing the physical characteristics of the conductor or strands.

5.3 Spring clamp connections

- a) The combination of conductor and spring clamp termination shall be compatible.
- b) The wire shall be stripped to the correct length specified by the manufacturer. The stripped part of the wire shall not be damaged and shall be clean and free from particles of insulation.
- c) The conductor shall be correctly located in the spring clamp termination at the correct depth specified by the manufacturer.

All strands of the wire shall be within the spring clamp termination.

6 Testing

6.1 General

The test schedule to be applied shall be chosen according to the following conditions:

- a) spring clamp connections which conform to all the requirements of Clause 5 shall be tested in accordance with and meet the requirements of the basic test schedule, see 8.2;
- b) spring clamp connections which do not fully conform to all the requirements of Clause 5, for example which are made with different wire types or termination sizes or materials, shall be tested and meet the requirements of the full test schedule given in 8.3;

Both these test schedules include a dedicated test group for spring clamp connections made with spring clamp terminations which have contact pressure via insulating material (CoPI) which shall be additionally tested according to Annex B.