

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 – Règles générales, méthodes d'essai et guide
pratique



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SOLDERLESS CONNECTIONS –**Part 7: Spring clamp connections – General requirements,
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International Standard IEC 60352-7 has been prepared by subcommittee SC 48B: Electrical connectors, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment.

This second edition cancels and replaces the first edition of IEC 60352-7, published in 2002. This edition constitutes a technical revision.

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

- a) correction of the two flow charts in Figure 6 and Figure 7,
- b) split the content into more clauses for better separation between full test schedule and basic test schedule,
- c) relocating the content of former Clause 6 Practical guidance into an informative Annex A, as now common in the IEC 60352 series for solderless connections,

d) clarification on conductor types with reference to classes defined in IEC 60228.

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

FDIS	Report on voting
48B/2823/CDV	48B/2851/RVC

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

This document was drafted in accordance with ISO/IEC Directives, Part 2.

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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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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 permits 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.

The values given in this document are minimum values, which are harmonized with other IEC documents. Other standards may specify other values.

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SOLDERLESS CONNECTIONS –

Part 7: Spring clamp connections – General requirements, test methods and practical guidance

1 Scope

This part of IEC 60352 is applicable to spring clamp connections made with stripped wire without further preparation:

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

according to IEC 60228 or IEC 60189-3 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 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60189-3:2007, *Low-frequency cables and wires with PVC insulation and PVC sheath – Part 3: Equipment wires with solid or stranded conductor wires, PVC insulated, in singles, pairs and triples*

IEC 60228:2004, *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, *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 60512-9-2, *Connectors for electronic equipment – Tests and measurements – Part 9-2: Endurance tests – Test 9b: Electrical load and temperature*

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 60512-16-20, *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 following terms and definitions apply.

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

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

non-universal 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.

3.2

spring clamp connection

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

SEE: Figure 1

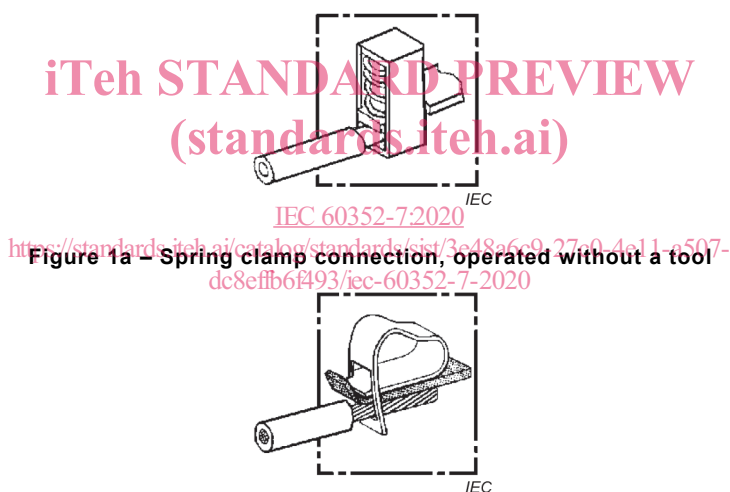


Figure 1a – Spring clamp connection, operated without a tool

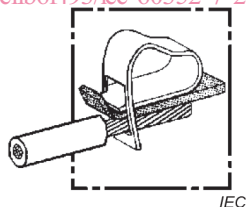


Figure 1b – Spring clamp connection, operated with a tool

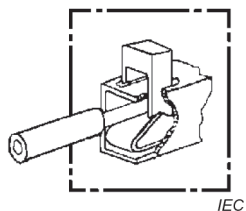


Figure 1c – Spring clamp connection, operated with an actuating element

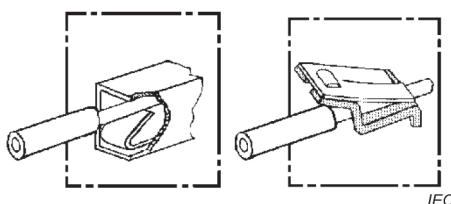


Figure 1d – Spring clamp connections, with a push-in spring clamp termination, with solid wires

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

SEE: Figure 2

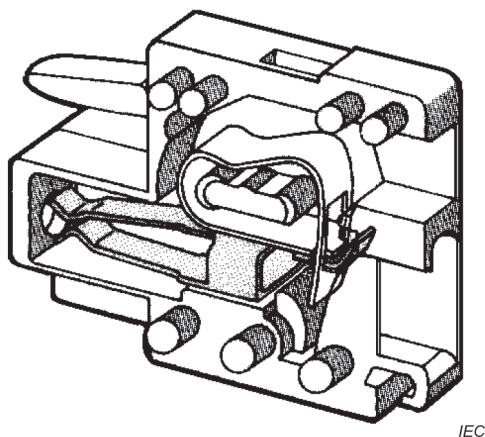


Figure 2 – Example of a spring clamp terminal

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, insulation and/or auxiliary parts

3.5

actuating element

part of a spring clamp termination or terminal to which an external force is to be applied, and the resulting movement of which provides a means for activating or deactivating the spring

4 Requirements

4.1 Workmanship

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

NOTE Some industry sectors (e.g. automotive, aerospace, marine, nuclear, military) use workmanship standards 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

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

- 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, those which are made with different wire types and/or termination sizes and/or materials, shall be tested and meet the requirements of the full test schedule given in 8.3.

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6.2 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 test results, the test shall be repeated at one of the test conditions for referee measurements and tests set out in IEC 60068-1.

6.3 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.

6.4 Recovery

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

6.5 Mounting of specimen

- a) When mounting is required in a test, the specimens shall be mounted using the normal mounting method, unless otherwise specified.
- b) Each test specimen shall consist of one spring clamp connection prepared as required in the test schedules.

When more test specimens are required, they may be part of the same multipole spring clamp connecting devices.

7 Tests

7.1 General examination

The examination shall be carried out in accordance with Test 1a of IEC 60512-1-1, and Test 1b of IEC 60512-1-2. The visual examination test may be carried out with magnification up to approximately five times.

All spring clamp terminations and wires shall be examined to ensure that the applicable requirements of Clause 5 have been met.

7.2 Mechanical tests

7.2.1 Tensile strength

The test shall be carried out in accordance with Test 16t, method A, of IEC 60512-16-20.

Requirement:

The tensile strength of spring clamp connections shall be not less than specified in Table 1, unless otherwise specified by the detail specification.

Table 1 – Values of tensile strength

Conductor cross-section mm ²	Values of tensile strength N minimum
0,08 up to 0,22 (not included)	4
0,22	10
0,34	15
0,5	20
0,75	30
1,0	35
1,5	40
2,5	50
4,0	60
6,0	80
10,0	90

7.2.2 Wire deflection

NOTE This test method is similar to the deflection test method for screwless terminals described in IEC 60884-1.

Spring clamp terminations shall be so designed that the inserted solid conductor remains clamped, even when the conductor has been deflected during normal installation, for example, during mounting in a box, and the deflecting stress is transferred to the spring clamp termination.

Compliance is checked by the following test which is made on specimens which have not been used for any other test.

a) Test apparatus

The test apparatus, the principle of which is shown in Figure 3, shall be so constructed that: