

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Solderless connections –**  
**Part 2: Crimped connections – General requirements, test methods and practical guidance**

**Connexions sans soudure –**  
**Partie 2: Connexions serties – Exigences générales, méthodes d'essai et guide pratique**

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**SOLDERLESS CONNECTIONS –****Part 2: Crimped connections –  
General requirements, test methods and practical guidance**

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**IEC 60352-2 edition 2.1 contains the second edition (2006) [documents 48B/1584/FDIS and 48B/1617/RVD] and its amendment 1 (2013) [documents 48B/2340/FDIS and 48B/2348/RVD].**

**A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.**

International Standard IEC 60352-2 has been prepared by subcommittee 48B: Connectors, of IEC technical committee 48: Electromechanical components and mechanical structures for electronic equipment.

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

- a) The contents of clauses have been re-arranged, for example the old clauses 5, 6, 7, 8 and 9 are now included in the new clause 4, Requirements.
- b) Subclause 4.3.1: the material requirements for crimp barrels have been changed from Vickers hardness into more appropriate tensile strength requirements and the requirements have been opened to other materials, if it is of suitable characteristics.
- c) Subclause 4.3.3, Surface finishes: the tin-lead has been replaced by tin-alloy to comply with RoHS legislation. Other plating materials, such as nickel, may be used provided their suitability has been proven.
- d) Subclause 5.1.4, Recovering, has been added.
- e) Table 2, example of other materials, has been shortened.
- f) Subclause 5.2.4.5 and Figure 7, Current loading, cyclic: the length of wire between two specimens has been changed to a "minimum of 150 mm" to comply with regional requirements.
- g) Subclause 5.2.4.6, Crimping at low temperature, has been changed to "under consideration".
- h) Subclause 15.4 of IEC 60352-2 amendment 1 (1996-11) has been deleted for the sake of design freedom, because the dimensions are not widely used as stated; only a minority of products, in most cases older ones have these dimensions.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 60352 consists of the following parts, under the general title *Solderless connections*:

- Part 1: Wrapped connections – General requirements, test methods and practical guidance
- Part 2: Crimped connections – General requirements, test methods and practical guidance
- Part 3: Solderless accessible insulation displacement connections – General requirements, test methods and practical guidance
- Part 4: Solderless non-accessible insulation displacement connections – General requirements, test methods and practical guidance
- Part 5: Press-in connections – General requirements, test methods and practical guidance
- Part 6: Insulation piercing connections – General requirements, test methods and practical guidance
- Part 7: Spring clamp connections – General requirements, test methods and practical guidance

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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## INTRODUCTION

IEC 60352-2 includes requirements, tests and practical guidance information. Two test schedules are provided: a basic test schedule which applies to solderless crimped connections which conform to all of the requirements given in Clause 4 and a full test schedule which applies to solderless crimped connections which do not fully conform to all of the requirements, for example which are made with solid wires, different materials, etc.

IEC Guide 109 advocates the need to minimise 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 standard may have a negative environmental impact. As technological advances lead to acceptable alternatives for these materials, they will be eliminated from the standard.

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## **SOLDERLESS CONNECTIONS –**

### **Part 2: Crimped connections – General requirements, test methods and practical guidance**

#### **1 Scope and object**

This part of IEC 60352 is applicable to solderless crimped connections made with stranded wires of 0,05 mm<sup>2</sup> to 10 mm<sup>2</sup> cross-section or solid wires of 0,25 mm to 3,6 mm diameter and appropriately designed uninsulated or pre-insulated crimp barrels for use in telecommunication equipment and in electronic devices employing similar techniques.

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

NOTE This part of IEC 60352 is not intended to be applicable to crimping of coaxial cables.

The object of this part of IEC 60352 is to determine the suitability of solderless crimped connections under specified mechanical, electrical and atmospheric conditions and to provide a means of comparing test results when the tools used to make the connections are of different designs or manufacture.

#### **2 Normative references**

The following referenced documents are indispensable for the application 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):1978, *International Electrotechnical Vocabulary (IEV) – Chapter 581: Electro-mechanical components for electronic equipment*

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

IEC 60189-3:1988, *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 60512 (all parts), *Connectors for electronic equipment – Tests and measurements*

IEC 60512-1-100:2001, *Connectors for electronic equipment – Tests and measurements – Part 1-100: General – Applicable publications*

IEC 60760:1989, *Flat, quick-connect terminations*  
Amendment 1 (1993)

ISO 6892:1998, *Metallic materials – Tensile testing at ambient temperature*

### 3 Terms and definitions

For the purpose of this document, the terms and definitions of IEC 60050(581), IEC 60512-1 and the following apply:

#### 3.1

##### **crimp barrel**

conductor barrel designed to accommodate one or more conductors and to be crimped by means of a crimping tool

#### 3.2

##### **open crimp barrel**

crimp barrel with an open shape before crimping, for example U- or V-shape (see Figure 1)

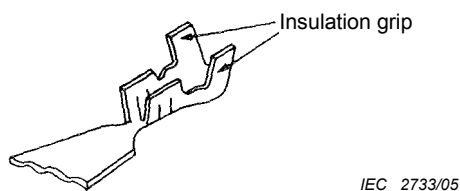


Figure 1 – Open crimp barrel

#### 3.3

##### **closed crimp barrel**

crimp barrel with a closed shape before crimping (see Figure 2)

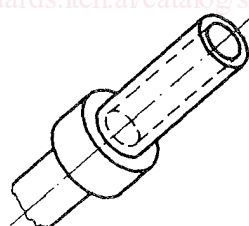


Figure 2a – Machined crimp barrel

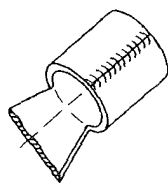


Figure 2b – Brazed/welded crimp barrel

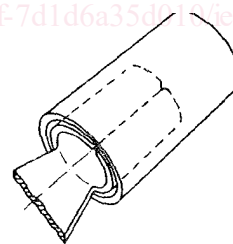


Figure 2c – Stamped/rolled crimp barrel

Figure 2 – Closed crimp barrels

#### 3.4

##### **pre-insulated crimp barrel**

crimp barrel with a permanent layer of insulation through which the crimp is made (see Figure 3)

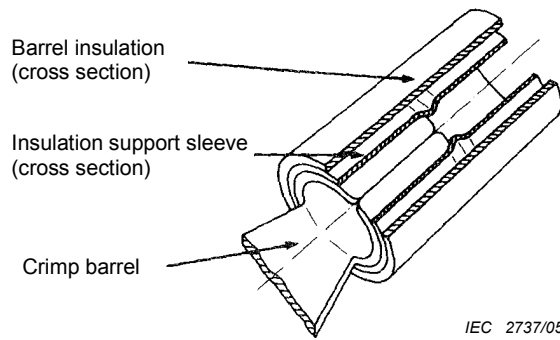


Figure 3 – Pre-insulated crimp barrel

**3.5 crimping zone**

that portion of a crimp barrel where the crimped connection is achieved by pressure deformation or reshaping of the barrel around the conductor (see Figure 4)

NOTE Where the crimp barrel is equipped with an insulation grip, this is also reshaped by compression by the crimping tool to secure the insulation of the wire.

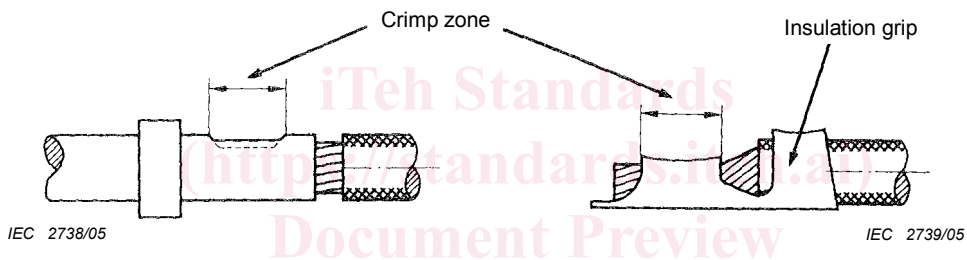


Figure 4a – Closed crimp barrel

Figure 4b – Open crimp barrel

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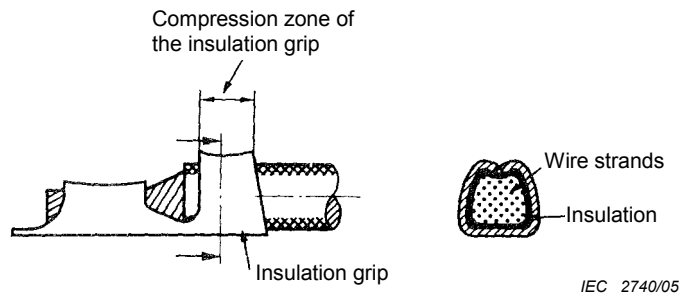


Figure 4c – Insulation grip

**Figure 4 – Crimping zones**

**3.6 crimping die**

that part of a crimping tool which forms the crimp(s) and usually incorporates the crimp anvil(s), the crimp indenter(s), and the positioner

NOTE Crimping dies may have separate or integral sections for compressing the insulation grip, if provided.

## 4 Requirements

### 4.1 Workmanship

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

### 4.2 Tools

Crimping tools shall be used and inspected according to the instructions given by the tool manufacturer.

The crimping tool shall be able to make uniformly reliable connections during its useful life.

The crimping tool shall be equipped with the appropriate dies. Where the dies are adjustable, the correct setting for the barrel to be crimped shall be used.

Hand crimping tools shall be provided with a full cycle crimping mechanism.

Automatic crimping tools shall be provided with a full cycle crimping mechanism or equivalent safeguard. They shall be correctly set and the setting shall be maintained.

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

### 4.3 Crimp barrels

#### 4.3.1 Materials

Crimp barrels shall be made of copper or copper alloy with a copper content of 60 % minimum.

The minimum tensile strength of the material shall not exceed 600 MPa in accordance with ISO 6892.

Other materials of suitable characteristics may be used, for example nickel, steel, stainless steel. Materials with a high resistivity-coefficient ( $K$  values, see 5.2.3.1) or materials exceeding the tensile strength specified above, may not be suitable for certain applications. In these cases, the full test schedule of 5.3.3 shall be applied (see 5.1.1).

#### 4.3.2 Dimensions

The dimensions shall be suitable for stranded wires as specified in 4.4.

#### 4.3.3 Surface finishes

The crimp barrel shall be unplated or plated with tin, tin-alloy, silver, gold or palladium.

The surface shall be free of contamination and corrosion. Other plating materials, such as nickel, (unless used as under-plate) may be used provided their suitability has been proven. In these cases, the full test schedule of 5.3.3 shall be applied (see 5.1.1).

#### 4.3.4 Design features

The crimp barrel shall be so designed that the crimped connection is achieved by pressure deformation or reshaping of the crimp barrel around the stripped conductor.

NOTE Techniques where the connection is achieved by parts of barrel penetrating through the insulation of an insulated conductor are not covered by this standard.

The following barrel types shall be used:

- open crimp barrels, uninsulated;
- closed crimp barrel, either pre-insulated or uninsulated.

The crimp barrels shall be free of sharp edges likely to damage the conductors.

#### **4.4 Wires**

##### **4.4.1 General**

Stranded conductors shall be used, solid round conductors of 0,25 mm to 3,6 mm diameter may be used provided their suitability has been proven.

##### **4.4.2 Materials**

Annealed copper having an elongation at break of not less than 10 % shall be used.

##### **4.4.3 Dimensions**

The cross-section of the stranded conductor shall be within the range 0,05 mm<sup>2</sup> to 10 mm<sup>2</sup>.

##### **4.4.4 Surface finishes**

Conductors which are unplated or finished with tin, tin-alloy or silver shall be used.

The surface shall be free of contamination and corrosion.

##### **4.4.5 Insulation**

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

#### **4.5 Crimped connections**

The combination of the tool, barrel and wire shall be compatible.

Where the crimp barrel is equipped with an insulation support or insulation grip, the overall diameter of the insulation wire shall be compatible with the dimensions of the support or grip.

The wire shall be stripped to the correct length. The strands of the stripped part of the conductor shall not be damaged, for example partly or totally broken.

The stripped part of the conductor shall be clean and free from particles of insulation.

The lay of the strands shall be correct. If the lay has been disturbed, it may be restored by a light twist.

The conductor shall be correctly located in the barrel, i.e. to the correct depth. This shall be verified as follows:

- in the case of open crimp barrels or closed crimp barrels with inspection provision, this shall be visually checked;
- in the case of closed crimp barrels without inspection provisions, for example an inspection hole, this shall be measured (indirectly by measuring the possible insertion depth of the barrel, the stripping length of the wire and the distance between the end of the barrel and the beginning of the wire insulation).

All strands of the wire shall be within the barrel. There shall be no damaged strands.