

BRITISH STANDARD

**BS 6516 :
Part 2 : 1990
IEC 352-2 :
1990**

Solderless connections

**Part 2. Specification for solderless
crimped connections (including test
methods and practical guidance)**

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Electronic Components Standards Policy Committee (ECL/-) to Technical Committee ECL/21, upon which the following bodies were represented:

- British Electrical and Allied Manufacturers' Association (BEAMA Ltd.)
- Electronic Components Industry Federation
- Electronic Engineering Association
- Ministry of Defence
- National Supervising Inspectorate
- British Telecommunications plc
- Society of British Aerospace Companies Limited
- Telecommunication Engineering and Manufacturing Association (TEMA)

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National foreword

This Part of BS 6516 has been prepared under the direction of the Electronic Components Standards Policy Committee. It is identical with IEC Publication 352-2 : 1990 'Solderless connections. Part 2 : Solderless crimped connections — General requirements, test methods and practical guidance' published by the International Electrotechnical Commission (IEC).

For the purposes of this Part of BS 6516, any references to IEC page numbers in the text should be ignored.

Cross-references

International standard	Corresponding British Standard
ISO 68-1 : 1982	BS 2011 Environmental testing Part 1.1 : 1989 General and guidance (Identical)
IEC 189-3 : 1988	PD 6455 : 1970 Metric dimensions for l.f. cables and wires for telecommunication (Technically equivalent) BS 5772 Basic testing procedures and measuring methods for electromechanical components for electronic equipment
IEC 512-1 : 1976	Part 1 : 1985 General (Identical)
IEC 512-2 : 1976	Part 2 : 1979 General examination, electrical continuity and contact resistance tests, insulation tests and voltage stress tests (Identical)
IEC 512-2A : 1980	Part 2 : Supplement 1 : 1981 Test 4c. Voltage proof of pre-insulated crimp barrels (Identical)
IEC 512-5 : 1977	Part 5 : 1979 Impact tests (free components), static load tests (fixed components), endurance tests and overload tests (Identical)
IEC 512-6 : 1977	Part 6 : 1984 Climatic tests and soldering tests (Identical)
IEC 512-6A : 1980	Part 6 : Supplement 1 : 1981 Test 11b. Test for combined-sequential cold, low air pressure, and damp heat (Identical)
IEC 512-8 : 1984	Part 8 : 1985 Connector tests (mechanical) and mechanical tests on contacts and terminations (Identical)
IEC 673 : 1980	BS 6156 : 1981 Specification for low-frequency miniature equipment wires with solid or stranded conductor, fluorinated polyhydrocarbon type insulation, single (Identical)

There are no corresponding British Standards for IEC 50(581) or IEC 130-7, but as they are referred to for information only, the validity of this British Standard is not affected.

The Technical Committee has reviewed the provisions of ISO 6507/1, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard.

A related British Standard to IEC 512 is BS CECC 00009 : 1982 'Harmonized system of quality for electronic components. Basic specification: basic testing procedures and measuring methods for electromechanical components'. Related standards to ISO 6507/1 : 1982 are BS 5600 'Powder metallurgical materials and products. Section 4.6 Vickers hardness test' and BS 427 'Method for Vickers hardness test. Part 1 Testing of metals'.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

SOLDERLESS CONNECTIONS

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

INTRODUCTION

This standard 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 Section Two and a full test schedule which applies to solderless crimped connections which do not fully conform to all of the requirements, e.g. which are made with solid wires, different materials, etc.

SECTION ONE – GENERAL

1. Scope

This standard is applicable to solderless crimped connections made with stranded wires of 0,05 mm² to 10 mm² 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 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 standard is not intended to be applied to crimping of coaxial cables.

2. Object

To determine the suitability of solderless crimped connections under specified mechanical, electrical and atmospheric conditions.

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

3. Terminology

The terms and definitions used in and applicable to this standard are included in IEC 50: International Electrotechnical Vocabulary, Chapter 581.

IEC 512 also contains some applicable terms and definitions.

For the purpose of this standard, the following additional terms and definitions shall apply:

3.1 *Crimp barrel*

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

3.2 *Open crimp barrel*

A crimp barrel with an open shape before crimping, e.g. U- or V-shape.

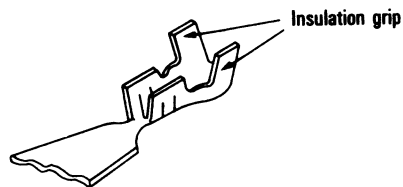
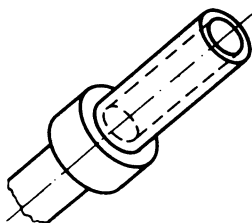


Figure 1

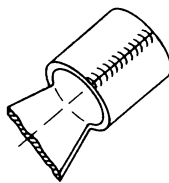
3.3 *Closed crimp barrel*

A crimp barrel with a closed shape before crimping.



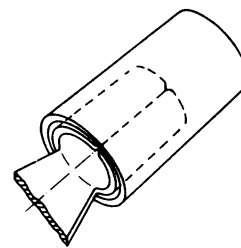
Machined
crimp barrel

Figure 2a



Brazed/welded
crimp barrel

Figure 2b



Stamped/rolled
crimp barrel

Figure 2c

3.4 *Pre-insulated crimp barrel*

A crimp barrel with a permanent layer of insulation through which the crimp is made.

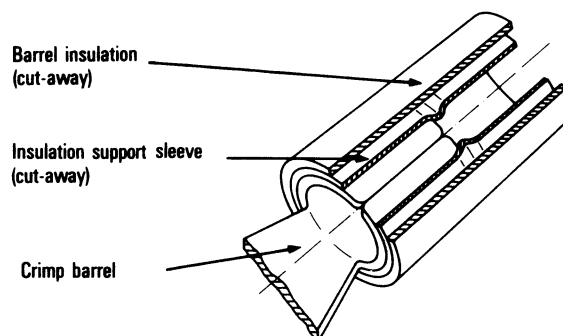
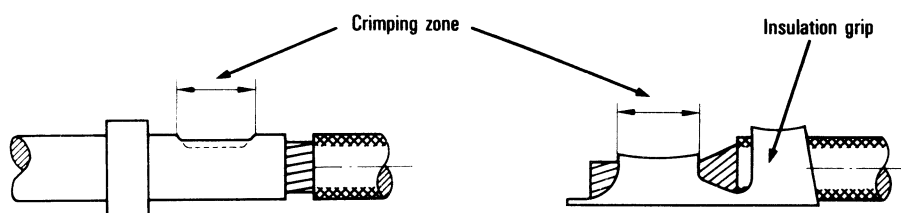


Figure 3

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.

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.



Closed crimp barrel
Figure 4a

Open crimp barrel
Figure 4b

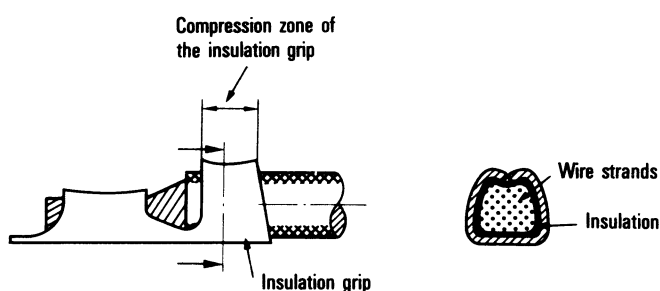


Figure 4c

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. IEC type designation

Not applicable.

SECTION TWO – REQUIREMENTS

5. Workmanship

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

6. 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.

7. Crimp barrels

7.1 Materials

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

The Vickers hardness shall not exceed 220 HV 5 when tested in accordance with ISO 6507/1.

7.2 Dimensions

The dimensions shall be suitable for stranded wires as specified in clause 8.

Note. – For guidance on the relationship between the size of the crimp barrel and the cross-section of the conductor, see 15.4.

7.3 Surface finishes

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

The surface shall be free of contamination and corrosion.

7.4 *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 the 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 barrels, either pre-insulated or uninsulated.

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

8. **Wires**

Stranded conductors shall be used.

8.1 *Materials*

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

8.2 *Dimensions*

The cross-section of the stranded conductor shall be within the range 0,05 mm² to 10 mm².

Note. – For guidance on the relationship between the size of the crimp barrel and the cross-section of the conductor, see 15.4.

8.3 *Surface finishes*

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

The surface shall be free of contamination and corrosion.

8.4 *Insulation*

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

9. **Crimped connections**

- a) The combination of the tool, barrel and wire shall be compatible.
- b) Where the crimp barrel is equipped with an insulation support or insulation grip, the overall diameter of the insulated wire shall be compatible with the dimensions of the support or grip.

- c) The wire shall be stripped to the correct length. The strands of the stripped part of the conductor shall not be damaged, e.g. 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.

- d) 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 provision, e.g. 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.

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

SECTION THREE – TESTS

10. Testing

10.1 *General*

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

- crimped connections which conform to all of the requirements of Section Two shall be tested to and meet the requirements of the basic test schedule of 12.2;
- crimped connections which do not fully conform to all of the requirements of Section Two, e.g. which are made with solid wires, different materials, etc., shall be tested to and meet the requirements of the full test schedule of 12.3.

10.2 *Standard conditions for testing*

Unless otherwise specified, all tests shall be carried out under the standard conditions for testing as specified in IEC 512-1.

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 referee conditions of IEC 68-1.

10.3 *Preconditioning*

Where specified, the connections shall be preconditioned under standard conditions for testing for a period of 24 h, in accordance with IEC 512-1.

10.4 *Mounting of the specimen*

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

11. Type tests

11.1 *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 512-2. The visual examination test may be carried out with magnification up to approximately five times.

All crimped connections shall be examined to ensure that the applicable requirements of clauses 7 to 9 have been met.

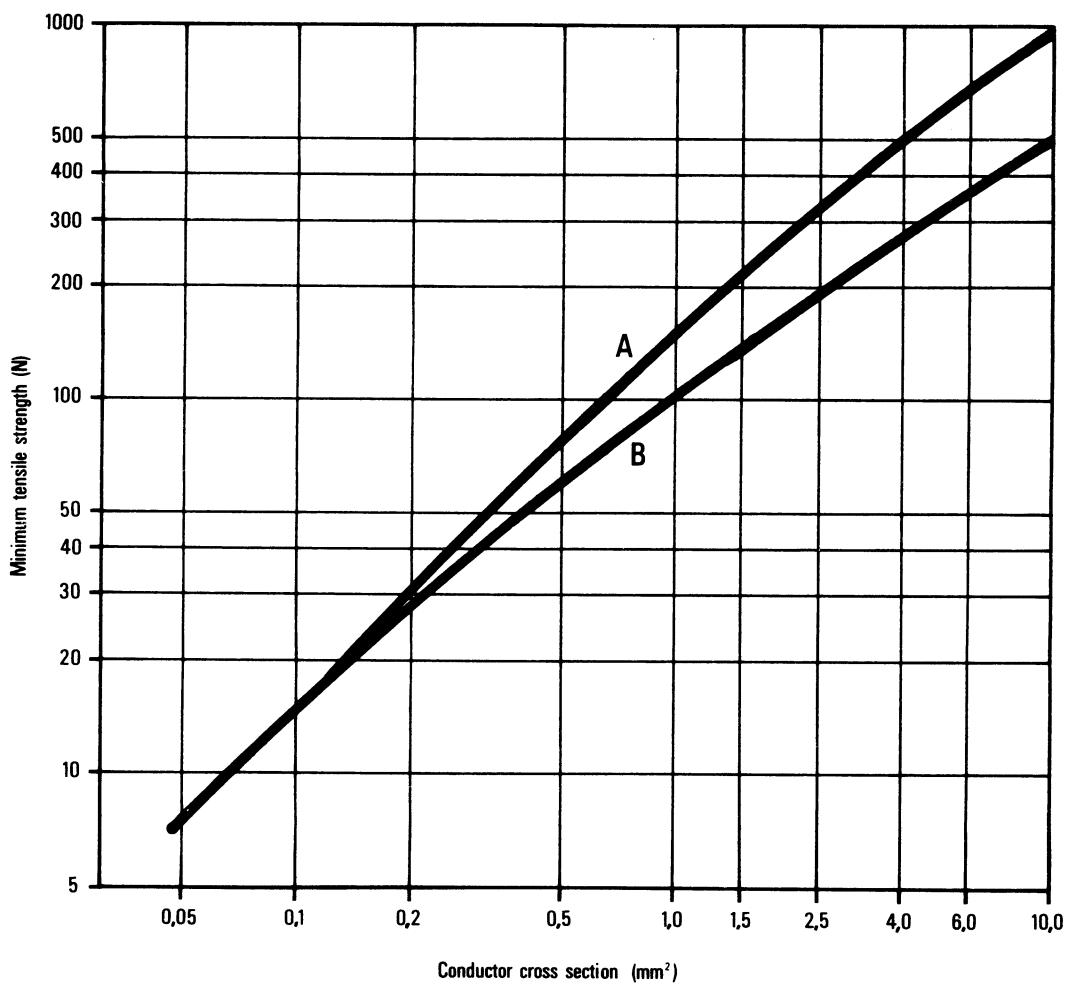
11.2 Mechanical tests

11.2.1 Tensile strength

The test shall be carried out in accordance with Test 16d: Tensile strength (crimped connections), of IEC 512-8.

The minimum permissible values of the tensile strength are given in Figure 5.

The cross-section to be used when applying Figure 5 is the cross-section calculated from the number of strands and the nominal diameter of one strand.



Curve A: Minimum values for closed crimp barrels

Curve B: Minimum values for open crimp barrels and for pre-insulated crimp barrels

Figure 5 – Tensile strength of crimped connections

11.2.2 *Insulation grip effectiveness*

The test shall be carried out in accordance with Test 16 h: Insulation grip effectiveness (crimped connections), of IEC 512-8.

Number of winding cycles : 2

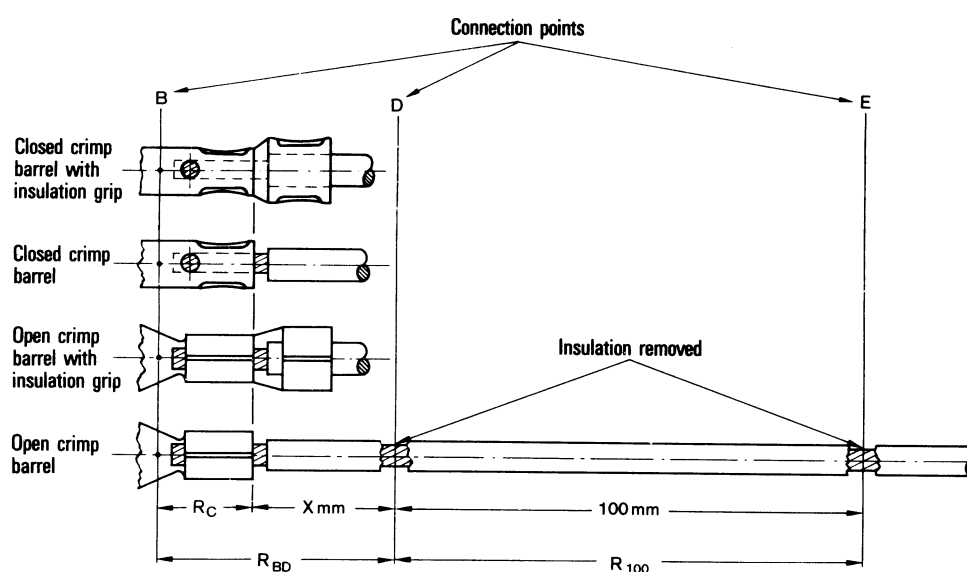
Tension to be applied : Lowest tension necessary to bring the wire into contact with the mandrel.

11.3 *Electrical tests*

11.3.1 *Contact resistance*

The test shall be carried out in accordance with Test 2a: Contact resistance – Millivolt level method, or Test 2b: Contact resistance – Specified test current method, of IEC 512-2, as specified in the relevant specification.

A suitable test arrangement is shown in Figure 6.



$$R_C = R_{BD} - \frac{X}{100} \times R_{100}$$

where

R_C = contact resistance of crimped connection

R_{BD} = measured resistance between connection points B and D

R_{100} = measured resistance over 100 mm wire length (D-E)

X = distance between crimp barrel end and connection point D in mm

Note. – Distance X : 25 mm to 100 mm is recommended

Figure 6