BRITISH STANDARD

BS EN 60352-3:1995
IEC 352-3: 1993

Solderless connections —

Part 3: Solderless accessible insulation displacement connections — General requirements, test methods and practical guidance

The European Standard EN 60352-3:1994 has the status of a British Standard

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee EPL/48, Electromechanical components for electronic equipment, upon which the following bodies were represented:

Federation of the Electronics Industry

Ministry of Defence

National Supervising Inspectorate

The following bodies were also represented in the drafting of the standard through subcommittees:

Association of Manufacturers allied to the electrical and electronics industry (BEAMA Ltd.)

British Telecommunications plc

Society of British Aerospace Companies Limited

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Contents

National foreword

This British Standard has been prepared by Technical Committee EPL/48 and is the English language version of EN 60352-3:1994, *Solderless connections — Part 3: Solderless accessible insulation displacement connections — General requirements, test methods and practical guidance,* published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 352-3:1993, published by the International Electrotechnical Commission (IEC).

Cross-references

Publication referred to	Corresponding British Standard
IEC 50 (581):1978	BS 4727 *Glossary of electrotechnical, power, telecommunications, electronics, lighting and colour terms* Part 1. *Terms common to power, telecommunications and electronics* Group 13:1991 *Electromechanical components for electronic equipment*
EN 60068-1:1994 (IEC 68-1:1988 + corrigendum October 1988 + A1:1992)	BS EN 60068 *Environmental testing* Part 1:1995 *General and guidance*
EN 60512-1:1994[a] (IEC 512-1:1994)	BS EN 60512 *Electromechanical components for electronic equipment — Basic testing procedures and measuring methods* Part 1:1995 *General* BS 5772 *Specification for electromechanical components for electronic equipment: basic testing procedures and measuring methods*
IEC 512-4:1976	Part 4:1979 *Dynamic stress tests*
IEC 512-5:1992	Part 5:1993 *Impact tests (free components), static load tests (fixed components), endurance tests and overload tests*
IEC 512-6:1984	Part 6:1984 *Climatic tests and soldering tests*
IEC 673:1980 + A1:1984 + A2:1986 + A3:1989	BS 6156:1981 *Specification for low-frequency miniature equipment wires with solid or stranded conductor, fluorinated polyhydrocarbon type insulation, single*

[a] EN 60512-1:1994 supersedes IEC 512-1:1988 and Amendment 1:1989.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 24, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60352-3

October 1994

ICS 29.120.20

Descriptors: Solderless connections, solderless accessible insulation displacement connections

English version

Solderless connections
Part 3: Solderless accessible insulation displacement connections — General requirements, test methods and practical guidance

(IEC 352-3:1993)

Connexions sans soudure
Partie 3: Connexions autodénudantes accessibles sans soudure — Règles générales, méthodes d'essai et guide pratique
(CEI 352-3:1993)

Lötfreie elektrische Verbindungen
Teil 3: Lötfreie zugängliche Schneidklemmverbindungen Allgemeine Anforderungen, Prüfverfahren und Anwendungshinweise
(IEC 352-3:1993)

This European Standard was approved by CENELEC on 1994-05-15. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 352-3:1993 could be accepted without textural changes, has shown that no common modifications were necessary for the acceptance as European Standard.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as EN 60352-3 on May 1994.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1995-07-15
- latest date of withdrawal of conflicting national standards (dow) 1995-07-15

Annexes designated "normative" are part of the body of the standard. In this standard, Annex ZA is normative.

Contents

Introduction

Two standards are available on solderless insulation displacement connections:

— *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.*

This standard includes requirements, tests and practical guidance information.

Two test schedules are provided:

— The Basic Test Schedule applies to insulation displacement connections which conform to all requirements of section 2.

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

— The Full Test Schedule applies to insulation displacement connections which do not fully conform to all requirements of section 2, for example those which are manufactured using materials or surface finishes not included in section 2.

This philosophy permits cost and time effective performance verification using a limited Basic Test Schedule for established connections and an expanded Full Test Schedule for connections requiring more extensive performance validation.

NOTE In this standard the term "insulation displacement" is abbreviated to "ID", for example "ID connection". "ID termination".

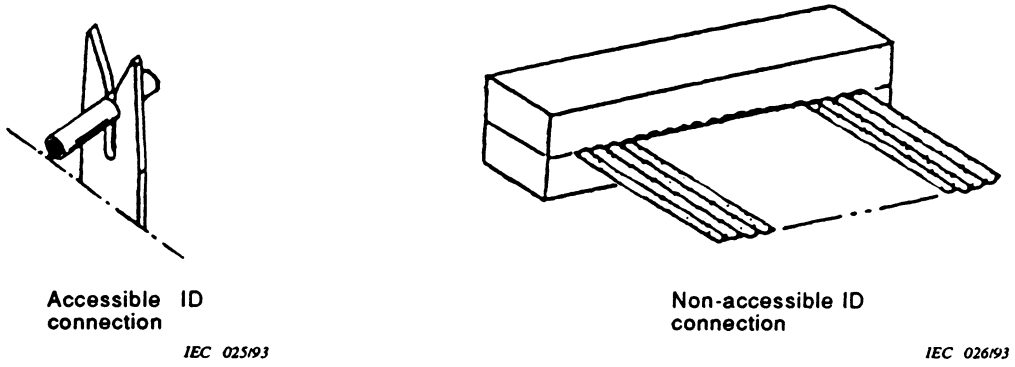

Figure 1 — Example of accessible and non-accessible insulation displacement connection

Section 1. General

1 Scope

This part of IEC 352 is applicable to ID connections which are accessible for tests and measurements according to section 3 and which are made with:

— appropriately designed ID terminations;

— wires having solid round conductors of 0,25 mm to 3,6 mm nominal diameter;

— wires having stranded conductors of 0,05 mm^2 to 10 mm^2 cross-section;

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.

2 Object

To determine the suitability of accessible ID connections under specified mechanical, electrical and atmospheric conditions.

There are different designs and materials for ID terminations in use. For this reason only fundamental parameters of the termination are specified while the performance requirements of the wire and the complete connection are specified in full detail.

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

3 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 352. 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 352 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 50(581):1978, *International Electrotechnical Vocabulary (IEV) — Chapter 581: Electromechanical components for electronic equipment.*

IEC 68-1:1988, *Environmental testing — Part 1: General and guidance.*

IEC 68-2-60 TTD:1989, *Environmental testing — Part 2: Tests — Test Ke: Corrosion tests in artificial atmosphere at very low concentration of polluting gas(es).*

IEC 189-3:1988, *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.*

Amendment 1 (1989)

IEC 352-4, *Solderless connections — Part 4: Solderless non-accessible insulation displacement connections — General requirements, tests methods and practical guidance (under consideration).*

IEC 512-1:1984, *Electromechanical components for electronic equipment; basic testing procedures and measuring methods — Part 1: General.*

Amendment 1 (1988)

IEC 512-2:1985, *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.*

IEC 512-4:1976, *Electromechanical components for electronic equipment; basic testing procedures and measuring methods — Part 4: Dynamic stress tests.*

IEC 512-5:1992, *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 512-6:1984, *Electromechanical components for electronic equipment; basic testing procedures and measuring methods — Part 6: Climatic tests and soldering tests.*

IEC 673:1980, *Low-frequency miniature equipment wires with solid or stranded conductor, fluorinated polyhydrocarbon type insulation, single.*

Amendment 3 (1989)

4 Definitions

Terms and definitions used in and applicable to this part of IEC 352 are included in IEC 50(581). IEC 512-1 also contains some applicable terms and definitions.

For the purpose of this part of IEC 352, the following additional terms and definitions shall apply.

4.1 Insulation displacement connection (ID connection)

A solderless electrical connection made by inserting a single wire into a precisely controlled slot in a termination such that the sides of the slot displace the insulation and deform the conductor of a solid wire or strands of stranded wire to produce a gas-tight connection.

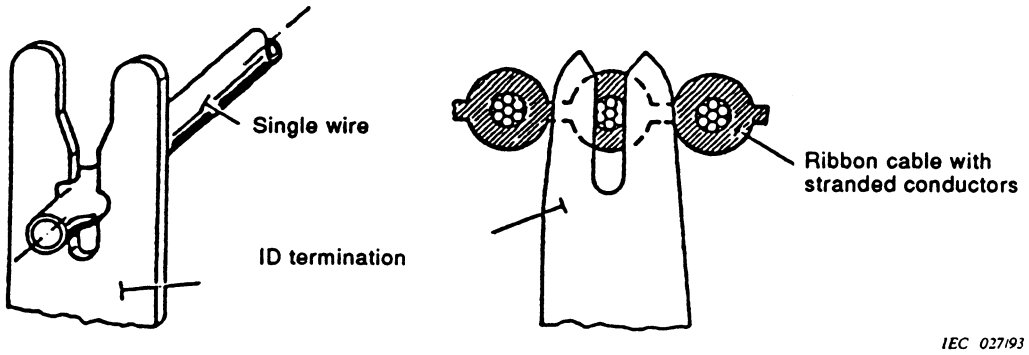

Figure 2 — Insulation displacement connection

4.1.1
accessible insulation displacement connection (accessible ID connection)

an ID connection in which it is possible to access test points for carrying out mechanical tests (for example, transverse extraction force) and electrical measurements (for example, contact resistance) without deactivation of any design feature intended to establish and/or maintain the ID connection

4.1.2
non-accessible insulation displacement connection (non-accessible ID connection)
(See IEC 352-4, under consideration)

an ID connection in which it is not possible to access test points for carrying out mechanical tests such as transverse extraction force and some electrical measurements (for example, contact resistance) without deactivation of any design feature intended to establish and/or maintain the ID connection, mainly where the ID connection is enclosed in a component

4.2 Insulation displacement termination (ID termination)

A termination designed to accept a wire for the purpose of establishing an ID connection.

4.2.1
reusable insulation displacement termination (reusable ID termination)

an ID termination that can be used more than once

4.2.2
non-reusable insulation displacement termination (non-reusable ID termination)

an ID termination that can be used only once

4.3 Slot

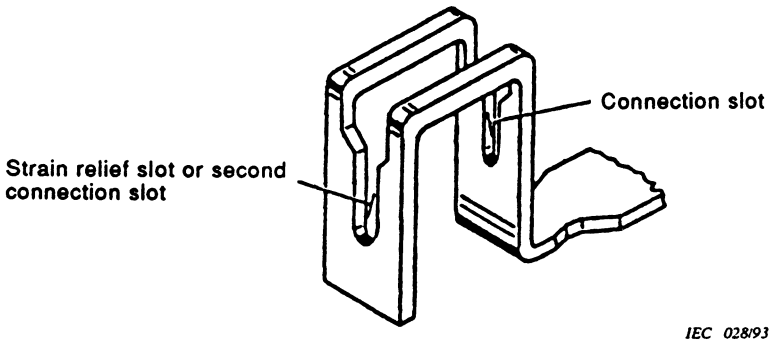

Figure 3 — Slot

4.3.1
connection slot

the specially shaped opening in an ID termination suitable to displace the insulation of a wire and to ensure a gas-tight connection between the termination and the conductor(s) of the wire

in certain cases a second connection slot is used to provide for a double connection

4.3.2
strain relief slot

the specially shaped opening in an ID termination suitable to provide for strain relief

4.4
beam

the specially shaped metallic part of an ID termination on each side of the slot

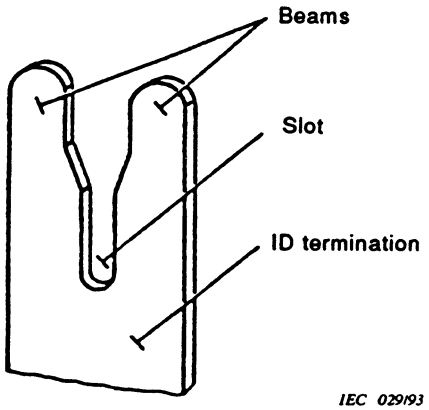

Figure 4 — Beam

4.5
apparent diameter (of a stranded conductor)

the diameter of the circumscribing circle of the bundle of strands

4.6
guiding block (see IEC 352-4)

a specially shaped part of a component, for example, a connector, which guides/inserts the wire(s) into the slot(s). Additionally it may provide for other mechanical features, for example, fixing the wire(s) in correct position(s), strain relief of the ID connection(s), secondary loading on the ID termination(s) or beams

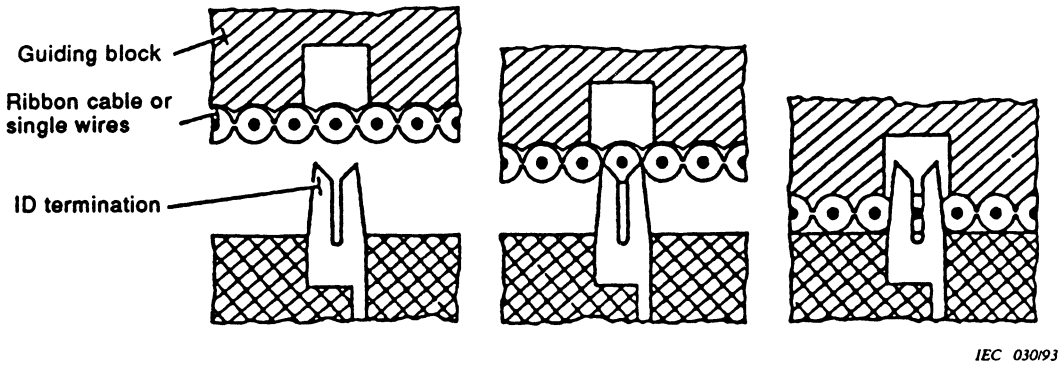

Figure 5 — Guiding block

4.7
wire insertion tool

a hand- or power-operated tool for producing an ID connection by inserting the wire(s) in a controlled manner to a predetermined position into the slot(s)

4.8
wire extraction tool

a device for extracting the wire(s) from the ID termination

5 IEC type designation

Not applicable.

Section 2. Requirements

6 Workmanship

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

7 Tools

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

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

A tool shall be designed and shall operate in such a manner that any damage to the ID termination and/or to the wire is avoided.

A tool shall provide for a correct location of the wire in the slot.

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

8 Insulation displacement terminations (ID terminations)

8.1 Materials

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

NOTE If copper-zinc is used care should be taken regarding corrosion effects caused by stress.

8.2 Dimensions

The quality of an ID connection depends on the dimensions of the ID termination, particularly of its slot and beams, together with the characteristics of the materials used. The dimensions shall be chosen so as to be suitable for the wire or range of wires for which the ID termination is designed. The suitability is verified by applying the test schedule given in section 3.

8.3 Surface finishes

The contact area of the termination shall be plated with tin or tin-lead or with silver, gold, palladium or their alloys. The surface shall be free of detrimental contamination or corrosion.

8.4 Design features

ID terminations may be distinguished according to reusability conditions and according to a range of wire sizes that can be accommodated. This results in the following types:

— reusable terminations, designed to be connected more than once and designed for one specified nominal conductor diameter or cross-section;

— reusable terminations, designed to be connected more than once and designed for a specified range of conductor diameters or cross-sections;

— non-reusable terminations, designed to be connected once and designed for one specified nominal conductor diameter or cross-section;

— non-reusable terminations, designed to be connected once and designed for a specified range of conductor diameters or cross-sections.

The edges of the beams shall be smooth and free of burrs to avoid unintentional damage to the conductor(s) or insulation.

9 Wires

Wires with solid round conductors or stranded conductors with seven single strands shall be used.

NOTE For further information on wires see IEC 189-3 and IEC 673.

9.1 Materials

The conductor material shall be annealed copper. It shall have an elongation at break of not less than 10 %.

9.2 Dimensions

Different ranges of wires shall be used:

— single solid round wires of 0,25 mm to 0,8 mm diameter (converted 0,049 mm^2 to 0,5 mm^2), or

— stranded wires of 0,075 mm^2 to 0,5 mm^2 cross-section.

9.3 Surface finishes

Solid round conductors shall be unplated or plated with tin, tin-lead or silver. Stranded conductors shall have strands plated with tin, tin-lead or silver.

The conductor surface shall be free of contamination and corrosion.

9.4 Wire insulation

The detail specification of the ID termination shall specify the outside diameter of the wire insulation that can be accommodated.

The insulation material shall be PVC or another material with properties compatible with the insulation displacement process, i.e. the insulation material shall be capable of being readily displaced by the inner edges of the beams without damaging the conductor. In the case of stranded conductors, the insulation shall, in addition, be capable of keeping the strands in place so that they are not unduly displaced when making the ID connection.

10 Accessible insulation displacement connections (ID connections)

a) The combination of wire, termination and connection tool shall be compatible.

b) When inserting the wire into the connection slot of the ID termination the inner sides of the beams shall displace the wire insulation and deform

— the diameter of a solid round conductor, or

— the apparent diameter of a stranded conductor and, in addition, the diameter of those strands which are in contact with the beams to produce a gas-tight connection.

c) The wire shall be correctly located in the connection slot of the ID termination as specified by the detail specification. There shall be a sufficient distance between the termination and the wire end. The minimum value of that distance depends on the wire used and shall be as specified by the detail specification.

d) Only one wire in one connection slot shall be used.

Section 3. Tests

11 Testing

11.1 Introduction

Where a termination is designed to accommodate more than one ID connection each connection shall be tested individually.

11.2 General

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

— ID connections which conform to all the requirements of section 2 shall be tested in accordance with and meet the requirements of **13.2**.

— ID connections which do not fully conform to all the requirements of section 2, for example, which are made with different wire and/or termination sizes and/or materials, shall be tested according to and meet the requirements of **13.3**.

11.3 Standard conditions for testing

Unless otherwise specified, all tests shall be carried out under 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 the case of dispute about test results, the test shall be repeated at one of the referee conditions of IEC 68-1.

11.4 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.

11.5 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.

11.6 Mounting of specimen

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

12 Type tests

NOTE As far as test methods are described in this standard, it is intended that the description be replaced by a reference to IEC 512 as soon as the relevant test method is included in IEC 512.

12.1 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 of up to approximately five times.

All parts shall be examined to determine whether the requirements of clauses **8** to **10** have been met.

12.2 Mechanical tests

12.2.1 *Transverse extraction force*

The object of this test is to determine the force necessary to move the wire within the connection slot of an accessible ID termination along the longitudinal axis of the termination.

The test specimen shall consist of an ID termination with one inserted wire. If necessary, the termination may be separated from the component, provided the ID connection is not affected. The ID termination shall be securely held.

A force *F* shall be applied to the inserted wire so as to move the wire in the longitudinal axis of the connection slot of the termination. The force shall be applied using a suitable device, for example, a test fork. An example of a suitable test arrangement is shown in Figure 6. The total clearance between the termination and the test fork shall not exceed 50 % of the wire diameter. The force shall be applied by a suitable means, for example, a tensile testing machine. The head of the tensile testing machine shall travel steadily at a speed of between 25 mm/min and 50 mm/min.

The specimen shall be tested until the wire moves in the connection slot of the ID termination. The ultimate load shall be measured.

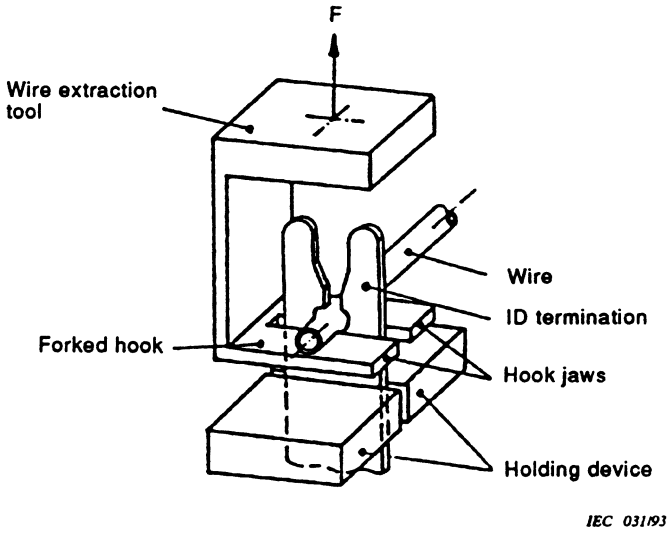

Figure 6 — Test arrangement, transverse extraction force

Requirement:

The force measured shall be not less than the minimum values given in Table 1.

Table 1 — Minimum transverse extraction force

Solid conductors, nominal diameter mm	Stranded conductors, nominal cross-section mm²	Minimum transverse extraction force	
		Solid conductors N	Stranded conductors N
0,25 to 0,32	0,05 to 0,08	2	1
> 0,32 to 0,5	> 0,08 to 0,2	3	2
> 0,5 to 0,8	> 0,2 to 0,5	5	3
> 0,8 to 1,4	> 0,5 to 1,5	8	5
> 1,4 to 2,3	> 1,5 to 4,0	10	8
> 2,3 to 3,6	> 4,0 to 10,0	12	10

12.2.2 ***Bending of the wire***

The object of this test is to assess the ability of an accessible ID connection to withstand the mechanical stress caused by bending the connected wire in a specified manner.

The test specimen shall consist of one ID termination with one inserted wire (see Figure 7).

If necessary, the termination may be separated from the component, provided the ID connection is not affected.

The test specimen shall be securely held in such a position that the wire hangs along its longitudinal axis in the connection slot as shown in Figure 7. An axial load *F* shall be applied to the free end of the wire to keep the wire straight. The value of this load shall be 5 % to 10 % of the breaking strength of the wire.

The wire shall then be bent in both directions from the vertical which constitutes one cycle. Unless otherwise specified by the detail specification, the bending angle α shall be 30°. Other recommended bending angles for detail specifications are 60° and 90°.

Bending of the wire shall be carried out using a suitable device, for example, as indicated in Figure 7.

Contact disturbance shall be monitored during the bending test in accordance with Test 2e: Contact disturbance, of IEC 512-2.

The limit of duration of contact disturbance shall be 10 ms unless otherwise specified by the detail specification.

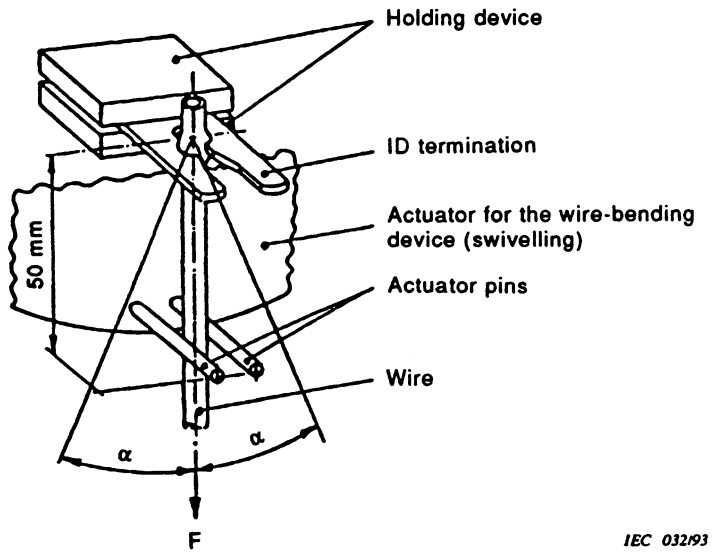

Figure 7 — Test arrangement, bending of the wire

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

After testing, the termination shall not be damaged and the conductor shall not be broken.

12.2.3 ***Vibration***

The test shall be carried out in accordance with Test 6d: Vibration, of IEC 512-4.

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

An example of a suitable test arrangement for testing accessible ID connections is shown in Figure 8.

Contact disturbance shall be monitored during the vibration test in accordance with Test 2e: Contact disturbance, of IEC 512-2.

The limit of duration of contact disturbance shall be 10 ms unless otherwise specified by the detail specification.

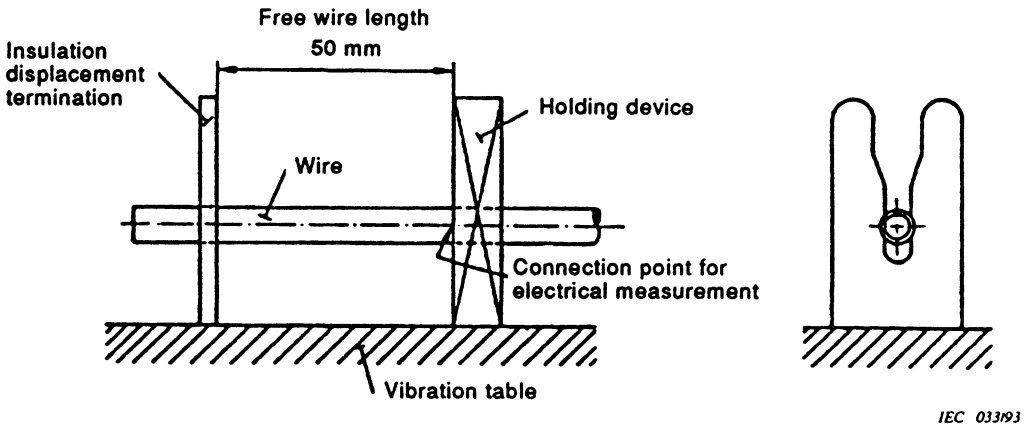

Figure 8 — Test arrangement, vibration

Table 2 — Vibration, preferred test severities

Range of frequency	10 Hz to 55 Hz	10 Hz to 500 Hz	10 Hz to 2 000 Hz
Crossover frequency	—	57 Hz to 62 Hz	57 Hz to 62 Hz
Displacement amplitude below the crossover frequency	0,35 mm	0,35 mm	1,5 mm
Acceleration amplitude above the crossover frequency	—	50 m/s^2 (5 *g*)	200 m/s^2 (20 *g*)
Directions	3 axes	3 axes	3 axes
Number of sweep cycles per direction	5	5	5

The applicable test severity shall be specified by the detail specification.

12.2.4 ***Repeated connection and disconnection, reusable accessible ID terminations***

The object of this test is to assess the ability of a reusable accessible ID termination to withstand a specified number of connections and disconnections.

A specified wire shall be inserted into a reusable ID termination in a specified manner. Following this, the wire shall be extracted in a specified manner. This shall be considered to be one cycle.

The last cycle of a specified number of test cycles consists of only inserting the wire into the termination, i.e. in any case there shall be a complete ID connection at the end of a specified number of test cycles.

The same reusable ID termination shall be used for the total number of test cycles specified.

A new part of the wire or a new wire of the same type shall be used for each test cycle.

Where terminations are designed to accept a range of conductor sizes all cycles except the last one shall be carried out with the maximum conductor sizes specified. The last cycle and the final measurement shall be carried out with the minimum conductor sizes specified by the detail specification.

Test severities:

The conductor sizes for the last cycle and the number of cycles to be carried out shall be specified by the detail specification. Preferred values for the number of cycles are 4, 20 or 100.

12.3 Electrical tests

The component detail specification shall prescribe the upper category temperature (UCT) and the lower category temperature (LCT) which shall be used in the following tests.

12.3.1 ***Contact resistance***

The contact resistance test shall be carried out according to Test 2a: Contact resistance, millivolt level method, or Test 2b: Contact resistance, specified test current method, of IEC 512-2 as specified in the detail specification.

A suitable test arrangement as shown in Figure 9 shall be used.

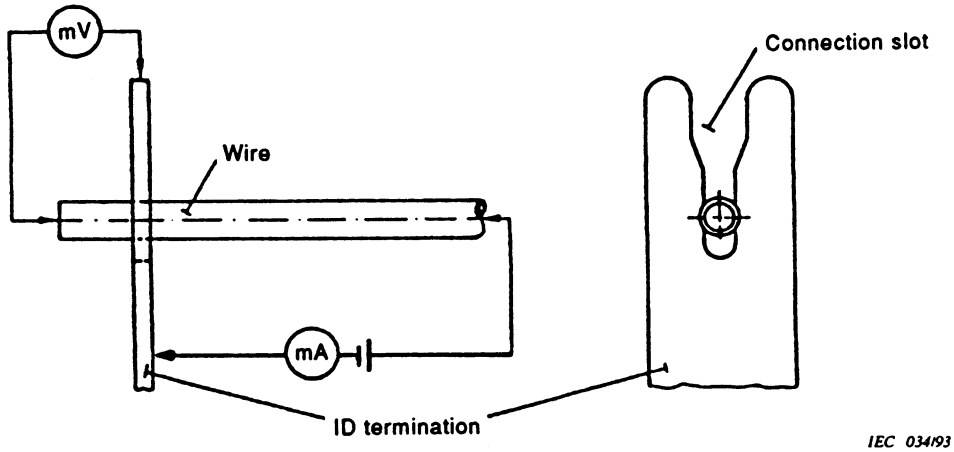

Figure 9 — Test arrangement, contact resistance

When Test 2b is applied, the test current shall be 1 A per mm^2 of the conductor cross-section. The duration of application of the test current shall be short enough to prevent heating of the specimens.

The maximum permitted change in resistance is to be added to the initially measured resistance, not to the permitted initial limit, i.e. the maximum permitted contact resistance after conditioning is equal to the measured initial value plus the maximum permitted change as given in Table 3.

Table 3 — Contact resistance of accessible ID connections, maximum permitted values

ID termination	Conductor		Initial contact resistance, maximum mΩ	Maximum change in resistance after mechanical, electrical or climatic conditioning mΩ
plated	solid round conductor	plated	2	1
		unplated	5	1
	stranded conductor	plated	2	2
		unplated	5	5
unplated	solid round conductor	plated	5	1
		unplated	5	1
	stranded conductor	plated	5	2
		unplated	5	5

12.3.2 ***Electrical load and temperature***

The test shall be carried out in accordance with Test 9b: Electrical load and temperature, of IEC 512-5. Unless otherwise specified by the detail specification, the following details shall apply:

maximum operating temperature: + 100 °C (UCT)
test duration: 1 000 h

Test current shall be as specified in the detail specification.

12.4 Climatic tests

The component detail specification shall prescribe the upper category temperature (UCT) and the lower category temperature (LCT) which shall be used in the following tests.

12.4.1 *Rapid change of temperature*

The test shall be carried out in accordance with Test 11d: Rapid change of temperature, of IEC 512-6. Unless otherwise specified by the detail specification, the following details shall apply:

low temperature:	T_A	– 55 °C (LCT)
high temperature:	T_B	+ 100 °C (UCT)
duration of exposure:	t_1	30 min
number of cycles:		5

12.4.2 *Climatic sequence*

The test shall be carried out in accordance with Test 11a: Climatic sequence, of IEC 512-6. Unless otherwise specified by the detail specification, the following details shall apply:

— dry heat:	Test 11i
test temperature:	+ 100 °C (UCT)
— damp heat, cyclic:	Test 11m
upper test temperature:	+ 55 °C
number of cycles:	6
variant:	2
— cold:	Test 11j
test temperature:	– 55 °C (LCT)

12.4.3 *Corrosion, industrial atmosphere*

The test shall be carried out in accordance with Test Ke, Method C: Mixture of polluting gases, of IEC 68-2-60 TTD. Unless otherwise specified by the detail specification, the following details shall apply:

Test severities:	
concentration SO_2:	$(0{,}5 \pm 0{,}1)\ 10^{-6}$ (vol/vol)
concentration H_2S:	$(0{,}1 \pm 0{,}02)\ 10^{-6}$ (vol/vol)
temperature:	(25 ± 2) °C
relative humidity:	(75 ± 3) %
duration of exposure:	10 days

NOTE This test will be replaced by a new test method when published by IEC/SC50B. TC 48/WG3 has the intention of including this corrosion test method in Test 11g, to dispose of relevant corrosion tests in industrial atmosphere at lower and higher concentration of polluting gas(es). Detailed explanations should be given in the relevant connector standards.

12.4.4 *Damp heat, cyclic*

The test shall be carried out in accordance with Test 11m: Damp heat, cyclic, of IEC 512-6. Unless otherwise specified by the detail specification, the following details shall apply:

test temperature:	+ 55 °C
number of cycles:	6
variant:	2

13 Test schedules

13.1 General

Prior to testing, specimens shall be made. Each specimen shall consist of an ID termination with a wire inserted.

13.1.1 When ID connections with terminations designed to be suitable for a range of wire diameters are to be tested the tests shall be carried out:

a) with the number of specimens specified in Table 4 made with wires having the minimum conductor diameter within the range;

and additionally

b) with the number of specimens specified in Table 4 made with wires having the maximum conductor diameter within the range.

13.1.2 When multipole components are to be tested the required number of specimens (ID connections) shall be evenly distributed over several components:

Before the specimens are prepared, it shall be verified that:

a) correct terminations and wires are used;

b) the correct wire insertion tool is used;

c) the tool works correctly;

d) the operator is able to produce ID connections which comply with the requirements of clause **10**.

Table 4 — Number of specimens required

Test schedule	Subclause	Required in all cases, when reusable or non-reusable ID terminations are to be tested	Additionally required, when	
			reusable ID terminations are to be tested	ID terminations suitable for a range of wire diameters are to be tested
Basic test schedule, **13.2**	**13.2.2.1**	20	—	20
	13.2.2.2	—	20	—
Full test schedule, **13.3**	**13.3.2.1.1**	20	—	20
	13.3.2.1.2	20	—	20
	13.3.2.1.3	20	—	20
	13.3.2.1.4	20	—	20
	13.3.2.2	—	60	—

13.2 Basic test schedule

Where the basic test schedule is applicable (see **11.2**), the number of specimens specified in Table 4 shall be prepared and subjected to the initial examination according to **13.2.1**.

Where accessible ID connections with reusable or non-reusable terminations are to be tested, the required 20 specimens shall be subjected to the tests according to **13.2.2.1**.

Where reusable or non-reusable terminations suitable for a range of wire diameters are to be tested, both required groups (see **13.1** and Table 4) with 20 specimens each shall be subjected to the tests according to **13.2.2.1**.

Where ID connections with reusable terminations are to be tested, the required 20 specimens shall be subjected to the additional tests according to **13.2.2.2**.

13.2.1 *Initial examination*

All specimens shall be subjected to visual examination using Test 1a of IEC 512-2 to ensure that the applicable requirements of clause **10** have been met.

13.2.2 *Testing of accessible ID connections*

13.2.2.1 *Testing of accessible ID connections with reusable or non-reusable terminations*

20 specimens, or

2 × 20 specimens, if terminations suitable for a range of wire diameters are to be tested.

After initial examination according to **13.2.1**, 10 specimens or 2 × 10 specimens, as applicable, shall be subjected to the following tests:

Test phase	Test		Measurement to be performed		Requirement
	Title	Subclause	Title	IEC 512, Test No.	Subclause
P1.1			Contact resistance	2a or 2b	**12.3.1**
P1.2	Bending of the wire	**12.2.2**	Contact disturbance	2e	**12.2.2**
P1.3	Rapid change of temperature	**12.4.1**		11d	
P1.4	Damp heat, cyclic	**12.4.4**		11m	
P1.5			Contact resistance	as in P1.1	**12.3.1**

After initial examination according to **13.2.1**, the remaining 10 specimens, or 2 × 10 specimens, as applicable, shall be subjected to the following tests:

Test phase	Test		Measurement to be performed		Requirement
	Title	Subclause	Title	IEC 512, Test No.	Subclause
P2	Transverse extraction force	**12.2.1**			**12.2.1**

13.2.2.2 *Additional testing of accessible ID connections with reusable terminations*

20 specimens

After initial examination according to **13.2.1**, all specimens shall be subjected to the following tests:

Test phase	Test		Measurement to be performed		Requirement
	Title	Subclause	Title	IEC 512, Test No.	Subclause
P3.1	Repeated connection and disconnection	**12.2.4**			
P3.2	Transverse extraction force	**12.2.1**			**12.2.1**

13.3 Full test schedule

Where the full test schedule is necessary (see **11.2**), the required number of specimens specified in Table 4 shall be prepared and subjected to the initial examination according to **13.3.1**.

Where accessible ID connections with reusable or non-reusable terminations are to be tested, the required 80 specimens shall be divided into 4 groups of 20 specimens each and shall be subjected to the tests according to **13.3.2.1.1**, **13.3.2.1.2**, **13.3.2.1.3** and **13.3.2.1.4** (test groups A, B, C and D).

Where reusable or non-reusable terminations suitable for a range of wire diameters are to be tested, both required groups (see **13.1** and Table 4) with 4 × 20 specimens each shall be subjected to the tests according to **13.3.2.1.1**, **13.3.2.1.2**, **13.3.2.1.3** and **13.3.2.1.4** (test groups A, B, C and D).

Where accessible ID connections with reusable terminations are to be tested, the required 60 specimens shall be subjected to the additional tests according to **13.3.2.2**.

13.3.1 *Initial examination*

All specimens required shall be subjected to visual examination using Test 1a of IEC 512-2.

13.3.2 *Testing of accessible ID connections*

13.3.2.1 *Testing of accessible ID connections with reusable or non-reusable terminations*

80 specimens, or

2 × 80 specimens, if terminations suitable for a range of wire diameters are to be tested.

After initial examination according to **13.3.1**, the number of specimens shall be divided into 4 groups with 20 specimens or 2 × 20 specimens each, as applicable.

Then the specimens shall be subjected to the following tests according to the test groups A, B, C and D.

13.3.2.1.1 *Test group A*

20 specimens, or

2 × 20 specimens, as applicable

Test phase	Test		Measurement to be performed		Requirement
	Title	Subclause	Title	IEC 512, Test No.	Subclause
AP1	Transverse extraction force	**12.2.1**			**12.2.1**

13.3.2.1.2 *Test group B*

20 specimens, or

2 × 20 specimens, as applicable

Test phase	Test		Measurement to be performed		Requirement
	Title	Subclause	Title	IEC 512, Test No.	Subclause
BP1			Contact resistance	2a or 2b	**12.3.1**
BP2	Bending of the wire	**12.2.2**	Contact disturbance	2e	**12.2.2**
BP3	Electrical load and temperature	**12.3.2**		9b	
BP4			Contact resistance	as in BP1	**12.3.1**

13.3.2.1.3 *Test group C*

20 specimens, or

2 × 20 specimens, as applicable

Test phase	Test		Measurement to be performed		Requirement
	Title	Subclause	Title	IEC 512, Test No.	Subclause
CP1			Contact resistance	2a	**12.3.1**
CP2	Vibration	**12.2.3**	Contact disturbance	6d and 2e	**12.2.3**
CP3	Rapid change of temperature	**12.4.1**		11d	
CP4	Climatic sequence	**12.4.2**		11a	
CP4.1	Dry heat	**12.4.2**		11i	
CP4.2	Damp heat, cyclic, 1st cycle	**12.4.2**		11m	
CP4.3	Cold	**12.4.2**		11j	
CP4.4	Damp heat, cyclic, remaining cycles	**12.4.2**		11m	
CP5			Contact resistance	2a	**12.3.1**

13.3.2.1.4 *Test group D*

20 specimens, or

2 × 20 specimens, as applicable

Test phase	Test		Measurement to be performed		Requirement
	Title	Subclause	Title	IEC 512, Test No.	Subclause
DP1			Contact resistance	2a	**12.3.1**
DP2	Corrosion, industrial atmosphere	**12.4.3**			
DP3			Contact resistance	2a	**12.3.1**

13.3.2.2 *Additional testing of accessible ID connections with reusable terminations*

60 specimens

After initial examination according to **13.3.1**, all specimens shall be subjected to the following test:

Test phase	Test		Measurement to be performed		Requirement
	Title	Subclause	Title	IEC 512, Test No.	Subclause
EP1	Repeated connection and disconnection	**12.2.4**			**12.2.4**

When test phase EP1 has been carried out, the 60 specimens shall be split into 3 groups of 20 specimens each.

The first group shall then be subject to the test according to **13.3.2.1.1** — test group A.

The second group shall then be subjected to the tests according to **13.3.2.1.3** — test group C.

The third group shall then be subjected to the tests according to **13.3.2.1.4** — test group D.

13.4 Flow charts

For quick orientation, the test schedules detailed in **13.2** and **13.3** are repeated as flow charts in a simplified manner in Figure 10 and Figure 11, respectively.

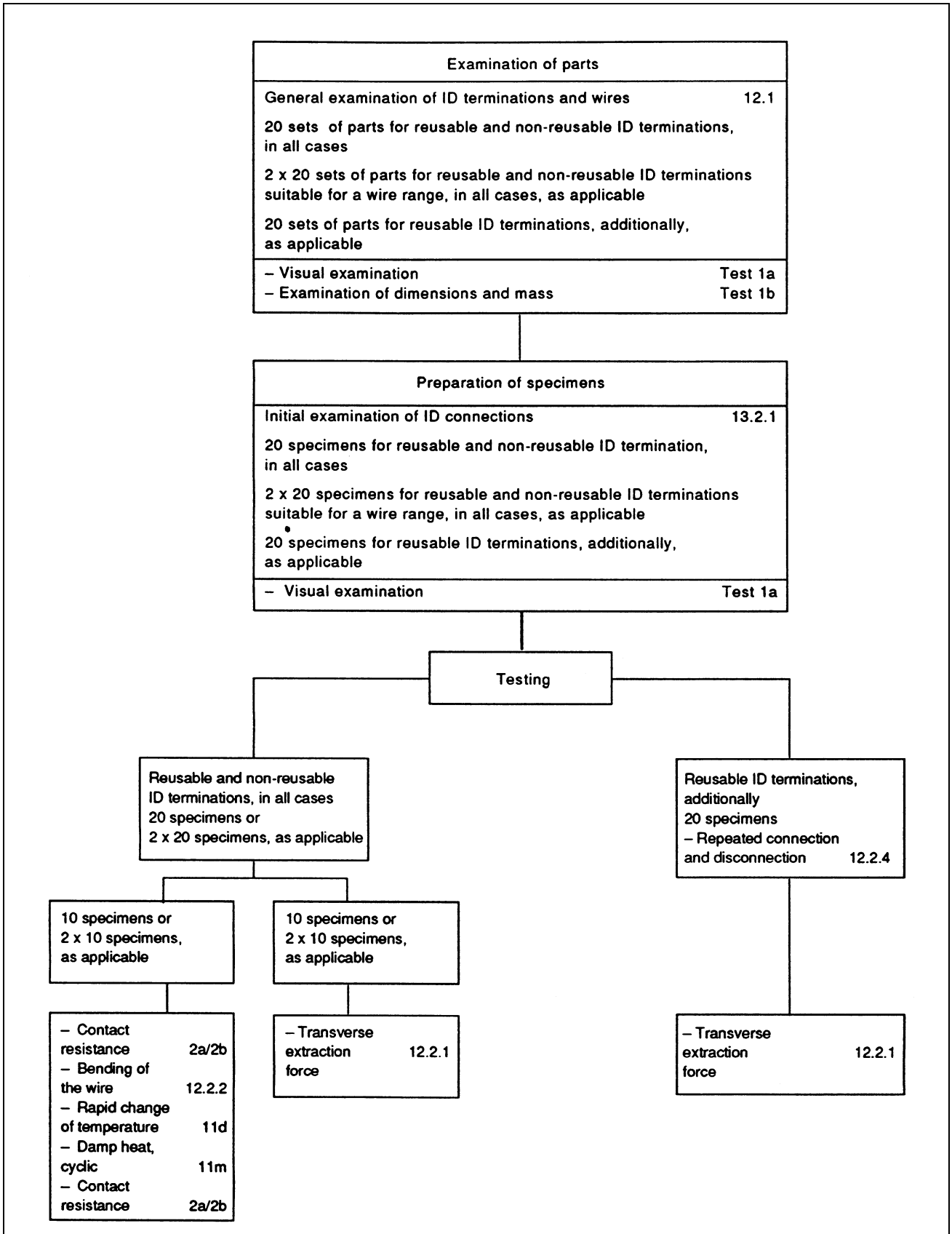

Figure 10 — Basic test schedule (see **13.2**)

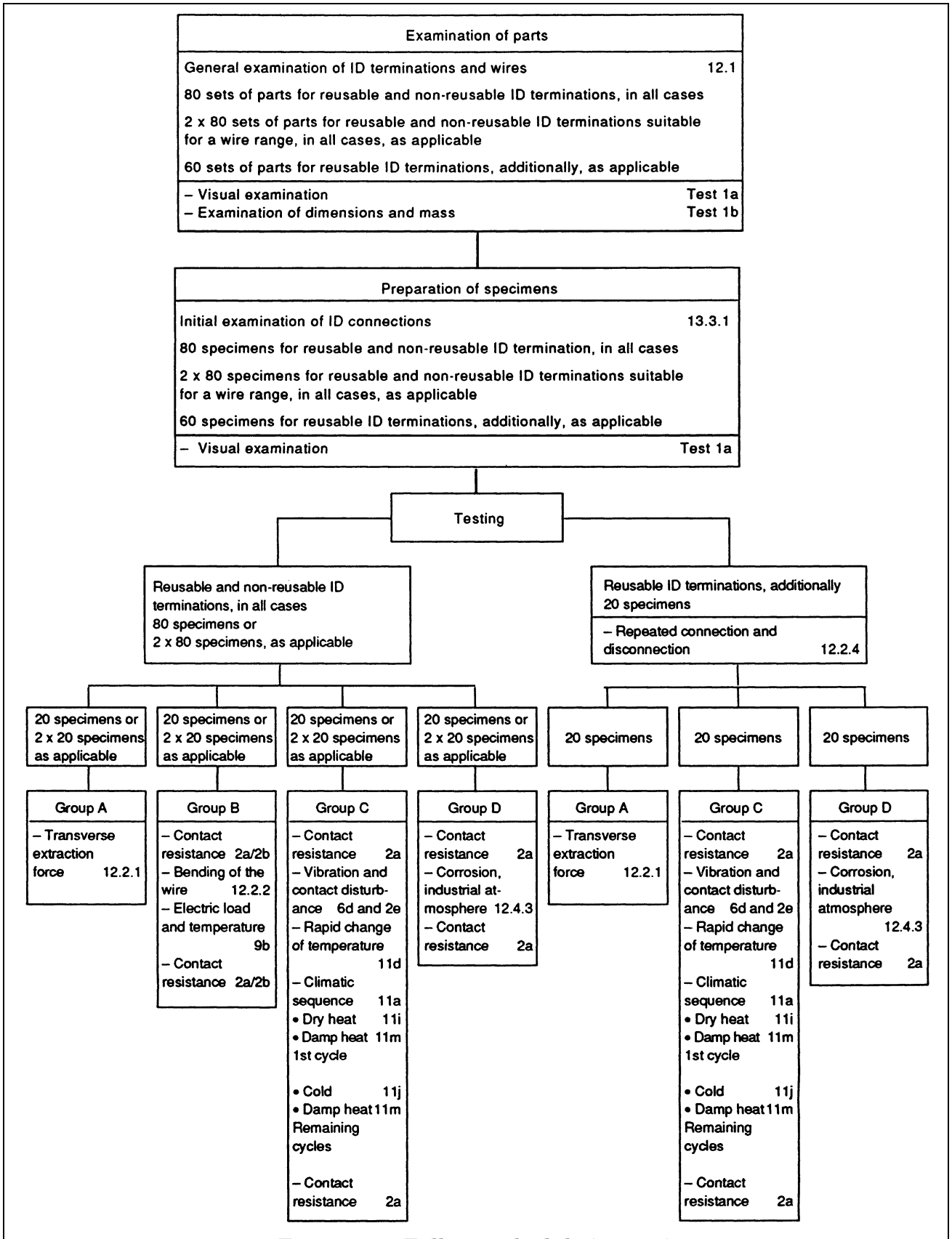

Figure 11 — Full test schedule (see **13.3**)

Section 4. Practical guidance

14 Current-carrying capacity

The current-carrying capacity of an accessible ID connection is determined by the lower value either given by the current-carrying capacity of the connected wire or that of the ID termination.

15 Tool information

15.1 Wire insertion tool

Generally, a wire insertion tool is required to establish an accessible ID connection. The tool should be able to support the wire on both sides of the connection slot, i.e. on both sides of the ID termination, during the wire insertion process. The tool should also provide for a correct location of the wire in the connection slot, for example, the correct depth. This may be ensured by arrangement of a depth stop.

There are special hand tools in use for establishing single ID connections, for example, for wiring operations at line distributors.

15.2 Wire extraction tool

If it is necessary to pull out or to remove an inserted wire in an accessible ID connection, it is recommended to use a wire extraction tool having a forked end for easy and safe removal of the wire without any danger of damaging the ID termination, for example, the connection slot or the beams.

15.3 Combination tool

There are hand-operated combination tools in use, for example, for wiring operations at line distributors and for similar applications which enable the operator to carry out all necessary wiring steps with one tool, i.e. inserting of the wire, cutting it to the correct length and extracting it.

16 Termination information

The following information is based on industrial experience.

16.1 Design features

The design of the ID termination should be such — material characteristics duly taken into account — that:

— the beams are capable of exerting the necessary force;

— resilience should be achieved by design of the ID termination;

— the slot edges of the beams are capable of readily displacing the wire insulation and of maintaining a force between beams and conductor/strands sufficient to maintain good electrical contact;

— the connection slot should have a lead-in for the wire.

16.2 Materials

All materials are subject to stress relaxation depending on time, temperature and stress.

The termination material and design should be such that the force maintaining the connection will not decrease with time to a degree where the connection suffers an unacceptable increase in resistance.

16.3 Surface finishes

The plating materials specified in **8.3** are normally used. Unplated terminations or other plating materials may be used, provided their suitability has been proven. In this case, the full test schedule according to **13.3** shall be applied (see **11.2**).

17 Wire information

17.1 Type

Stranded wires others than those described in clause **9**, for example, wires with a number of strands other than seven, may be used. In this case, the full test schedule according to **13.3** should be applied (see **11.2**).

17.2 Dimensions

Conductor diameters or cross-sections outside the ranges given in **9.2** may be used provided they are within the scope of this part of IEC 352 (see clause **1**). In this case, the full test schedule according to **13.3** shall be applied (see **11.2**).

17.3 Surface finishes

Solid round conductors unplated or plated and stranded conductors plated as given in **9.3** are normally used. Unplated stranded conductors or other finishes may be used, provided their suitability has been proven. In this case, the full test schedule according to **13.3** shall be applied (see **11.2**).

The surface finish should be smooth and uniform.

17.4 Insulation

The maximum diameter of the wire insulation should be specified by the detail specification.

The insulation material should be PVC or another material with properties compatible with the requirements of this part of IEC 352.

18 Connection information

The ID connection shall be in accordance with the relevant detail specification.

An accessible ID connection may need protection from external strains on, or movement of, the conductor. This may be achieved by any suitable means.

The wire insulation should surround the conductor on both sides of the termination and the conductor should not be visible between the insulation and the termination.

The wire should be in a correct position in the connection slot, i.e.:

— the conductor should be located in the connection slot in such a way that the resilient effect of the beams is not hampered;

— in its longitudinal axis the wire should have a sufficient distance between the ID termination and the wire end. This end tail is mainly of importance when using a stranded wire in an ID connection since the insulation of the end tail should maintain the wire bundle.

The inner sides of the beams should have deformed:

— the diameter of a solid round conductor, or

— the apparent diameter of a stranded conductor and the diameter of those strands which are in contact with the beams.

No particles of insulation shall be between the deformed part of the conductor or strands, respectively, and the inner sides of the beams.

There are different types of ID terminations in use for accessible ID connections, for example, terminations designed to:

— accept a single ID connection;

— accept two or more ID connections.

Some examples are shown in Figure 10 and Figure 11.

In order to minimize electrolytic corrosion effects, care should be taken when selecting the materials for conductor and termination to ensure that they are as close as practicable in the electrogalvanic series of metals.

Where the termination is to be used more than once, the reusable type of termination should be used. It is necessary to use a new part of the wire or a new wire for each new connection.

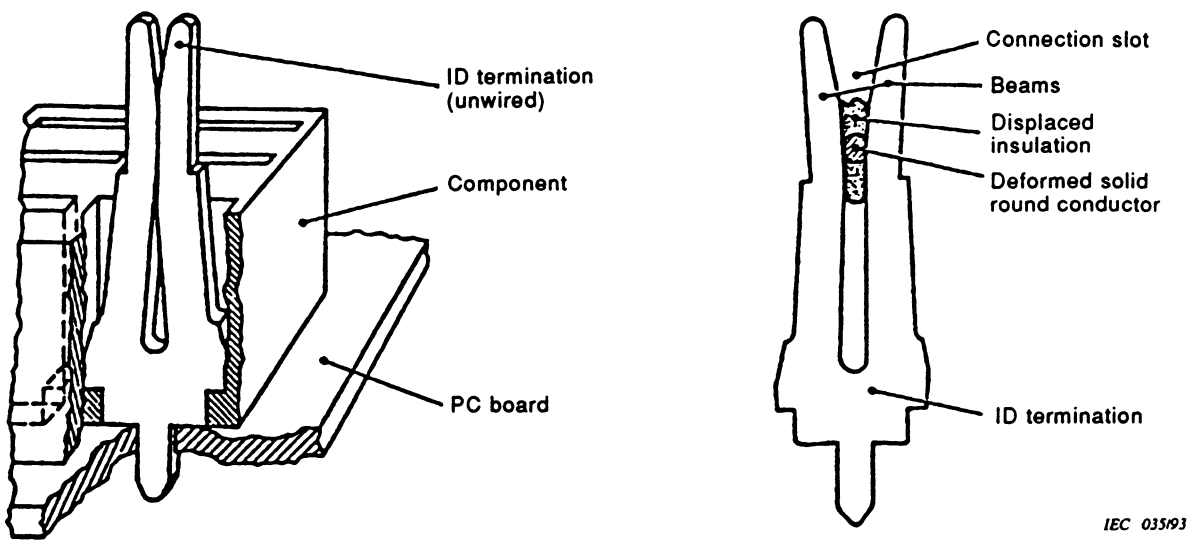

Figure 12 — Example of a single-type ID termination with a solid round conductor

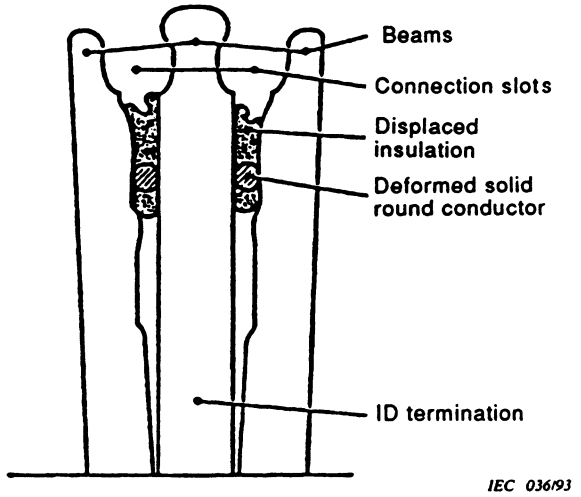

Figure 13 — Example of a double-type ID termination with solid round conductors

Annex ZA (normative)
Other international publications quoted in this standard with the references of the relevant European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incoporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE When the international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

IEC Publication	Date	Title	EN/HD	Date
50 (581)	1978	*International Electrotechnical Vocabulary (IEV) — Chapter 581: Electromechanical components for electronic equipment*	—	—
68-1	1988	*Environmental testing — Part 1: General and guidance (corrigendum October 1988)*	EN 60068-1[a]	1994
68-2-60	1989	*Part 2: Tests Test Ke: Corrosion tests in artificial atmosphere at very low concentration of polluting gas(es)*	—	—
189-3	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*	—	—
A1	1989			
512-1	1984	*Electromechanical components for electronic equipment; basic testing procedures and measuring methods — Part 1: General*	—	—
A1	1988			
512-2	1985	*Part 2: General examination, electrical continuity and contact resistance tests, insulation tests and voltage stress tests*	—	—
512-4	1976	*Part 4: Dynamic stress tests*	—	—
512-5	1992	*Part 5: Impact tests (free components), static load tests (fixed components), endurance tests and overload test*	—	—
512-6	1984	*Part 6: Climatic tests and soldering tests*	—	—
673	1980	*Low-frequency miniature equipment wires with solid or stranded conductor, fluorinated polyhydrocarbon type insulation, single*	—	—
A1	1984			
A2	1986			
A3	1989			

[a] EN 60068-1 includes A1:1992 to IEC 68-1.

List of references

See national foreword.

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