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INTERNATIONAL STANDARD

colour inside

Connectors for electrical and electronic equipment – Tests and measurements – Part 99-002: Endurance test schedules – Test 99b: Test schedule for unmating under electrical load

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – TESTS AND MEASUREMENTS –

Part 99-002: Endurance test schedules – Test 99b: Test schedule for unmating under electrical load

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60512-99-002:2019. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60512-99-002 has been prepared by subcommittee 48B: Electrical connectors, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment. It is an International Standard.

This second edition cancels and replaces the first edition published in 2019. This edition constitutes a technical revision.

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

a) Test group UEL has been revised with respect to the order of the test phases, the test severities and the requirements.

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

Draft	Report on voting
48B/2922/FDIS	48B/2938/RVD

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

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

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

A list of all parts in the IEC 60512 series, published under the general title *Connectors for electrical and electronic equipment – Tests and measurements*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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

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

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CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT – TESTS AND MEASUREMENTS –

Part 99-002: Endurance test schedules – Test 99b: Test schedule for unmating under electrical load

1 Scope

This part of IEC 60512 is used for ~~testing~~ the assessment of connectors within the scope of SC 48B that are used in twisted pair communication cabling with remote power, such as ISO/IEC 11801-1 Class D, or better, balanced cabling in support of ~~IEEE Std 802.3bt™, (PoE Plus – Power over Ethernet Plus)~~ IEEE 802.3bt™ (Power over Ethernet, supporting up to 90 W from the power sourcing equipment).

The object of this document is to detail a test schedule to determine the ability of ~~pairs~~ sets of connectors to withstand a ~~sequence of tests with a total of 100 engagements and separations. The electrical current is passed through the connectors during the separation (unmating) step only, in accordance with IEC 60512-9-3~~ minimum of 100 mechanical operations with electrical load, where an electrical current is being passed through the connectors in accordance with IEC 60512-9-3 during the separation (unmating) step.

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

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 60512-3-1, *Connectors for electronic equipment – Tests and measurements – Part 3-1: Insulation tests – Test 3a: Insulation resistance*

IEC 60512-4-1, *Connectors for electronic equipment – Tests and measurements – Part 4-1: Voltage stress tests – Test 4a: Voltage proof*

IEC 60512-9-3~~:2011~~, *Connectors for electronic equipment – Tests and measurements – Part 9-3: Endurance tests – Test 9c: Mechanical operation (engaging and separating) with electrical load*

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

~~IEC 60512-99-001, *Connectors for electronic equipment – Tests and measurements – Part 99-001: Test schedule for engaging and separating connectors under electrical load – Test 99a: Connectors used in twisted pair communication cabling with remote power*~~

~~ISO/IEC 11801(all parts): *Information technology – Generic cabling for customer premises*~~

~~ISO/IEC TS 29125: 2017, *Information technology – Telecommunications cabling requirements for remote powering of terminal equipment*~~

~~TIA-568-A:1995, *Commercial building telecommunications cabling standard*~~

~~TIA-568-B.2:2001, *Commercial building telecommunications cabling standard, Part 2: Balanced twisted-pair cabling components*~~

~~TIA TSB-184-A:2017, *Guidelines for supporting power delivery over balanced twisted-pair cabling*~~

IEEE Std 802.3™-2018, *IEEE Standard for Ethernet*

IEEE Std 802.3bt™-2018, *IEEE Standard for Ethernet. Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 pairs*

3 Terms and definitions

No terms and definitions are listed in this document.

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

4 General

~~An application-specific current and the associated open circuit voltage are specified, that correspond with the current and voltage of the supported application. This test schedule is suitable for verification of separating of connectors under PoE Plus load conditions; although it is a misuse of the connector, it may occur in practice.~~

~~As it is recognized that not all connectors will see these currents and voltage, this test schedule is regarded as an optional test, not normative for all connectors.~~

Although separating (unmating) connectors under the scope of this document, while used for remote powering, is a misuse of the connector, it may occur in practice.

This test schedule is suitable for verification of separating (unmating) of connectors under load conditions representative for Power over Ethernet Type 4 as specified per IEEE 802.3bt™. An application-specific current and the associated open circuit voltage are specified, that correspond with the current and voltage of the supported application.

5 Preparation of specimens

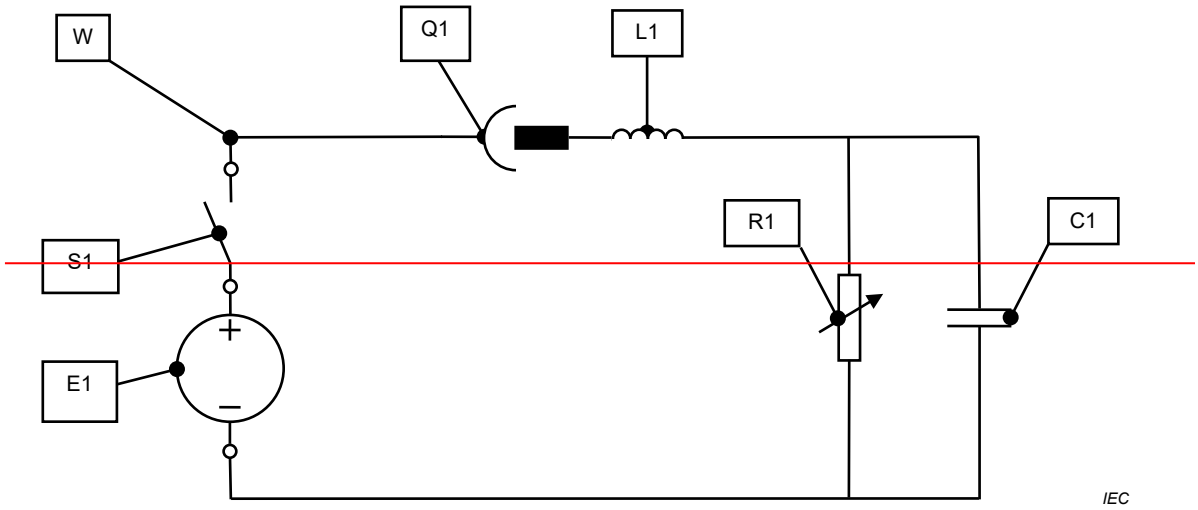
Each specimen shall consist of a mated set of connectors ~~pair~~ with its terminations. Specimens shall ~~be conformant~~ conform to the~~ir~~ relevant IEC connector standard. Each free and each fixed connector shall be terminated with 3 m (max.) of the maximum conductor size cable for which it is intended to be terminated, according to the appropriate IEC standard(s). ~~A printed circuit board may be used for the fixed connectors, so as not to influence the test results.~~ Fixed connectors may alternatively be terminated ~~as the free ones~~ using a printed circuit board which shall not influence the test results.

For each specimen, all circuits (mated contacts) shall be wired in parallel as given in IEC 60512-9-3~~, (see Figure 1)~~, and all circuits shall be tested.

6 Test circuit requirements

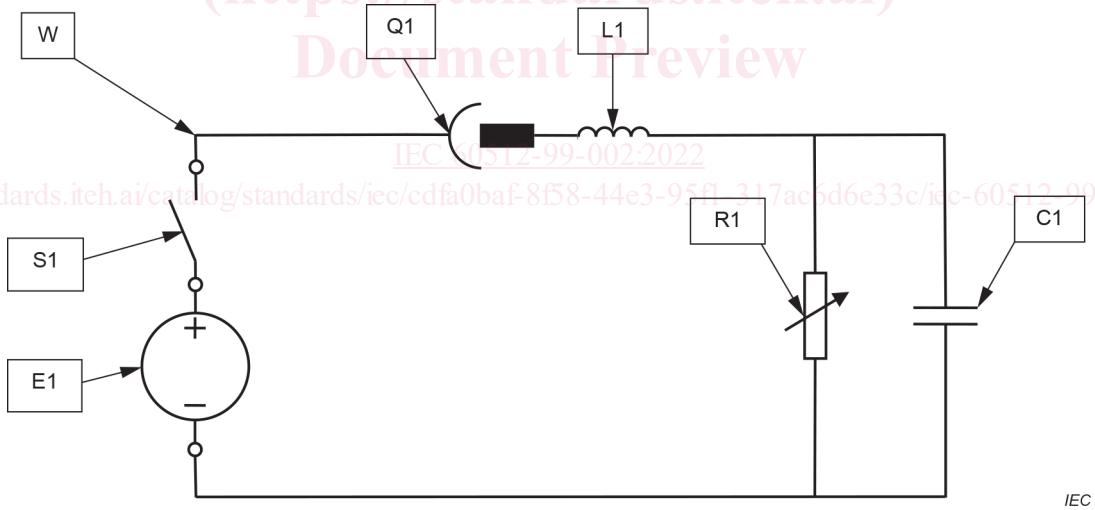
6.1 General

The values for the circuit components and the details of the test circuit, referenced in IEC 60512-9-3, shall be as shown in Figure 1.



~~**Key**~~

~~W Cables in accordance with 5~~
~~Q1 Connector under test~~
~~L1 Inductor L = 100 µH~~
~~R1 Variable resistor (e.g. 50 Ω to 300 Ω)~~
~~C1 Capacitor 5 µF~~
~~E1 Voltage source~~
~~S1 Switch~~



Key

W Cables in accordance with Clause 5
Q1 Specimen under test
L1 Inductor, L = 100 µH
R1 Variable resistor (e.g. R = 25 Ω to 300 Ω)
C1 Capacitor, C = 5 µF
E1 Voltage source
S1 Switch

Figure 1 – Test circuit details

NOTE 1 Only one circuit of the ~~connector~~ specimen under test, as referenced in IEC 60512-9-3, is shown for clarity. Items W, ~~Q1,~~ L1, R1 and C1 are replicated for each circuit of the ~~connector~~ specimen. Items E1 and S1 may be single or multiple. All circuits of the specimen are wired in parallel with appropriate duplication of circuit components, and all circuits of the specimen are operated simultaneously.

NOTE 2 The variable resistor is used to adjust the current to the specified value.

~~Each circuit of the specimen may be wired in parallel with the other circuits of the specimen, and all circuits of each specimen shall operate simultaneously. The variable resistor(s) shall be used to adjust the current(s) to the specified value.~~

6.2 Voltage and current

~~ISO/IEC TS 29125 specifies a maximum current as shown in Table 1 and an open circuit voltage of 55 V DC. The test current has been set to 2,0 A because a maximum of 4 contact pairs can be connected in parallel. In the highly probable case that one contact is separated after all others, this contact will carry this 2,0 A just before disconnecting.~~

~~As the resistive load is likely to rise due to heating and due to wear of contacts in the connector under test, care should be placed in keeping the value of test current within the specified tolerance range e.g. by means of a suitable feedback control circuit acting on the value of the variable resistor. See Annex A (informative) for further guidance.~~

~~The test procedures for Type 1 and Type 2 are defined in IEC 60512-99-001. For Type 3 and Type 4 the variable resistor(s) shall be set so that the electrical current in each circuit (mated contacts) of the specimen is 2,0 A $^{+0,05}_{0}$. When the specimen is unmated, the open circuit voltage, in all circuits, shall be 55 V DC $^{+1}_{0}$ V DC. When the specimen is mated, the open circuit voltage, in all circuits, shall be 0 V DC by operating the switch, S1, before each connector engagement (mating).~~

~~Table 1 – Maximum electrical circuit current~~

~~PSE Type~~	~~Nominal highest current per pair (I_{Cable}, A)~~	~~Number of powered pairs~~	~~Channel pairset maximum DC loop resistance (R_{Ch}, Ω)~~	~~Minimum cabling type~~
~~Type 1~~	~~0,350~~	~~2~~	~~20,0~~	~~Class D (ISO/IEC 11801) or Category 5 (ANSI/EIA/TIA-568-A: 1995)~~
~~Type 2~~	~~0,600~~	~~2~~	~~12,5~~	~~Class D (ISO/IEC 11801) or Category 5 (ANSI/EIA/TIA-568-A: 1995)~~
~~Type 3~~	~~0,600~~	~~2 or 4~~	~~12,5~~	~~Class D (ISO/IEC 11801) or Category 5 (ANSI/EIA/TIA-568-B.2: 2001)~~
~~Type 4~~	~~0,960~~	~~2 or 4~~	~~12,5~~	~~Class D (ISO/IEC 11801) or Category 5 (ANSI/EIA/TIA-568-B.2: 2001)~~

~~In Type 3 and Type 4 operation, the current per pairset may be impacted by pair-to-pair system resistance unbalance. See 33.2.8.5.1 of ISO/IEC TS 29125:2017. For additional information on Type 4 current unbalance, see TIA TSB-184-A and ISO/IEC TS 29125.~~

The variable resistor(s) shall be set so that the electrical current in each circuit (mated contacts) of the specimen is 2,0 $^{+0,05}_{0}$ A. During the separation (unmating) step, the open circuit voltage, in all circuits, shall be 55 $^{+1}_{0}$ V DC. During the engagement (mating) step, the open circuit voltage, in all circuits, shall be 0 V DC by operating the switch, S1, before each connector engagement (mating).

IEEE 802.3™-2018 and IEEE 802.3bt™ specify Power over Ethernet systems with a nominal highest current per pair depending on the type of power sourcing equipment (PSE) and the number of powered pairs, and with an open circuit voltage of 55 V DC.

For PSE Type 4, the nominal highest current per pair is 0,96 A when all four pairs are powered, giving a total source current of 1,92 A. The test current per contact has been set to 2,0 A to represent the highly probable case that one contact is separated after all others, causing this contact to carry the full current just before disconnecting.

As the resistive load is likely to rise due to heating and due to wear of contacts in the connector under test, care should be placed in keeping the value of test current within the specified tolerance range, e.g. by means of a suitable feedback control circuit acting on the value of the variable resistor. See Annex A (informative) for further guidance.

6.3 Auxiliary equipment

Switches may be used to reverse polarity. However, use of such switches shall not influence the test parameters.

7 Test methods

7.1 ~~Initial cycles~~ Mechanical operations with electrical load

An electrical load, current and open circuit voltage, as detailed in 6.2, shall be applied to each specimen ~~during the separation step only~~.

For the purpose of this test, one connector shall be fixed and the other disengaged at a speed of 150 mm/s ± 10 mm/s.

One engagement and one separation constitute one cycle.

25 cycles at one polarity of the DC source shall be performed. The polarity of the DC source shall then be reversed and 25 further cycles at the other polarity shall be performed (50 cycles total). The electrical current shall be applied during the separation step only.

7.2 Flowing mixed gas corrosion

The flowing mixed gas corrosion test ~~(method 1)~~ shall be performed ~~for~~ according to IEC 60512-11-7, method 1, with a test duration of 4 days. ~~Half of the samples mated; half of the samples unmated.~~

Half of the specimens shall be unmated and the other half shall be left mated during the test.

~~7.3 Final cycles~~

~~25 cycles at one polarity of the DC source shall be performed. And then the polarity of the DC source shall be reversed, and 25 further cycles at the other polarity shall be performed (50 additional cycles total). The electrical current shall be applied during the separation step only.~~

8 Tests and test schedule – Test group UEL 1

A minimum of 8 specimens shall be prepared for this group; then tested according to Table 1.