



UL 61810-1

STANDARD FOR SAFETY

Electromechanical Elementary Relays – Part 1:
General Requirements

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UL Standard for Safety for Electromechanical Elementary Relays – Part 1: General Requirements, UL 61810-1

First Edition, Dated July 31, 2015

Summary of Topics

Adoption of IEC 61810-1, Electromechanical elementary relays - Part 1: General and safety requirements (fourth edition, issued by IEC February 2015) as a new IEC-based UL standard, UL 61810-1.

The new requirements are substantially in accordance with Proposal(s) on this subject dated August 29, 2014 and April 24, 2015.

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Electronic
Components Industry
Association
UL 61810-1-2015
First Edition



Underwriters
Laboratories Inc.
UL 61810-1
First Edition

Electromechanical Elementary Relays – Part 1: General Requirements

July 31, 2015



ANSI/UL 61810-1-2015

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Preface (UL)

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This edition has been issued to satisfy UL Standards policy.

Efforts have been made to synchronize the UL edition number with that of the corresponding IEC standard with which this standard is harmonized. As a result, one or more UL edition numbers have been skipped to match that of the IEC edition number.

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Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

UL Effective Date

A UL effective date is one established by UL LLC and is not part of the ANSI approved standard.

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NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 61810-1, Electromechanical Elementary Relays – Part 1: General and safety requirements copyright 2015 are indicated by notations (differences) and are presented in bold text.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are national differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMECHANICAL ELEMENTARY RELAYS – Part 1: General and safety requirements

FOREWORD

The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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International Standard IEC 61810-1 has been prepared by IEC technical committee 94: All-or-nothing electrical relays.

This fourth edition cancels and replaces the third edition published in 2008. This edition constitutes a technical revision.

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

- two main test procedures were introduced: procedure A, reflecting the procedure known from Edition 3 of this standard and procedure B, reflecting the assessment according to North American requirements;
- inclusion of dedicated device application tests especially relevant for applications in the North American Market (see Clause D.1);
- introduction of testing under single mounting condition;
- clarification of insulation requirements after endurance testing;
- inclusion of provisions for basic safety requirements;
- update of references.

The text of this standard is based on the following documents:

FDIS	Report on voting
94/380/FDIS	94/384/RVD

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

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

A list of all parts of IEC 61810 series, published under the general title *Electromechanical elementary relays* can be found on the IEC website.

The committee has decided that the contents of this publication 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

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

ELECTROMECHANICAL ELEMENTARY RELAYS – Part 1: General requirements

1 Scope

This part of IEC 61810 applies to electromechanical elementary relays (non-specified time all-or-nothing relays) for incorporation into low voltage equipment (circuits up to 1000 V alternate current or 1500 V direct current). It defines the basic functional and safety requirements and safety-related aspects for applications in all areas of electrical engineering or electronics, such as:

- general industrial equipment,
- electrical facilities,
- electrical machines,
- electrical appliances for household and similar use,
- information technology and business equipment,
- building automation equipment,
- automation equipment,
- electrical installation equipment,
- medical equipment,
- control equipment,
- telecommunications,
- vehicles,
- transportation (e.g. railways).

Compliance with the requirements of this standard is verified by the type tests indicated.

In case the application of a relay determines additional requirements exceeding those specified in this standard, the relay should be assessed in line with this application in accordance with the relevant IEC standard(s) (e.g. IEC 60730-1, IEC 60335-1, IEC 60950-1).

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.

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2DV D2 Modify Clause 2 and all subclauses as follows:

For a list of normative standards, see Annex DVA, Tables DVA.1 and DVA.2 for normative references. See Annex DVB, Table DVB.1 for a list of normative component standards.

IEC 60038: 2009,
IEC standard voltages

IEC 60050 (all parts),
International Electrotechnical Vocabulary
(available at <http://www.electropedia.org>)

IEC 60068-2-2:2007,
Environmental testing – Part 2-2: Tests – Test B: Dry heat

IEC 60068-2-17:1994,
Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing

IEC 60068-2-20: 2008,
Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads

IEC 60079-15:2010,
Explosive atmospheres – Part 15: Equipment protection by type of protection "n"

IEC 60085: 2007,
Electrical insulation – Thermal evaluation and designation

IEC 60099-1,
Surge arresters – Part 1: Non-linear resistor type gapped surge arresters for a.c. systems¹

IEC 60112:2003,
Method for the determination of the proof and the comparative tracking indices of solid insulating materials

IEC 60364-4-44:2007,
Low voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances

IEC 60417,
Graphical symbols for use on equipment
(available at <http://www.graphical-symbols.info/equipment>)

IEC 60664-1:2007,
Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests

IEC 60664-3:2003,
Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution

IEC 60664-4:2005,
Insulation coordination for equipment within low-voltage systems – Part 4: Consideration of high-frequency voltage stress

IEC 60664-5:2007,
Insulation coordination for equipment within low-voltage systems – Part 5: Comprehensive method for determining clearances and creepage distances equal to or less than 2 mm

IEC 60695-2-10: 2013,
Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure

IEC 60695-2-11:2000,
Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products

IEC 60695-2-12: 2010,
Fire hazard testing - Part 2-12: Glowing/hot-wire based test methods - Glow-wire flammability index (GWFI) test method for materials

IEC 60695-2-13: 2010,
Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods - Glow-wire ignition temperature (GWIT) test method for materials

IEC 60695-10-2:2003,
Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test

IEC 60721-3-3:1994,
Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations
Amendment 1 (1995)
Amendment 2 (1996)

IEC 60999-1:1999,
Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)

IEC 61140:2001,
Protection against electric shock – Common aspects for installation and equipment

IEC 61210:2010,
Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements

IEC 61760-1:2006,
Surface mounting technology – Part 1: Standard method for the specification of surface mounting components (SMDs)

IEC 61984: 2008,
Connectors – Safety requirements and tests

¹ This publication was withdrawn.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-444 and the following apply.

An alphabetical list of terms can be found at the end of this standard.

NOTE In the text of this standard, the term *relay* is used instead of *elementary relay* to improve the readability.

3.1 Definitions related to general terms

3.1.1 marking identification of a relay which, when completely given to the manufacturer of this relay, allows the unambiguous indication of its electrical, mechanical, dimensional and functional parameters

EXAMPLE Through the indication of the trade mark and the type designation on the relay, all relay-specific data can be derived from the type code.

3.1.2 intended use use of a relay for the purpose for which it was made, and in the manner intended by the manufacturer

3.1.3 relay technology categories categories of relays, based upon environmental protection

Note 1 to entry: Six categories are in use (RT 0 to RT V).

[SOURCE: IEC 60050-444:2002, 444-01-11]

3.1.4 pulse width modulation PWM pulse time modulation in which the pulse duration varies in accordance with a given function of the value of the modulating signal

[SOURCE: IEC 60050-702:1992, 702-06-57]

3.1.5 existing design design which was already approved by the preceding Edition of this standard

3.1.6 Hazard potential source of harm

Note 1 to entry: Relevant hazards taken into account in this standard are heating, electrical shock, ignition and foreseeable misuse before the end of life.

3.1.7 Type test test of one or more devices made to a certain design to show that the design meets certain specifications

3.1.8 Routine test test to which each individual device is subjected during and/or after manufacture to ascertain whether it complies with certain criteria

3.1.9 Sampling test test on a number of devices taken at random from a batch

3.2 Terms and definitions of relay types

3.2.1 electrical relay device designed to produce sudden and predetermined changes in one or more output circuits when certain conditions are fulfilled in the electric input circuits controlling the device

Note 1 to entry: For the purpose of this standard, output circuits are contact circuits.

Note 2 to entry: For the purpose of this standard, the term "coil" is used to denote "input circuit", although other types of input circuits are possible.

[SOURCE: IEC 60050-444:2002, 444-01-01]

3.2.2 all-or-nothing relay electrical relay, which is intended to be energized by a quantity, the value of which is either within its operative range or effectively zero

Note 1 to entry: "All-or-nothing relays" include both "elementary relays" and "time relays".

[SOURCE: IEC 60050-444:2002, 444-01-02]

3.2.3 elementary relay all-or-nothing relay which operates and releases without any intentional time delay

[SOURCE: IEC 60050-444:2002, 444-01-03]

3.2.4 electromechanical relay electrical relay in which the intended response results mainly from the movement of mechanical elements

[SOURCE: IEC 60050-444:2002, 444-01-04]

3.2.5 monostable relay electrical relay which, having responded to an energizing quantity and having changed its condition, returns to its previous condition when that quantity is removed

[SOURCE: IEC 60050-444:2002, 444-01-07]

3.2.6 bistable relay electrical relay which, having responded to an energizing quantity and having changed its condition, remains in that condition after the quantity has been removed; a further appropriate energization is required to make it change its condition

SOURCE: IEC 60050-444:2002, 444-01-08

Note 1 to entry: Bistable relays are also called latching relays.

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3.3 Terms and definitions related to conditions and operations

3.3.1 release condition for a monostable relay, specified condition of the relay when it is not energized; for a bistable relay, one of the specified conditions, as declared by the manufacturer

Note 1 to entry: See Figure A.1.

[SOURCE: IEC 60050-444:2002, 444-02-01]

3.3.2 operate condition for a monostable relay, specified condition of the relay when it is energized by the specified energizing quantity and has responded to that quantity; for a bistable relay, the condition other than the release condition as declared by the manufacturer

Note 1 to entry: See Figure A.1.

[SOURCE: IEC 60050-444:2002, 444-02-02]

3.3.3 operate (verb) change from the release condition to the operate condition

Note 1 to entry: See Figure A.1.

[SOURCE: IEC 60050-444:2002, 444-02-04]

3.3.4 release (verb) for a monostable relay, change from the operate condition to the release condition

Note 1 to entry: See Figure A.1.

[SOURCE: IEC 60050-444:2002, 444-02-05]

3.3.5 reset (verb) for a bistable relay, change from the operate condition to the release condition

[SOURCE: IEC 60050-444:2002, 444-02-06]

3.3.6 cycle operation and subsequent release/reset

[SOURCE: IEC 60050-444:2002, 444-02-11]

3.3.7 frequency of operation number of cycles per unit of time

[SOURCE: IEC 60050-444:2002, 444-02-12]

3.3.8 continuous duty duty in which the relay remains energized for a period long enough to reach thermal equilibrium

[SOURCE: IEC 60050-444:2002, 444-02-13]

3.3.9 intermittent duty duty in which the relay performs a series of identical cycles, the durations in the energized and unenergized conditions being specified; the duration of energization of the relay is such as will not permit the relay to reach thermal equilibrium

[SOURCE: IEC 60050-444:2002, 444-02-14, modified – modification of the definition]

3.3.10 temporary duty duty in which the relay remains energized for insufficient duration to reach thermal equilibrium, the time intervals of energization being separated by unenergized time intervals of duration sufficient to restore equality of temperature between the relay and the surrounding medium

[SOURCE: IEC 60050-444:2002, 444-02-16]

3.3.11 duty factor ratio of the duration of energization to the total period in which intermittent or continuous or temporary duty takes place

Note 1 to entry: The duty factor can be expressed as a percentage of the total period.

[SOURCE: IEC 60050-444:2002, 444-02-15]

3.3.12 ambient temperature temperature(s) prescribed for the air surrounding the relay under certain conditions, when the relay is mounted as indicated by the manufacturer

[SOURCE: IEC 60050-444:2002, 444-03-18, modified – modification of the definition and addition of a new note]

3.3.13 thermal equilibrium variation of less than 1 K between any two out of three consecutive measurements made at an interval of 5 min

3.3.14 rated value value of a quantity used for specification purposes, established for a specific set of operating conditions

[SOURCE: IEC 60050-444:2002, 444-02-18, modified – modification of the definition]

3.3.15 test value value of a quantity for which the relay shall comply with a specified action during a test

[SOURCE: IEC 60050-444:2002, 444-02-20]

3.3.16 mechanical endurance number of cycles under specified conditions with unloaded contact(s)

[SOURCE: IEC 60050-444:2002, 444-07-10, modified – modification of the definition]

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3.4 Terms and definitions of operating values

3.4.1 energizing quantity electrical quantity which, when applied to the coil(s) of a relay under specified conditions, enables it to fulfil its purpose

Note 1 to entry: For relays, the energizing quantity is usually a voltage. Therefore, the input voltage as energizing quantity is used in the definitions given in 3.4. Where a relay is energized by a given current instead, the respective terms and definitions apply with "current" used instead of "voltage".

[SOURCE: IEC 60050-444:2002, 444-03-01, modified – modification of the definition]

3.4.2 operate voltage – set voltage value of the coil voltage at which a relay operates

Note 1 to entry: "Set voltage" applies to bistable relays only.

[SOURCE: IEC 60050-444:2002, 444-03-06, modified – modification of the term and the definition]

3.4.3 operate voltage U_1 value of the coil voltage at which a relay operates, having previously been energized at that same voltage

Note 1 to entry: Thermal equilibrium has to be achieved.

3.4.4 limiting voltage U_2 value of the coil voltage, taking into account the effect of heating due to the power dissipated by the coil(s), which when exceeded may result in a relay failure caused by thermal overload

Note 1 to entry: Thermal equilibrium has to be achieved.

3.4.5 operative range range of values of coil voltage for which a relay is able to perform its specified function

[SOURCE: IEC 60050-444:2002, 444-03-05, modified – modification of the term and the definition]

3.4.6 release voltage value of the coil voltage at which a monostable relay releases

[SOURCE: IEC 60050-444:2002, 444-03-08, modified – modification of the definition]

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3.5 Terms and definitions related to contacts

For a.c., r.m.s. values for voltage and current are specified, unless otherwise indicated.

3.5.1 contact arrangement of contact members, with their insulation, which close or open their contact circuit by their relative movement

Note 1 to entry: See Figure A.2

[SOURCE: IEC 60050-444:2002, 444-04-03]

3.5.2 contact set combination of contacts within a relay, separated by their insulation

Note 1 to entry: See Figure A.2

[SOURCE: IEC 60050-444:2002, 444-04-04]

3.5.3 contact gap gap between the contact points when the contact circuit is open

[SOURCE: IEC 60050-444:2002, 444-04-09]

3.5.4 make contact contact which is closed when the relay is in its operate condition and which is open when the relay is in its release condition

[SOURCE: IEC 60050-444:2002, 444-04-17]

3.5.5 break contact contact which is open when the relay is in its operate condition and which is closed when the relay is in its release condition

[SOURCE: IEC 60050-444:2002, 444-04-18]

3.5.6 change-over contact combination of two contact circuits with three contact members, one of which is common to the two contact circuits; such that when one of these contact circuits is open, the other is closed

[SOURCE: IEC 60050-444:2002, 444-04-19]

3.5.7 switching voltage voltage between the contact members before closing or after opening of a relay contact

Note 1 to entry: The term "contact voltage" (see IEC 60050-444:2002, 444-04-25) has been replaced by "switching voltage". The definition remains unchanged, however.

3.5.8 contact current electric current which a relay contact carries before opening or after closing

[SOURCE: IEC 60050-444:2002, 444-04-26]

3.5.9 switching current electric current which a relay contact makes and/or breaks

[SOURCE: IEC 60050-444:2002, 444-04-27]

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3.5.10 limiting continuous current greatest value of electric current which a closed contact is capable of carrying continuously under specified conditions

[SOURCE: IEC 60050-444:2002, 444-04-28, modified]

3.5.11 micro-interruption interruption of a circuit by contact separation which does not provide full-disconnection or micro-disconnection

Note 1 to entry: There are no dielectric strength or dimensional requirements for the contact gap.

[SOURCE: IEC 60730-1, 2.4.4, modified – modification of the definition]

3.5.12 micro-disconnection adequate contact separation in at least one contact so as to provide functional security

Note 1 to entry: There is a requirement for the dielectric strength of the contact gap but no dimensional requirement.

[SOURCE: IEC 60730-1:2013, 2.4.3, modified – modification of the term and definition]

3.5.13 full-disconnection contact separation for the disconnection of conductors so as to provide the equivalent of basic insulation between those parts intended to be disconnected

Note 1 to entry: There are dielectric strength and dimensional requirements.

[SOURCE: IEC 60730-1:2013, 2.4.2, modified – modification of the term and definition]

3.5.14 failure termination of the ability of an item to perform a required function as defined in the failure criteria.

Note 1 to entry: For the purpose of this standard, items are elementary relays.

[SOURCE: IEC 60050-191:1990, 191-04-01]

3.5.15 failure criteria specified conditions to judge if a fault or malfunction is a failure

3.5.16 malfunction single event when an item does not perform an expected function

3.5.17 fault deviation of the existing condition from the expected condition

3.5.18 contact failure occurrence of break and/or make malfunctions of a contact under test, exceeding a specified number

3.5.19 failure to break current flows although it should not

Note 1 to entry: This could be a contact welding/sticking as well as a delayed contact operate or release.

3.5.20 failure to make no sufficient contact is ensured

Note 1 to entry: This could be a not acceptable or excessive contact resistance as well as a bouncing of the contact due to the lost of overtravel.

3.5.21 electrical endurance number of cycles without contact failure under specified conditions, with loaded contacts

3.5.22 end of life the point at which the physical relay conditions for operate and release can no longer be ensured after an unspecified number of cycles

Note 1 to entry: The intended use of electromechanical relays is to switch loads depending on the control circuit. The relay will follow this request until the mechanical and/or electrical breakdown of the relay (the relay is per definition a wear device).

Note 2 to entry: Using relays after end of life could cause hazards.

3.6 Terms and definitions related to accessories

3.6.1 manual operation manual movement of the actuating member of the relay

3.6.2 actuating member part which is pulled, pushed, turned or otherwise operated in order to initiate a function

3.7 Terms and definitions related to insulation

3.7.1 functional insulation insulation between conductive parts which is necessary only for the proper functioning of the relay

[SOURCE: IEC 60664-1:1992, 1.3.17.1, modified – modification of the definition]

3.7.2 basic insulation insulation of hazardous-live-parts which basic protection against electric shock

Note 1 to entry: Basic insulation does not necessarily include insulation used exclusively for functional purposes.

[SOURCE: IEC 60664-1:2002, 3.17.2, modified – modification of the definition]

3.7.3 supplementary insulation independent insulation applied in addition to basic insulation, in order to provide protection against electric shock in the event of a failure of basic insulation

[SOURCE: IEC 61140:2001, 3.10.2, modified – modification of the definition]

3.7.4 double insulation insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 61140:2001, 3.10.3]

3.7.5 reinforced insulation insulation of hazardous- live- parts which provides a degree of protection against electric shock equivalent to double insulation

[SOURCE: IEC 61140:2001, 3.10.4, modified – modification of the definition]

3.7.6 conductive part part which is capable of conducting electric current, although it may not necessarily be used for this purpose

3.7.7 live part conductor or conductive part intended to be energized in normal operation, including a neutral conductor, but by convention not a PEN conductor

Note 1 to entry: A PEN conductor combines the functions of both a protective earthing conductor and a neutral conductor.

[SOURCE: IEC 60050-195:1998, 195-02-19, modified – modification of the definition]

3.7.8 clearance shortest distance in air between two conductive parts, or between a conductive part and the accessible surface of a relay

Note 1 to entry: An example for an accessible surface is the actuating member of a relay used for manual operation.

[SOURCE: IEC 60664-1:2007, 3.2, modified – modification of the definition]

3.7.9 solid insulation solid insulating material interposed between two conductive parts

[SOURCE: IEC 60664-1:2007, 3.4]

3.7.10 creepage distance shortest distance along the surface of the insulating material between two conductive parts

[SOURCE: IEC 60664-1:2007, 3.3, modified – modification of the definition]

3.7.11 tracking progressive degradation of a solid insulating material by local discharges to form conducting or partially conducting paths

Note 1 to entry: Tracking usually occurs due to surface contamination.

[SOURCE: IEC 60050-212:2010, 212-11-56, modified – modification of the definition]

3.7.12 proof tracking index PTI numerical value of the proof voltage expressed in volts which a material can withstand without tracking under specified test conditions

[SOURCE: IEC 60050-212:2010, 212-11-60, modified]

3.7.13 pollution any addition of foreign matter, solid, liquid, or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation

[SOURCE: IEC 60664-1:2007, 3.11]

3.7.14 pollution degree numeral characterizing the expected pollution of the micro-environment

Note 1 to entry: Pollution degrees 1, 2 and 3 are used, see Annex H.

[SOURCE: IEC 60664-1:2007, 3.13]

3.7.15 micro-environment the immediate environment of the insulation which particularly influences the dimensioning of the creepage distances

[SOURCE: IEC 60664-1:2007, 3.12.2]

4 Influence quantities

The specified performance of a relay shall be given with respect to the reference conditions, i.e. the set of reference values of all influence quantities.

Unless otherwise explicitly stated by the manufacturer, the reference values and tolerance ranges listed in Table 1 apply.

Table 1 – Reference values of influence quantities

Influence quantity	Reference value	Tolerance range and conditions for testing ^a
Ambient temperature	23 °C	±5 K
Atmospheric pressure	96 kPa	86 kPa to 106 kPa
Relative humidity	50 %	25 % to 75 %
External magnetic induction	0	$0 \pm 5 \times 10^{-4}$ T in any direction
Position	As indicated by the manufacturer	According to 8.2 a)
Voltage/current (for coil and load)	As indicated by the manufacturer	±5 % for steady-state conditions
Frequency	16-2/3 Hz or 50 Hz or 60 Hz or 400 Hz	Same as reference value with tolerance ±2 %
Waveform	Sinusoidal	Sinusoidal; maximum distortion factor 5 % ^b
Alternating component in d.c. (ripple)	0	Maximum 6 % ^c
Direct component in a.c.	0	Maximum 2 % of peak value
Shock and vibration	0	Maximum 1 m/s ²
Industrial and other atmospheres	Clean air	Clean air (pollution not exceeding class 3C2 of IEC 60721-3-3)

^a The test may be carried out with other values of the influence quantities, provided the quantitative relationship between one or more influence quantities and the value of the considered characteristic is known.

^b Distortion factor: ratio of the harmonic content obtained by subtracting the fundamental wave from a non-sinusoidal harmonic quantity and the r.m.s. value of the non-sinusoidal quantity. It is usually expressed as a percentage.

^c The alternating component (ripple content) of a d.c. supply, expressed as a percentage, is defined as follows:

$$\frac{\text{maximum value} - \text{minimum value}}{\text{d.c. component}} \times 100$$

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5 Rated values

5.1 General

The recommended values listed below do not comprise all technical possibilities and other values may be adopted according to conditions of operation and use.

5.2 Rated coil voltage/rated coil voltage range

a) AC voltage, recommended r.m.s. values:

6 V; 12 V; 24 V; 48 V; $100/\sqrt{3}$ V; $110/\sqrt{3}$ V; $120/\sqrt{3}$ V; 100 V; 110 V; 115 V; 120 V; 127 V; 200 V; 220 V; 230 V; 240 V; 277 V; 400 V; 480 V; 500 V.

b) DC voltage, recommended values:

1,5 V; 3 V; 4,5 V; 5 V; 6 V; 9 V; 12 V; 24 V; 28 V; 48 V; 60 V; 100 V; 110 V; 125 V; 220 V; 250 V; 440 V; 500 V.

c) Rated voltage range (for example 220 V to 240 V) and corresponding frequencies (e.g. 50 Hz/60 Hz) shall be specified by the manufacturer.

5.3 Operative range

The operative range of a relay coil can be specified either according to 5.3.1 or 5.3.2 or 5.3.3.

5.3DV D2 Modify Clause 5.3 and all subclauses as follows:

DC rated relay coils shall operate in accordance with Class 1 limits, and AC rated relay coils shall operate in accordance with Class 2 limits.

5.3.1 The recommended operative range is to be specified according to one of two classes:

- Class 1: 80 % to 110 % of the rated coil voltage (or range).
- Class 2: 85 % to 110 % of the rated coil voltage (or range).

NOTE Where a rated coil voltage range applies, the operative range is from 80 % (or 85 %) of the lower limit to 110 % of the upper limit of the rated coil voltage range.

The above values apply over the full ambient temperature range as declared by the manufacturer.

Where the manufacturer deviates from the recommended classes, he shall specify both the rated coil voltage (or range) and the corresponding operative range, see Figure A.3.

5.3.2 As an alternative to the operative range specified in 5.3.1, the manufacturer may graphically represent the operative range against ambient temperature. This is achieved by describing the upper limit (U_2 = limiting coil voltage) and the lower limit (U_1 = operate voltage) of the operative range, as illustrated by Figure A.3.

5.3.3 Where relays are operated with pulse width modulation (PWM) and/or other methods of coil power reduction the coil energization shall be as stated by the manufacturer.

5.4 Release

The release values indicated below apply over the full ambient temperature range as declared by the manufacturer.

a) DC relay

Where the operative range is specified according to 5.3.1, the release voltage of monostable relays shall be not lower than 5 % of the rated coil voltage (or the upper limit of the rated coil voltage range), see Figure A.3.

Where the operative range is specified according to 5.3.2, the release voltage of monostable relays shall be not lower than 10 % of the lower limit U_1 of the operative range, see Figure A.3.

b) AC relay

The same conditions as for d.c. relays apply, except that a value of 15 % shall be used in place of 5 % or 10 %, respectively.

5.5 Reset

The recommended values shall be the same as those specified in 5.3, unless otherwise specified by the manufacturer (for instance for single coil bistable remanence relays).

5.6 Electrical endurance

Recommended number of cycles: 5 000; 6 000; 10 000; 20 000; 25 000; 30 000; 50 000; 100 000; 200 000; 300 000; 500 000; etc.

5.7 Frequency of operation

Recommended frequencies: 360/h; 720/h; 900/h and multiples thereof.

0,1 Hz; 0,2 Hz; 0,5 Hz and multiples thereof.

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5.8 Contact loads

a) Resistive loads, recommended value

Current: 0,1 A; 0,5 A; 1 A; 2 A; 3 A; 5 A; 6 A; 8 A; 10 A; 12 A; 16 A; 20 A; 25 A; 30 A; 35 A; 60 A; 100 A.

Voltage: 4,5 V; 5 V; 12 V; 24 V; 36 V; 42 V; 48 V; 110 V; 125 V; 230 V; 250 V; 300 V; 400 V; 480 V; 500 V; 690 V; 1 000 V (AC/DC); 1 500 V DC.

b) Recommended inductive loads: see Annex B.

5.8DV D2 Modify Clause 5.8 b) by adding the following:

See also Annex D for dedicated device loads.

5.9 Ambient temperature

Unless otherwise stated, the preferred ambient temperature range is $-10\text{ }^{\circ}\text{C}$ to $+55\text{ }^{\circ}\text{C}$ for the operation of relays.

Other recommended values for the upper limit are:

+200 $^{\circ}\text{C}$ +175 $^{\circ}\text{C}$ +155 $^{\circ}\text{C}$ +125 $^{\circ}\text{C}$ +100 $^{\circ}\text{C}$ +85 $^{\circ}\text{C}$ +70 $^{\circ}\text{C}$ +40 $^{\circ}\text{C}$ +30 $^{\circ}\text{C}$

Other recommended values for the lower limit are:

$-65\text{ }^{\circ}\text{C}$ $-55\text{ }^{\circ}\text{C}$ $-40\text{ }^{\circ}\text{C}$ $-25\text{ }^{\circ}\text{C}$ $-5\text{ }^{\circ}\text{C}$ $+5\text{ }^{\circ}\text{C}$

5.9DV D2 Modify Clause 5.9 as follows:

The intended ambient temperature range shall be 0°C to $+40^{\circ}\text{C}$ unless otherwise specified by the manufacturer and marked per Table 5, Item 5b.

5.10 Categories of environmental protection

The relay technology categories describing the degree of sealing of the relay case or its contact unit are given in Table 2 below.

5.10DV DE Modify Clause 5.10 as follows:

Declaration of relay technology categories per Clause 5.9 is optional.

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Table 2 – Categories of protection

Relay technology category	Protection
RT 0: Unenclosed relay	Relay not provided with a protective case
RT I: Dust protected relay	Relay provided with a case which protects its mechanism from dust
RT II: Flux proof relay	Relay capable of being automatically soldered without allowing the migration of solder fluxes beyond the intended areas
RT III: Wash tight relay	Relay capable of being automatically soldered and subsequently undergoing a washing process to remove flux residues without allowing the ingress of flux or washing solvents. NOTE In service, this type of relay is sometimes vented to the atmosphere after the soldering or washing process; in this case the requirements with respect to clearances and creepage distances can change
RT IV: Sealed relay	Relay provided with a case which has no venting to the outside atmosphere, and having a time constant better than 2×10^4 s in accordance with IEC 60068-2-17
RT V: Hermetically sealed relay	Sealed relay having an enhanced level of sealing, assuring a time constant better than 2×10^6 s in accordance with IEC 60068-2-17

5.11 Duty factor

Recommended values:

10 %, 15 %; 25 %; 33 %; 40 %; 50 %; 60 %.

NOTE 1 In addition, the frequency of operation stated by the manufacturer is to be maintained.

6 General provisions for testing

In the subsequent clauses, the requirements to be checked as well as the related tests are specified.

The tests according to this standard are type tests.

NOTE Tests according to this standard can be applied to routine and sampling tests as appropriate. Preferred tests for routine testing are given in Table 4

HAZARDS considered in this standard are hazards from heating, electrical shock, ignition and foreseeable misuse before the end of life.

HAZARDS shall not exceed a tolerable level. For the component, the compliance to the tests specified in Table 3 are considered to represent a tolerable level. For the application of the relay a risk assessment shall be carried out according to Annex O.

NOTE 2 The risk evaluation for the component and for the application follows the same assessment rules for risk evaluation. For the component itself, the risk evaluation could be shown via this standard. However for the application this has to be done once more to determine the interaction of the single components and the foreseeable misuse, e.g. when various relays can be used in combination with a single socket.

The specimens shall be grouped in seven inspection lots, and the related tests shall be taken from Table 3.

The number of test specimen for each inspection lot shall be taken from Table 5 according to the test procedure specified.

For each inspection lot, the tests shall be carried out in the given order.

If one or more specimen(s) of an inspection lot do(es) not pass a test, this test as well as every other one that may have influenced the result of this test shall be repeated once with an additional set of specimens of the same design. In case the manufacturer modifies the relays, all tests technically influenced by this modification shall also be repeated.

Unless otherwise stated in this standard, the tests and measurements shall be carried out in accordance with the reference values and tolerance ranges of the influence quantities given in Table 1.

In special cases, the use of deviating values may be justified. These values shall be as given by the manufacturer and shall be indicated in the test report. The same applies to special test conditions deviating from the conditions specified in this standard (e.g. mounting position for heating tests).

6DV D2 Modify Clause 6 and associated tables as follows:

6DV.1 Per Table 5, test procedure B shall be used for all type tests. In addition, non-compliant test results are not acceptable.

6DV.2 Routine tests specified per Table 4 are optional.

Table 3 – Type testing

Inspection lot	Tests	Clause	Additional references
1	Marking and documentation	7	IEC 60417
1	Heating (all coil voltages)	8	IEC 60085
1	Basic operating function (all coil voltages)	9	
2	Dielectric strength	10	
3	Electrical endurance (per contact load and contact material)	11	
4	Mechanical endurance	12	
5	Clearances, creepage distances and distances through solid insulation	13	IEC 60664-1
6	Screw type terminals and screwless terminals (if applicable)	14.2	IEC 60999-1
6	Flat quick-connect terminations (if applicable)	14.3	IEC 61210
6	Solder terminals (if applicable)	14.4	IEC 60068-2-20
6	Sockets (if applicable)	14.5	IEC 61984
6	Alternative termination types (if applicable)	14.6	
6	Sealing (if applicable)	15	IEC 60068-2-17
7	Heat and fire resistance	16	IEC 60695-2-10

NOTE The number of coil voltages in inspection lot 1 to be tested can be reduced under certain conditions explained in Clauses 8 and 9.

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Table 4 – Routine tests

Inspection lot	Tests	Clause	Additional references
1	Marking and documentation	7	Table 6: 1a;1b;1c
2	Basic operating function	9	
3	Dielectric strength	10.2	
Dielectric test for routine test could be carried out for duration of 1s in accordance with IEC 61810-7:2006, 4.9. The test voltage shall not have any negative impact on the insulation (further use).			

Table 5 – Number of test samples

Kind of testing	Test procedure	Number of samples	Mounting conditions
Type test	A ^a	3	Group mounting
	B	1	Single mounting
Sampling test	n.a.	3	n.a.
^a See also Annex E.			
NOTE: For routine tests by definition all products are tested. For routine tests and sampling tests no test procedure or mounting condition can be specified.			

7 Documentation and marking

7.1 Data

The manufacturer shall make the following data available (with indication of the units):

7.1DV D2 Modify Clause 7.1 as follows:

7.1DV.1 The data of 1c, 2c, 3b through 3f, 5c, and 5h is optional. The data of 3g, 4a through 4e, 5a, 5d, and 5i through 5k does not apply.

7.1DV.2 Relays with pressure wire connectors (screw terminals) for field wiring shall be marked to show a range of values or a nominal value of tightening torque in N•m (lb-in) to be applied to the terminal screws. Marking may be adjacent to the terminal or provided in the instruction sheet.

Table 6 – Required relay data

N°	Data	Notes	Place of indication
1 Identification data			
1a	Manufacturer's name, identification code or trade mark	It shall be unambiguous and ensure identification of the product by respective documentation May be coded if specified in the documentation	Relay
1b	Type designation		Relay
1c	Date of manufacture		Relay (preferred) or package
2 Coil data			
2a	Rated coil voltage, or rated coil voltage range, or operative range of the coil voltage	Values of the limits or class (see 5.2), including coil power reduction	Relay or catalogue or instruction sheet
2b	Frequency for a.c.		Relay or catalogue or instruction sheet
2c	Coil resistance(s)		Relay or catalogue or instruction sheet
3 Contact data			
3a	Contact load(s)	Type – current – voltage – schematics (see Table 16 for examples) Micro-interruption, micro-disconnection, full disconnection	Relay or catalogue or instruction sheet
3b	Number of cycles for electrical endurance		Catalogue or instruction sheet
3c	Frequency of operation		Catalogue or instruction sheet
3d	Duty factor		Catalogue or instruction sheet
3e	Number of cycles for mechanical endurance		Catalogue or instruction sheet
3f	Contact material(s)		Catalogue or instruction sheet
3g	Type of interruption		Catalogue or instruction sheet
4 Insulation data			
4a	Type of insulation (depending on the application of the relay)	Functional, basic, reinforced, double insulation	Catalogue or instruction sheet
4b	Deviation from standard dimensioning	According to options a) to c) of 13.1	Catalogue or instruction sheet
4c	Pollution degree	Of relay environment	Catalogue or instruction sheet
4d	Impulse withstand voltage(s)	For all circuits	Catalogue or instruction sheet
4e	Rated insulation voltage(s)	For all circuits	Catalogue or instruction sheet
5 General data			
5a	Test procedure	Procedure A or B	Catalogue or instruction sheet
5b	Ambient temperature range		Catalogue or instruction sheet
5c	Categories of environmental protection (RT)		Catalogue or instruction sheet
5d	Mounting position	If applicable	Catalogue or instruction sheet
5e	Data to permit suitable connection of the relay	Including polarity	Catalogue or instruction sheet
5f	Accessories	If essential to the relay performance	Catalogue or instruction sheet
5g	Data concerning earthing or grounding of metal parts	If applicable	Catalogue or instruction sheet
5h	Duty restrictions	If any	Catalogue or instruction sheet
5i	Mounting distance	See Annex E	Catalogue or instruction sheet
5j	Maximum permissible steady-state temperature of the terminals (if applicable), and/or material combination for flat quick-connect terminations	Applies also to the combination of relay and mating socket	Manufacturer documentation
5k	Resistance to soldering heat	Including reference to the test procedure	Manufacturer documentation

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7.2 Additional data

Manufacturers of elementary relays provided with an actuating member for manual operation in order to facilitate the test of the equipment in which the relay is incorporated, shall specify any special operating requirements.

EXAMPLE When operating the actuating member (e.g. push-button) for manual operation, the action from OFF-state to ON-state (or vice versa) is operated as quickly as possible.

7.3 Marking

The data of 1a) and 1b) of Table 6 shall be marked on the relay so that they are legible and durable.

The test indicated below is carried out when only additional material(s) are used for marking (e.g. inkjet or pad printing).

Compliance with the durability requirements for the marking is checked by inspection and by rubbing the marking by hand as follows:

- a) 15 back-and-forth movements in about 15 s with a piece of cloth soaked with distilled water, followed by
- b) 15 back-and-forth movements in about 15 s with a piece of cloth soaked with petroleum spirit.

During the tests, the soaked piece of cloth shall be pressed on the marking with a pressure of about 2 N/cm².

After these tests, the marking shall still be legible.

NOTE The petroleum spirit used is defined as an aliphatic solvent hexane with a content of aromatics of maximum 0,1 volume %, a kauributanol-value of 29, initial boiling point approximately 65 °C, dry point approximately 69 °C and specific gravity of 0,68 g/cm³.

7.3DV D2 Modify Clause 7.3 by replacing with the following:

The marking durability tests described in Clause 7.3 are optional.

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7.4 Symbols

When symbols are used, they shall be in line with those given in Table 7.

Rated values of switching voltage and switching current may be indicated as given in Table 8.

Table 7 – Symbols

Volt	V
Ampere	A
Frequency of the supply	Hz
Volt-ampere	VA
Watt	W
Direct current ((IEC 60417-5031) (2002-10))	--- or DC
Alternating current (single-phase) ((IEC 60417-5032) (2002-10))	$\sim$ or AC
Alternating current (two-phase)	2 $\sim$
Alternating current (two-phase with neutral)	2N $\sim$
Alternating current (three-phase)	3 $\sim$
Alternating current (three-phase with neutral)	3N $\sim$
Alternating/direct current ((IEC 60417-5033) (2002-10))	$\sim$ or DC/AC
Protective earth ((IEC 60417-5019) (2006-08))	$\oplus$
Make contact (normally open contact)	NO
Break contact (normally closed contact)	NC
Change-over contact	CO

Table 8 – Examples for indication of rated values

10 A 250 V $\sim$	16 A 230 V $\sim$
or 10 A 250 V AC	or 16 / 230 $\sim$
or 10 A 250 V $\sim$ cos ϕ 0,4	or 16 / 230 $\sim$

8 Heating

8.1 Requirements

Relays shall be constructed so that they do not attain excessive temperatures in normal use. The relay manufacturer shall either

– select the thermal classification of materials in accordance with Table 9 and indicate this classification for the respective tests, or

– specify the maximum temperature and verify the suitability of the material in accordance with the ball pressure test of Clause 16.

Table 9 – Thermal classification

Thermal classification (Coil insulation system)	Maximum temperature	Maximum temperature for existing designs
Y	90 °C	–
A	105 °C	120 °C
E	120 °C	135 °C
B	130 °C	145 °C
F	155 °C	155 °C
H	180 °C	175 °C
200 (N)	200 °C	195 °C
220 (R)	220 °C	215 °C
250 (C)	250 °C	–

This Table 9 is valid for change of resistance method. When the coil temperature is measured by the thermocouple method, the values for maximum temperature shall be reduced by 20 K.

For relays of the same construction, the test can be reduced from all coil voltages to the coil voltage with the maximum coil power consumption.

NOTE The thermal classification is in accordance with IEC 60085.

Actuating members for manual operation which are touched for a short time only in normal use shall comply with the following limiting temperatures:

- Metal 60 °C
- Ceramics or vitreous material 70 °C
- Plastics, rubber or moulded material 85 °C

If the temperature surpasses the given limit during the test of 8.2, a respective warning shall be included in the documentation established for the user of the relay.

8.1DV D2 Modify Clause 8.1 by adding the following:

8.1DV.1 In addition to the requirements in Clause 8.1, temperature rises shall not exceed those given in Table 8DV.1.

8.1DV.2 For relays rated above 40°C, the allowable temperature rise for the elevated ambient shall be calculated as follows:

$$T_R = T_T - [T_M - 40^\circ\text{C}]$$

where:

T_R = Allowable temperature rise;

T_T = Maximum temperature rise allowed by Table 8DV.1; and

T_M = Elevated ambient temperature specified for the equipment.

8.1DV.3 For relays rated below 40°C, the allowable temperature rise for the reduced ambient shall be calculated as follows:

$$T_R = T_T - [40^\circ\text{C} - T_M]$$

where:

T_R = Allowable temperature rise;

T_T = Maximum temperature rise allowed by Table 8DV.1; and

T_M = Reduced ambient temperature specified for the equipment.

Table 8DV.1 – Maximum allowable temperature rises

Materials and components	K
1. Rubber or thermoplastic insulated conductors	a
2. Field-wiring terminals	
Pressure wire connectors, wire binding screws, flying leads (marked for use with 60°C or 60/75°C conductors)	50
Pressure wire connectors, wire binding screws, flying leads (marked for 75°C conductors)	65
Quick connect terminals	30
Spring-force terminals	30
3. Contacts	
Solid and built-up silver, silver alloy, and silver faced	c
All other metals	65
4. Insulating materials ^d	e
5. On bare resistor material, thermocouple method	375
6. Printed-wiring boards	f
7. Any component or material not specifically identified in 1 – 6	f
^a For insulated conductors the maximum temperature rise shall not exceed the maximum operating temperature specified for the wire in question minus an assumed ambient (room) temperature of 40°C. ^b Temperature limited by the temperature limitations on the material for adjacent parts. There shall be no structural deterioration of the contact assembly, loosening of parts, cracking or flaking of materials, loss of temper of spring, annealing of parts, or other visible damage. ^c For compounds which have been investigated for particular temperature ratings, the maximum temperature rise shall not exceed the temperature rating minus an assumed ambient of 40°C. ^d See Annex DVC. ^e The maximum temperature rise of the printed-wiring board is the operating temperature of the board minus an assumed ambient of 40°C. ^f The maximum temperature rise of any component shall not exceed the temperature limit of the component minus an assumed ambient temperature of 40°C.	

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8.2 Test set-up

a) Test procedure A – Group mounting: The test is carried out with three relays mounted side by side in the same direction, see Table 5 – test procedure A and Annex E.

Test procedure B – Single mounting: The test is carried out with one relay (see Table 5 – test procedure B).

Unless specifically designed otherwise, the specimens are tested in the horizontal position with the terminals pointing downwards. The mounting distance shall be stated by the manufacturer.

b) Terminal screws and/or nuts are tightened with a torque equal to two-thirds of that specified in IEC 60999-1.

c) In case of screwless terminals, care is to be taken to ensure that the conductors are correctly fitted to the terminals in accordance with IEC 60999-1.

d) The relays shall be mounted in a sufficiently large heat chamber without forced convection. When an air circulating test chamber is used for testing, baffles shall be provided within the test chamber, unless all other conditions in this clause are met.

e) The specimen shall be protected from air draughts, solar influences and the like and it is not allowed to be subjected to any artificial cooling.

f) During the test, the predetermined ambient temperature of the heat chamber shall not be influenced by the relay.

g) The ambient temperature shall be constantly at room temperature or alternatively equal to the upper limit of the operating temperature range.

h) When thermocouples are used for measuring the temperatures of a coil, at least two thermocouples are to be used. The thermocouples are to be placed on the surface of the magnet wire which is the upper surface based on the orientation during testing.

8.2DV D2 Modify Clause 8.2 b) by replacing with 8.2DV.1, and Clause 8.2 h) by adding 8.2DV.2:

8.2DV.1 Pressure wire connectors (screw terminals) shall be tightened to the torque specified by the manufacturer. If the torque is specified as a range, the lowest value in the range shall be used.

8.2DV.2 Thermocouples shall be made of wires not larger than 24 AWG (0.21mm²), in conformance with the requirements for special tolerance thermocouples specified in the Initial Calibration Tolerances for Thermocouples table in Temperature Measurement Thermocouples, ANSI/ISAM C96.1.