BS EN 61812-1:2011

BSI Standards Publication

Time relays for industrial and residential use

Part 1: Requirements and tests

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National foreword

This British Standard is the UK implementation of EN 61812-1:2011. It is identical to IEC 61812-1:2011. It supersedes BS EN 116000-2:1994 and BS EN 61812-1:1997, which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/94, General purpose relays and reed contact units.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2011.

Amendments issued since publication

Amd. No.	Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61812-1

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Supersedes EN 61812-1:1996 + corr. Feb.1999 + A11:1999, EN 116000-2:1992

English version

Time relays for industrial and residential use - Part 1: Requirements and tests

(IEC 61812-1:2011)

Relais à temps spécifié pour applications industrielles et résidentielles - Partie 1: Exigences et essais (CEI 61812-1:2011)

Zeitrelais (Relais mit festgelegtem Zeitverhalten) für industrielle Anwendungen und für den Hausgebrauch - Teil 1: Anforderungen und Prüfungen (IEC 61812-1:2011)

This European Standard was approved by CENELEC on 2011-06-29. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 94/324/FDIS, future edition 2 of IEC 61812-1, prepared by IEC TC 94, All-or-nothing electrical relays, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61812-1 on 2011-06-29.

This European Standard supersedes EN 61812-1:1996 + corrigendum February 1999 + A11:1999 and EN 116000-2:1992.

EN 61812-1:2011 includes the following significant technical changes with respect to EN 61812-1:1996:

– update of references;

– addition of terms and definitions more commonly used by industry;

– addition of timing charts to help explain terms and definitions involving a sequence of events;

– renumbering of clauses to bring them into a more logical order;

– addition of provisions for residential use.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2012-03-29
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-06-29

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive (2004/108/EC). See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 61812-1:2011 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60060-1:2010	NOTE Harmonized as EN 60060-1:2010 (not modified).
IEC 60068-2-78:2001	NOTE Harmonized as EN 60068-2-78:2001 (not modified).
IEC 60664-4:2005	NOTE Harmonized as EN 60664-4:2006 (not modified).
IEC 60669-2-3:2006	NOTE Harmonized as EN 60669-2-3:2006 (not modified).
IEC 60721-3-3:1994	NOTE Harmonized as EN 60721-3-3:1995 (not modified).
IEC 60730-2-7:2008	NOTE Harmonized as EN 60730-2-7:2010 (modified).
IEC 60947-1:2007	NOTE Harmonized as EN 60947-1:2007 (not modified).
IEC 60947-5-1:2003	NOTE Harmonized as EN 60947-5-1:2004 (not modified).
IEC 61180-1:1992	NOTE Harmonized as EN 61180-1:1994 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

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

Publication	Year	Title	EN/HD	Year
IEC 60050-444	2002	International Electrotechnical Vocabulary - Part 444: Elementary relays	-	-
IEC 60050-445	2010	International Electrotechnical Vocabulary - Part 445: Time relays	-	-
IEC 60068	Series	Environmental testing	EN 60068	Series
IEC 60068-2-2	2007	Environmental testing - Part 2-2: Tests - Test B: Dry heat	EN 60068-2-2	2007
IEC 60068-2-6	2007	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	2008
IEC 60068-2-27	2008	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	EN 60068-2-27	2009
IEC 60085	2007	Electrical insulation - Thermal evaluation and designation	EN 60085	2008
IEC 60112	2003	Method for the determination of the proof and the comparative tracking indices of solid insulating materials	EN 60112	2003
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 1993
IEC 60664	Series	Insulation coordination for equipment within low-voltage systems	EN 60664-1	Series
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007
IEC 60664-3	2003	Insulation coordination for equipment within low-voltage systems - Part 3: Use of coating, potting or moulding for protection against pollution	EN 60664-3	2003
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	EN 60664-5	2007
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	EN 60695-2-11	2001
IEC 60695-10-2	2003	Fire hazard testing - Part 10-2: Abnormal heat - Ball pressure test	EN 60695-10-2	2003

Publication	Year	Title	EN/HD	Year
IEC 60947-5-4	2002	Low-voltage switchgear and controlgear - Part 5-4: Control circuit devices and switching elements - Method of assessing the performance of low-energy contacts - Special tests	EN 60947-5-4	2003
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)	EN 60999-1	2000
IEC 61000-4-2	2008	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	2009
IEC 61000-4-3	2006	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	2006
IEC 61000-4-4	2004	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	2004
IEC 61000-4-5	2005	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	2006
IEC 61000-4-6	2008	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	2009
IEC 61000-4-8	2009	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test	EN 61000-4-8	2010
IEC 61000-4-11	2004	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	2004
IEC 61210 (mod)	2010	Connecting devices - Flat quick-connect terminations for electrical copper conductors - Safety requirements	EN 61210	2010
IEC 61810-1	2008	Electromechanical elementary relays - Part 1: General requirements	EN 61810-1	2008
IEC 61984	2008	Connectors - Safety requirements and tests	EN 61984	2009
IEC 62314	2006	Solid-state relays	EN 62314	2006
CISPR 11 (mod) + A1	2009 2010	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement	EN 55011 + A1	2009 2010
CISPR 22 (mod)	2008	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement	EN 55022	2010

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Annex ZZ
(informative)

Coverage of Essential Requirements of EC Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers all relevant essential requirements as given in Article 1 of Annex I of EC Directive 2004/108/EC.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

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CONTENTS

TIME RELAYS FOR INDUSTRIAL AND RESIDENTIAL USE –

Part 1: Requirements and tests

1 Scope

This part of the IEC 61812 applies to time relays for industrial applications (e.g. control, automation, signal and industrial equipment).

It also applies to time relays for automatic electrical controls for use in, on, or in association with equipment for residential and similar use.

The term “relay” as used in this standard comprises all types of relays with specified time functions, other than measuring relays.

NOTE Depending on the field of application of these relays (for example automatic electrical controls for household and similar use, switches for household and similar fixed electrical installations), further standards may be applicable, for example IEC 60730-2-7 or IEC 60669-2-3.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-444:2002, *International Electrotechnical Vocabulary – Part 444: Elementary relays*

IEC 60050-445:2010, *International Electrotechnical Vocabulary – Part 445: Time relays*

IEC 60068 (all parts), *Environmental testing*

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

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

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

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

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664 (all parts), *Insulation coordination for equipment within low-voltage systems*

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 60664-5:2007, *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 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

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

IEC 60947-5-4:2002, *Low-voltage switchgear and controlgear – Part 5-4: Control circuit devices and switching elements – Method of assessing the performance of low-energy contacts – Special tests*

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 mm^2 up to 35 mm^2 (included)*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4:2004, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6:2008, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

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

IEC 61810-1:2008, *Electromechanical elementary relays – Part 1: General requirements*

IEC 61984:2008, *Connectors – Safety requirements and tests*

IEC 62314:2006, *Solid-state relays*

CISPR 11:2009, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
Amendment 1 (2010)

CISPR 22:2008, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-444 and IEC 60050-445, as well as the following apply.

NOTE Terms having the same or nearly the same meaning are printed in boldface on separate lines and can be used as an alternative.

3.1 Terms and definitions related to general terms

3.1.1
time relay
specified-time relay
all-or-nothing relay (IEC 60050-444:2002, 444-01-02) with one or more time functions

[IEC 60050-445:2010, 445-01-01 modified]

3.1.2
specified time
specified characteristic of a time relay at given type of function, e.g. operate time, release time, pulse on time, interval time

[IEC 60050-445:2010, 445-05-01]

3.1.3
setting accuracy
difference between the measured value of the specified time and the reference value set on the scale

NOTE For analogue setting this value relates to the maximum setting value.

[IEC 60050-445:2010, 445-06-07]

3.1.4
effect of influence (on specified time)
degree with which the influence quantity within its nominal range has an effect on the specified time

[IEC 60050-445:2010, 445-06-02]

3.1.5
recovery time
minimum time interval for which the power supply is removed or control signal is applied or removed before the specified function can be performed again

[IEC 60050-445:2010, 445-05-04]

3.1.6
minimum control impulse time
shortest duration of the power supply or control signal to fulfil the specified function

[IEC 60050-445:2010, 445-05-02]

3.1.7
repeatability
difference between the upper and lower limits of the specified confidence range determined from several time measurements of a time relay under identical conditions

NOTE Preferably the repeatability is indicated as a percentage of the mean value of all measured values.

[IEC 60050-445:2010, 445-06-08]

3.1.8
power supply
energizing quantity
electrical quantity (e.g. electric current, voltage) which has to be applied or removed from the input circuit of the time relay in order to enable it to fulfil its purpose

[IEC 60050-445:2010, 445-03-01]

3.1.9
input voltage
input current
electrical quantity that can be applied (or removed) to the power supply and to the control signal

3.1.10
control signal
trigger signal (deprecated)
input signal which has to be applied or removed in addition to the power supply in order to ensure a function of the time relay

NOTE The control signal is provided by a separate device designed to close or open an electrical circuit.

[IEC 60050-445:2010, 445-02-05]

3.1.11
conditional short-circuit current of an output circuit
prospective electric current that a contact circuit, protected by a specified short-circuit protective device, can satisfactorily withstand for the total breaking time of that protective device under specified conditions of use and behaviour

[IEC 60050-445:2010, 445-04-03]

3.1.12
on-state voltage drop of a solid-state output circuit
voltage drop of a solid-state output circuit (deprecated)
voltage measured across the effectively conducting solid-state output of a time relay, when carrying the given load current

[IEC 60050-445:2010, 445-04-04]

3.1.13
leakage current of a solid-state output
off-state current of a solid-state output (deprecated)
electric current which flows through the effectively non-conducting solid-state output of a time relay at a specified voltage

[IEC 60050-445:2010, 445-04-05]

3.1.14
power port
point at which the supply voltage (either a.c. or d.c.) is connected to the time relay

[IEC 60050-445:2010, 445-07-01]

3.1.15
control port
additional port for the starting of functions whilst supply voltage is applied, or for the connection of a remote potentiometer, control signal, etc.

NOTE There are control ports for floating (potential-free) and non-floating control.

[IEC 60050-445:2010, 445-07-02]

3.1.16
output port
port at which a load is connected to the time relay

NOTE The output port could consist of electromechanical contacts or be a solid-state output.

[IEC 60050-445:2010, 445-07-03]

3.1.17
enclosure port
physical boundary of the time relay through which electromagnetic fields can radiate or impinge

[IEC 60050-445:2010, 445-07-04]

NOTE See Figure 1.

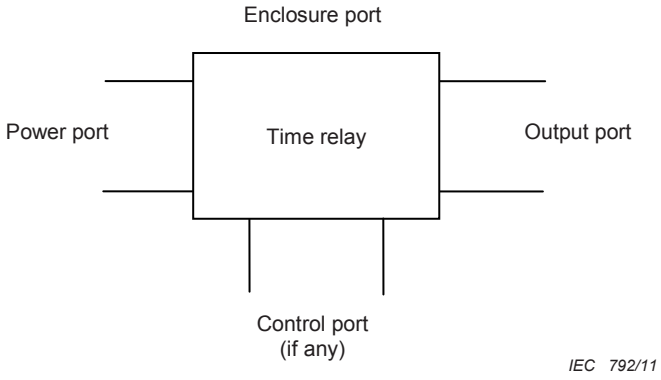


Figure 1 – Definition of ports

3.2 Terms and definitions of relay types

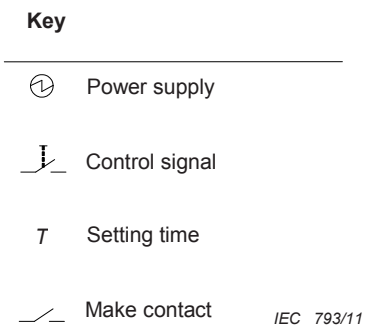


Figure 2 – Definition of symbols

3.2.1
power on-delay relay
on-delay relay
time relay in which the time delay starts when applying the power supply and the output switches to the operate condition after the setting time has elapsed (see Figure 2 and Figure 3)

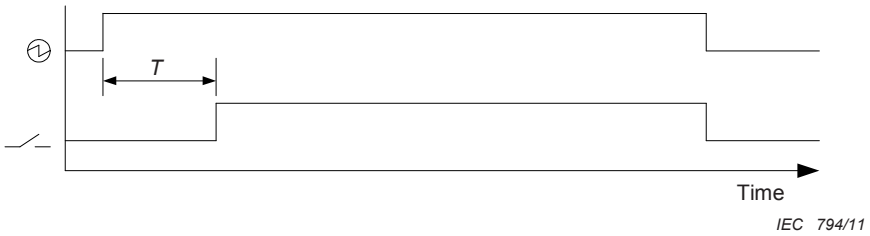


Figure 3 – Power on-delay relay

[IEC 60050-445:2010, 445-01-02]

3.2.2
power off-delay relay
true off-delay relay
time relay in which the output immediately switches to the operate condition when applying the power supply; the time delay starts when the power supply is removed; the output switches to the release condition after the setting time has elapsed (see Figure 2 and Figure 4)

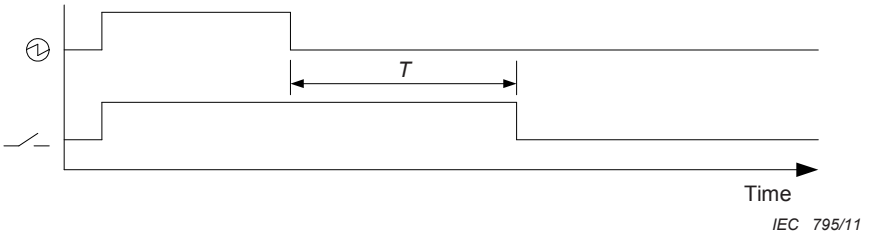


Figure 4 – Power off-delay relay

[IEC 60050-445:2010, 445-01-03]

3.2.3
off-delay relay with control signal
off-delay relay
time relay in which the output immediately switches to the operate condition when applying the power supply and the control signal; the time delay starts when removing the control signal, and the output switches to the release condition after the setting time has elapsed (see Figure 2 and Figure 5)

NOTE Effects of subsequent operating or resetting of the control signal should be declared by the manufacturer.

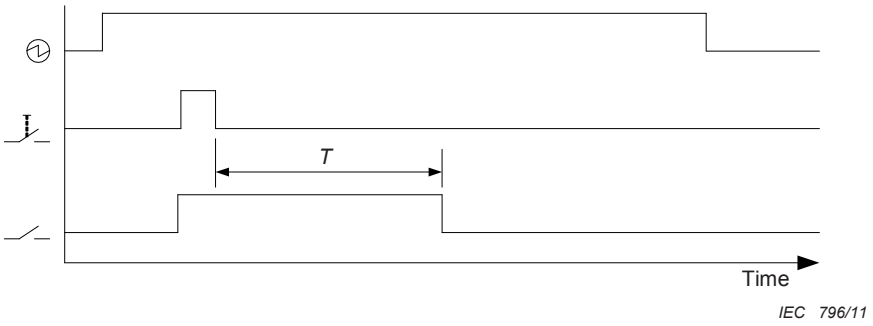


Figure 5 – Off-delay relay with control signal

[IEC 60050-445:2010, 445-01-04]

3.2.4
on- and off-delay relay with control signal
time relay in which the output switches to the operate condition when applying the power supply and the control signal and after the setting time has elapsed; the output switches to the release condition when the control signal is removed and after the setting time has elapsed (see Figure 2 and Figure 6)

NOTE Effects of subsequent operating or retriggering of the control signal should be declared by the manufacturer.

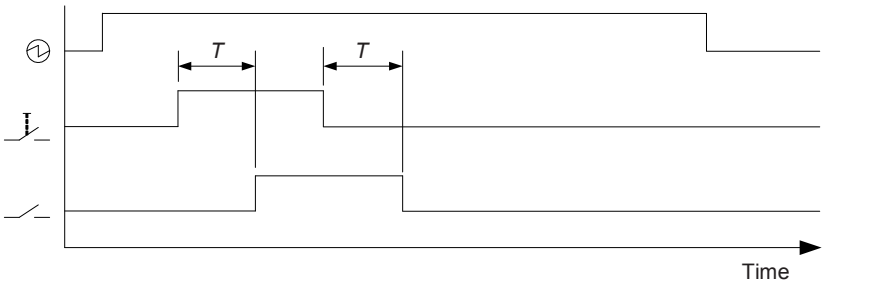


Figure 6 – On- and off-delay relay with control signal

[IEC 60050-445:2010, 445-01-05]

3.2.5
flasher relay
repeat cycle relay
time relay in which the output periodically switches on and off as long as the power supply or control signal is applied (see Figure 2 and Figure 7)

NOTE 1 Depending on the relay type, the output starts with "pulse on" or "pulse off".

NOTE 2 Flasher relay may also be initiated with a control signal.

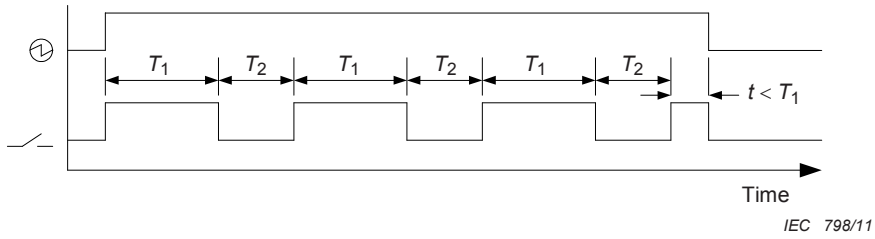


Figure 7 – Flasher relay

[IEC 60050-445:2010, 445-01-06]

3.2.6
symmetrical flasher relay
symmetrical repeat cycle relay
flasher relay in which the output periodically switches on and off with substantially identical durations of pulse on time and pulse off time

[IEC 60050-445:2010, 445-01-07]

3.2.7
asymmetrical flasher relay
asymmetrical repeat cycle relay
flasher relay in which the pulse on time and pulse off time are selectable separately

[IEC 60050-445:2010, 445-01-08]

3.2.8
star-delta relay
time relay including two delayed outputs switching one after the other, for starting of motors in the star mode and subsequent change to the delta mode (see Figure 2 and Figure 8)

NOTE The star and delta connections are defined in IEC 60050-141:2010, 141-02-06 and IEC 60050-141:2010, 141-02-09 respectively.

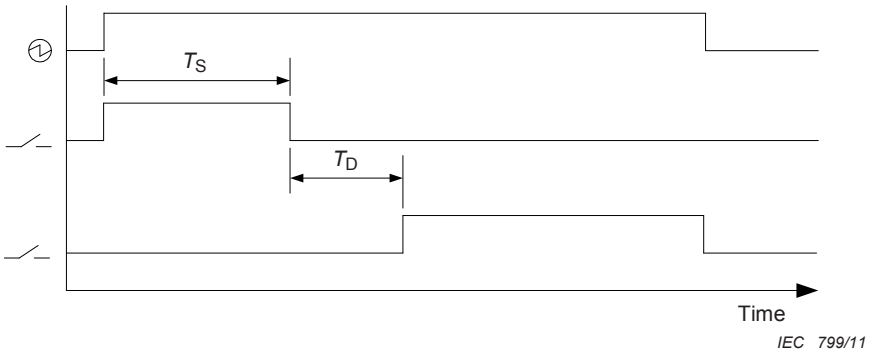


Figure 8 – Star-delta relay

[IEC 60050-445:2010, 445-01-09]

3.2.9
summation time relay
time relay in which the output switches when the setting time has elapsed by summation of the time periods during which the control signal has been applied (see Figure 2 and Figure 9)

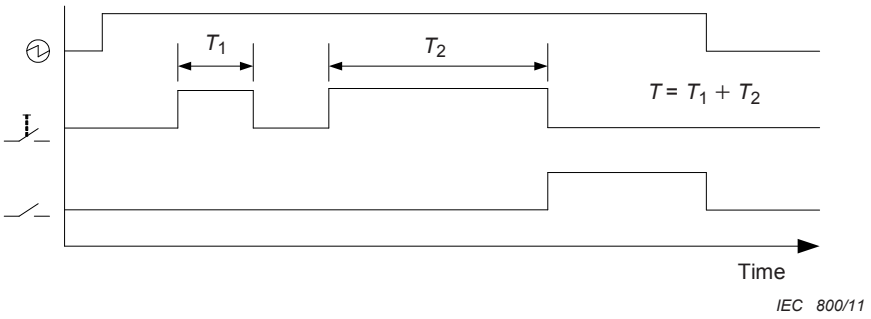


Figure 9 – Summation time relay

[IEC 60050-445:2010, 445-01-10]

3.2.10
pulse delayed relay
time relay in which the time delay starts when applying the power supply; the output momentarily switches for an interval to the operate condition after the time delay has elapsed (see Figure 2 and Figure 10)

NOTE Manufacturer should specify if interval is fixed or variable.

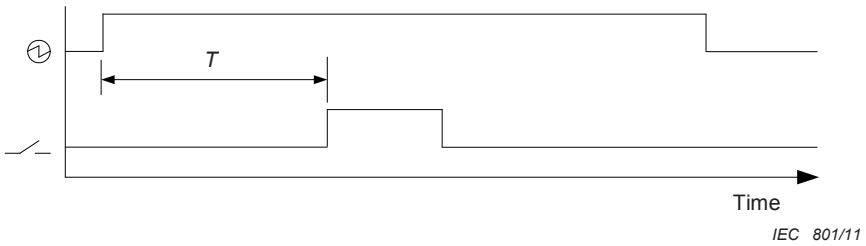


Figure 10 – Pulse delayed relay

[IEC 60050-445:2010, 445-01-11]

3.2.11
pulse delayed relay with control signal
time relay in which the time delay starts when applying the power supply and the control signal; the output momentarily switches for an interval to the operate condition after the setting time has elapsed (see Figure 2 and Figure 11)

NOTE 1 Cycling the control signal during the time delay will not retrigger the time delay.

NOTE 2 Manufacturer should specify if interval is fixed or variable.

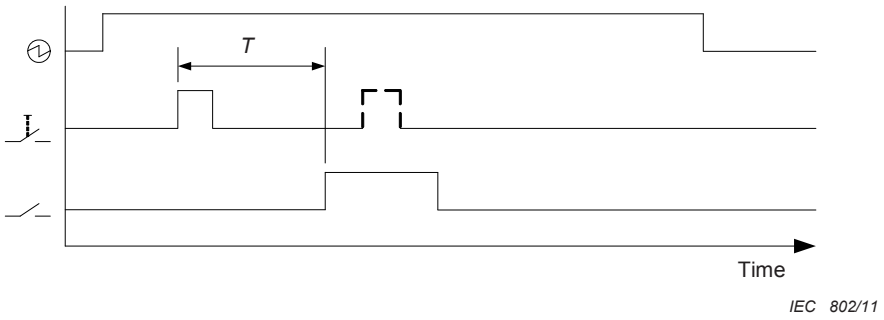


Figure 11 – Pulse delayed relay with control signal

[IEC 60050-445:2010, 445-01-12]

3.2.12
interval relay
time relay in which the output immediately switches to the operate condition and the time delay starts when applying the power supply, and the output switches to the release condition after the setting time has elapsed (see Figure 2 and Figure 12)

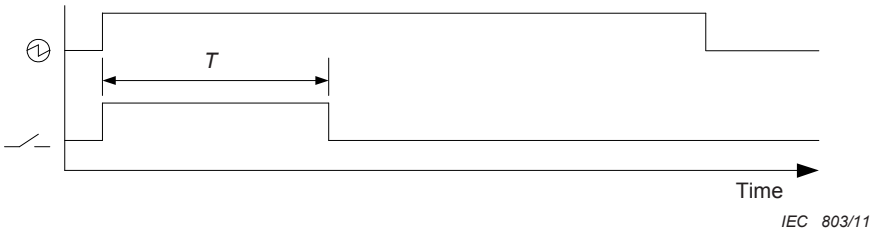


Figure 12 – Interval relay

[IEC 60050-445:2010, 445-01-13]

3.2.13
interval relay with control signal
single shot relay
time relay in which the output immediately changes to the operate condition and the time delay starts when applying the power supply and the control signal; the output switches to the release condition after the setting time has elapsed (see Figure 2 and Figure 13)

NOTE Cycling the control signal during the time delay will not retrigger the time delay.

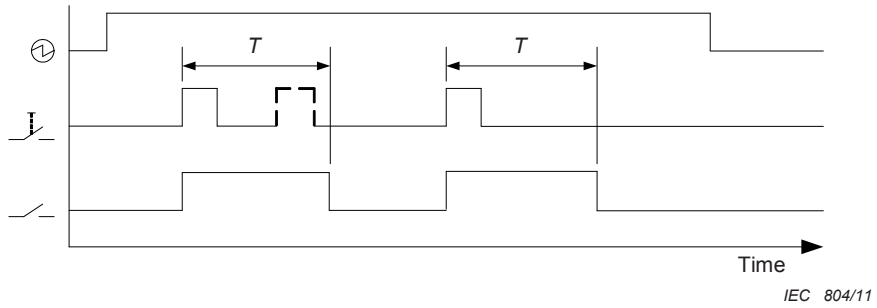


Figure 13 – Interval relay with control signal

[IEC 60050-445:2010, 445-01-14]

3.2.14
retriggerable interval relay with control signal on
watchdog relay
time relay in which the output immediately switches to the operate condition and the time delay starts when applying the power supply and the control signal; the output switches to the release condition after the setting time has elapsed and if the control signal is not operated during the setting time (see Figure 2 and Figure 14)

NOTE Cycling the control signal during the time delay will retrigger the time delay.

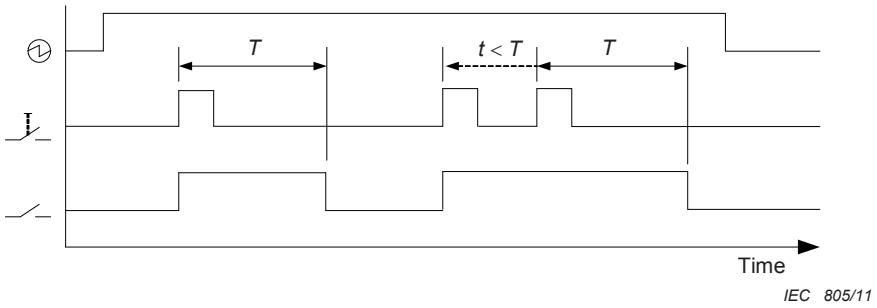


Figure 14 – Retriggerable interval relay with control signal on

[IEC 60050-445:2010, 445-01-15]

3.2.15
retriggerable interval relay with control signal off
fleeting off delay relay
time relay in which the output immediately changes to the operate condition and the time delay starts when applying the power supply and removing the control signal; the output switches to the release condition after the setting time has elapsed (see Figure 2 and Figure 15)

NOTE Cycling the control signal during the time delay will retrigger the time delay.

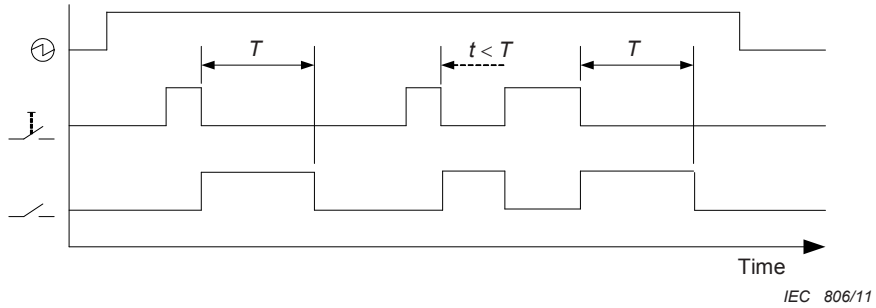


Figure 15 – Retriggerable interval relay with control signal off

[IEC 60050-445:2010, 445-01-16]

3.2.16
maintained time relay
time relay which does not prematurely release if the energizing quantity is removed and the time interval is not concluded (see Figure 2 and Figure 16)

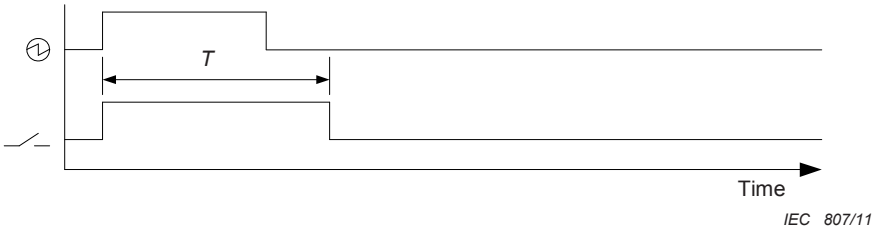


Figure 16 – Maintained time relay

[IEC 60050-445:2010, 445-01-17]

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 values and tolerance ranges listed in Table 1 apply.

Table 1 – Influence quantities and reference values

Influence quantities	Reference values for tests	Tolerances during tests
Ambient temperature	23 °C	± 5 °C
Air pressure	96 kPa	± 10 kPa
Relative humidity	50 %	± 25 %
Position	As indicated by the manufacturer	2° in any direction
Input voltage	Rated value(s)	± 5 % for steady-state conditions [a]
Output circuit (voltage/current)	Rated value(s)	± 5 % for steady-state conditions
Frequency	As indicated by the manufacturer	± 1 %

Influence quantities	Reference values for tests	Tolerances during tests
Waveform	Sinusoidal	Maximum distortion factor 5 % [b]
Direct component in a.c.	As indicated by input voltage	Max. 2 % of peak value
Alternating component in d.c. (ripple)	As indicated by input voltage	Maximum 6 % [c]
Shock and vibration	As indicated by the manufacturer	Maximum 1 m/s²
Industrial and other atmospheres	Clean air	Clean air (pollution not exceeding class 3C2 of IEC 60721-3-3)

[a] In so far as they are regarded as influencing quantities in the case of time errors tolerance to be ± 1 %.

[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] For calculating the ripple content of d.c. (expressed as a percentage) the following formula applies:

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

5 Rated values

5.1 General

The numerical values given in this standard are either recommended standard values or typical practical values for electronic and electromechanical time relays at the known state of the art. The corresponding actual values for any specific product should be confirmed by the manufacturer as complying with this standard or quoted explicitly if they deviate from this standard.

5.2 Input voltage and frequency

a) The recommended a.c. rated input voltage r.m.s. is to be specified according to one of the following values:

   12 V; 24 V; 48 V; 100 V; 110 V; 115 V; 120 V; 127 V; 200 V; 208 V; 220 V; 230 V; 240 V; 277 V; 400 V; 415 V; 480 V.

b) The recommended d.c. rated input voltage is to be specified according to one of the following values:

   5 V; 12 V; 24 V; 48 V; 60 V; 100 V; 110 V; 125 V; 220 V; 250 V.

c) Rated frequency, recommended values: 50 Hz, 60 Hz, 400 Hz.

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

e) The recommended operating range is to be specified according to one of the following values:

   - 80 % to 110 % or
   - 85 % to 110 % or
   - 90 % to 110 % of input voltage.

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

Where the manufacturer deviates from the recommended range, both the rated input voltage (or range) and the corresponding operative range shall be specified.

5.3 Release voltage

The release voltage shall not be less than 10 % of the minimum rated input voltage that is specified according to 5.2.

NOTE Higher values can be stated upon agreement between manufacturer and user.

The release voltages apply over the full ambient temperature range as declared by the manufacturer.

5.4 Power consumption

The rated power consumption of a relay shall be given at rated input voltage. In case of relays with several input circuits, the respective rated power consumption shall be given.

NOTE For relays with an input which varies depending on the position of the moved parts or for any other reason, the higher value should be given in VA or in W. In the case of alternating current the power factor is optional.

5.5 Output circuit

Output load ratings shall be specified by the manufacturer.

5.5.1 Electromechanical output circuit

a) Resistive loads, inductive loads, and special loads (e.g. lamp loads, cable loads) shall be specified in accordance with 5.7, Annex B and Annex D of IEC 61810-1:2008.

   The manufacturer shall state the following:

   - rated load values for the output circuits;
   - number of cycles for electrical endurance;
   - number of cycles for mechanical endurance;
   - frequency of operation.

b) Low energy loads (for example electronic systems and programmable controllers) shall be specified in accordance with IEC 60947-5-4. The manufacturer shall state the rated load values and statistical assessed constant mean number of operating cycles (m_c). The following examples are preferred formats for specifying rated load values:

   - minimum voltage and current (for example 24 V, 1 mA);
   - minimum power (for example 50 mW, 5 V / 5 mA), meaning with 5 V the current shall be at least 10 mA, or with 5 mA the voltage shall be at least 10 V.

5.5.2 Mechanical endurance

Mechanical endurance value of the internal relay shall be used. As an alternative the manufacturer may perform a mechanical endurance test according to IEC 61810-1.

5.5.3 Solid state output circuit

Load categories shall be specified in accordance with 4.4 of IEC 62314:2006 as applicable.

The manufacturer shall state the maximum value of

- voltage drop at rated load current;
- leakage current at maximum specified ambient temperature.

5.5.4 Endurance and operating frequency

The preferred values of the endurance and operating frequency are given in Table 2 and Table 3.

Table 2 – Preferred values of endurance

Operating cycles × 10^6
0,03
0,1
0,2
0,3
0,5
1
3
10
20
30

Table 3 – Preferred values of maximum permissible operating frequency

Operating frequency under load conditions (cycles per hour) [a]
12
30
120
300
600
1 200
1 800
3 600
7 200
[a] This applies only in so far as permissible due to the shortest adjustable time delay.

5.5.5 Conditional short circuit current

When protected by a short-circuit protective device e.g. 6,3 A quick response fuse, the rated conditional short-circuit current of a relay is a minimum value of 100 A.

5.6 Ambient temperature

Unless otherwise stated, the preferred ambient temperature range is –10 °C to +40 °C for the operation of relays.

5.7 Transport and storage temperature

Equipment subjected to these extreme temperatures without being operated shall not undergo any irreversible damage and shall then operate normally under the specified conditions.

Temperature range for:

- storage: –25 °C to +55 °C;
- transport: –40 °C to +70 °C.

5.8 Humidity

Unless otherwise stated, the preferred relative humidity range is 25 % to 75 %.

5.9 Pollution degree

Unless otherwise stated, the relay is for use in pollution degree 2 environmental conditions in accordance with IEC 60664-1. However, other pollution degrees may be considered to apply, depending upon the micro-environment.

NOTE 1 The pollution degree of the micro-environment of the relay may be influenced by installation in an enclosure.

NOTE 2 The pollution degree of the micro-environment of the circuits inside the integral enclosure of the relay may be different from the micro-environment of the relay.

5.10 Altitude

The altitude of the site of installation shall not exceed 2 000 m.

NOTE For equipment to be used at higher altitudes, it is necessary to take into account the reduction of the dielectric strength and the cooling effect of the air. Electrical equipment intended to operate under these conditions is to be designed or used in accordance with an agreement between manufacturer and user.

5.11 Timing circuit function

5.11.1 General

The constructional design of the timing circuit determines the relay function.

The specified time may be permanently set or be adjustable.

The nominal values as given in Table 4 are recommended as final values for the setting range of a specified time.

Table 4 – Recommended final values of the setting range

Seconds	0,5	1	3	–	10	–	–	30	60	–	100	300	600
Minutes	–	1	3	–	10	–	–	30	60	–	–	300	–
Hours	–	1	3	6	–	12	24	30	60	72	100	–	–

For digital time relays, final values of the setting range are additionally recommended consisting of the digit 9 (e.g. 999 min).

5.11.2 Setting accuracy

The setting accuracy will be given:

- in percent of the full-scale value for relays with analogue setting;
- in percent of the setting value or in absolute values for relays with digital setting.

5.11.3 Repeatability

The following preferred values shall be observed with regard to the repeatability of function time values:

± 0,01 %; ± 0,05 %; ± 0,1 %; ± 0,2 %; ± 0,3 %; ± 0,5 %; ± 1 %; ± 2 %; ± 3 %; ± 5 %.

The repeatability may be specified as the higher value of either a percentage value or an absolute value, e.g. 0,01 % or 10 ms.

5.11.4 Recovery time and minimum control impulse

To be stated by the manufacturer.

6 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 given in Table 5.

NOTE Tests according to this standard can be applied to routine and sampling tests as appropriate.

If a specimen does not pass a test, this test shall be repeated once with an additional specimen 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.

Special conditions are those which deviate from the reference values specified in Table 1 with regard to temperature, altitude, humidity, heavy air pollution by dust, smoke, vapour or salts. In such cases the manufacturer shall state the tests and severities which have been carried out on the device in accordance with the relevant parts of IEC 60068 series.

Table 5 – Type testing

Type test	Clause	Minimum number of test specimens	Inspection lot	Additional references
Basic operating function	9	3	1	
Marking and documentation	7	1	1	
Heating	8	1	1	IEC 60085
Clearances, creepage distances	13	1	1	IEC 60664-1
Vibration and shock	16	1	1	
Insulation	10	1	2	
Electrical endurance	11	1[a]	3	
Conditional short-circuit current	12	1	4	
Mechanical strength	14	1	5	
Heat and fire resistance	15	1	6	IEC 60695-2-11
EMC	17	1	7	
[a] See 11.1.				

7 Documentation and marking

7.1 Data

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

Table 6 – Required relay information

N°	Information	Notes	Place of indication
1 Identification data			
1a	Manufacturer's name, identification code or trade mark		Relay
1b	Type designation	It shall be unambiguous and ensure identification of the product by respective documentation	Relay
1c	Date of manufacture	May be coded if specified in the documentation	Relay (preferred) or package
2 Input data			
2a	Range of rated input voltage(s) with symbol for d.c. or a.c. voltages		Relay
2b	Frequency for a.c.		Relay
2c	Rated power consumption		Catalogue or instruction sheet
2d	Release value of input voltage		Catalogue or instruction sheet
3 Output data			
3a	Output circuit data	Rated operating voltage, rated operating current and category of use	Relay
3b	Number of cycles for electrical endurance		Catalogue or instruction sheet
3c	Frequency of operation		Catalogue or instruction sheet
3d	Number of cycles for mechanical endurance	If applicable	Catalogue or instruction sheet
3e	Contact material(s)	If applicable	Catalogue or instruction sheet
3f	Low energy reliability - characteristics of the test results	If applicable	Manufacturer documentation
3g	Low energy loads	If applicable, voltage, current, operating cycles	Catalogue or instruction sheet
3h	On-state voltage drop of a solid-state output	If applicable	Catalogue or instruction sheet
3i	Leakage current of a solid-state output	If applicable	Catalogue or instruction sheet
4 Insulation data			
4a	Type of insulation	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	If other than pollution degree 2	Catalogue or instruction sheet
4d	Impulse test voltage(s)	For all circuits	Catalogue or instruction sheet
4e	Dielectric test voltage(s)	For all circuits	Catalogue or instruction sheet
4f	Overvoltage category		Catalogue or instruction sheet
5 General data			
5a	Ambient temperature range		Catalogue or instruction sheet
5b	Relative humidity range		Catalogue or instruction sheet
5c	Mounting position	If applicable	Catalogue or instruction sheet
5d	Data to permit suitable connection of the relay	Including polarity	Catalogue or instruction sheet

N°	Information	Notes	Place of indication
5e	Identification of connections and circuits		Relay
5f	Accessories	If essential to the relay performance	Catalogue or instruction sheet
5g	Indications for earthing or grounding of metal parts	If applicable	Relay
5h	Mounting distance	If applicable	Catalogue or instruction sheet
5i	EMC immunity test levels		Catalogue or instruction sheet
5j	Degree of protection in accordance with IEC 60529		Catalogue or instruction sheet
5k	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
5l	Prospective current value (if less than 1 000 A)	For conditional short circuit current test	Catalogue or instruction sheet
6 Time function data			
6a	Specified time (nominal range of time)		Relay
6b	Type of function of the relay	According to 3.2	Catalogue or instruction sheet
6c	Recovery time		Catalogue or instruction sheet
6d	Minimum control impulse		Catalogue or instruction sheet
6e	Setting accuracy		Catalogue or instruction sheet
6f	Repeatability		Catalogue or instruction sheet
6g	Influence effects	Voltage, temperature recommended	Catalogue or instruction sheet or Manufacturer documentation

7.2 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 (for example 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/cm^2.

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/cm^3.

8 Heating

8.1 General

Relays shall be constructed so they do not attain excessive temperatures in normal use.

8.2 Test conditions

The relay is operated in an appropriate heating chamber until temperature equilibrium is attained with the following conditions:

a) The ambient temperature shall be equal to the upper limit of the operating temperature range.

b) The output circuit is loaded with the resistive limiting continuous current as specified by the manufacturer. It shall not be switched during the test; for this purpose, the current shall be switched on and off by means of a separate switch with closed output circuit.

c) The input circuit is supplied by the maximum rated voltage.

d) The operating mode is set to the maximum power loss which occurs during operation as in normal use.

Thermal equilibrium is attained when variation of less than 1 K occurs between any two out of three consecutive measurements made at an interval of 5 min.

8.3 Heating of terminals

8.3.1 General

Temperature at the terminals is determined by means of fine wire thermocouples which are positioned so that they have negligible effect on the temperature being determined. The measuring points are positioned on the terminals as close as possible to the body of the relay. If the thermocouples cannot be positioned directly on the terminals, the thermocouples may be fixed on the conductors as close as possible to the relay.

Temperature sensors other than thermocouples are permitted, provided they show equivalent test results.

The maximum permissible steady-state temperature of the terminals as indicated by the manufacturer shall not be exceeded.

8.3.2 Heating of screw terminals and screwless terminals

The electrical connections of the relay to the voltage or current source(s) are realized with flexible conductors according to Table 7.

Table 7 – Areas and lengths of conductors dependent on the current carried by the terminal

Current carried by the terminal A		Cross-sectional area of conductors		Minimum conductor length for testing
Above	up to and including	mm^2	AWG	mm
-	3	0,5	20	500
3	6	0,75	18	500
6	10	1,0	17	500
10	16	1,5	16	500
16	25	2,5	14	500
25	32	4,0	12	500
32	40	6,0	10	1 400
40	63	10,0	8	1 400

The temperature rise at the terminals shall not exceed 45 K.

8.3.3 Heating of quick-connect terminations

The electrical connections of the relay to the voltage or current source(s) are realized with flexible conductors, using female connectors (made of nickel-plated steel) according to IEC 61210 and with flexible conductors according to Table 7.

NOTE 1 It is recommended that the female connectors are soldered in the crimping area. This is intended to enable the determination of the flat quick-connect termination of the relay without significant influence from either the female connector or the quality of the crimping.

The determined absolute temperature shall not exceed the lowest permissible value for flat quick-connect terminations given in Annex A of IEC 61210:2010, unless the manufacturer specifies the appropriate material combination(s).

The temperature rise at the flat quick-connect terminations shall not exceed 45 K. This may be verified without the temperature rise influence of the relay contacts and the coil (e.g. bridged or short circuited or soldered relay contacts).

NOTE 2 The following nominal dimensions of quick-connect terminations are recommended:

Connector size mm	Maximum steady state current A
2,8	6
4,8	16
6,3	25
9,5	32

8.3.4 Heating of sockets

The maximum steady-state temperature limits permissible for the connections between relay and socket as well as for the insulating materials of both relay and socket adjacent to the connection shall not be exceeded.

The mounting distance between sockets shall be specified by the manufacturer.

8.3.5 Heating of alternative termination types

The electrical connections of the relay to the voltage or current source(s) are realized with flexible conductors according to Table 7.

8.4 Heating of accessible parts

The temperature rise of accessible parts shall not exceed the values stated in Table 8.

Table 8 – Temperature rise limits of accessible parts

Accessible parts	Temperature rise limits K
Manual operating means:	
Metallic	15
Non-metallic	25
Parts intended to be touched but not hand-held:	
Metallic	30
Non-metallic	40
Exteriors of enclosures adjacent to cable entries:	
Metallic	40
Non-metallic	50

8.5 Heating of insulating materials

The temperatures of insulating materials shall be not higher than permitted in IEC 60085.

New insulating materials not covered by IEC 60085 may be used if the same degree of safety is assured. Alternatively, performance of insulation materials may be tested according to Annex A, or other suitable test methods.

The stated limits of temperature may be exceeded in restricted parts of the insulating material, provided there is no apparent sign of damage and no apparent changes in the characteristics.

9 Basic operating function

9.1 General

Prior to the tests, the relays are subjected to the specified atmospheric test conditions so that they are in thermal equilibrium.

9.2 Operate

The relay shall be preconditioned at the maximum permissible ambient temperature specified by the manufacturer by applying – as indicated by the manufacturer – the rated input voltage, or the upper limit of the rated input voltage range specified in 5.2, and with the contacts (contact set) loaded with the maximum continuous current(s) specified by the manufacturer for this test until thermal equilibrium is reached. Immediately after removal of the input voltage and related arrival at the release condition, the relay shall operate again when energized at the lower limit of the operative range.

9.3 Release

The relays shall reach thermal equilibrium at the minimum permissible ambient temperature. After a short application of the operate voltage to establish the operate condition, the coil voltage shall be immediately reduced to the relevant value specified in 5.3.

When this occurs, the relay shall release.

9.4 Time function

9.4.1 Functional test at reference values of input quantities

9.4.1.1 General

The functional tests are to be carried out with the reference values of the input quantities as given in Table 1. The number of successive measurements shall be 10 minimum.

9.4.1.2 Determination of the setting accuracy

The difference between the mean of the measured values and the setting value shall be within the tolerances of the setting accuracy indicated by the manufacturer.

9.4.1.3 Determination of the repeatability

The difference between the mean of the measured values and the measured values shall be within the tolerances of the repeatability indicated by the manufacturer.

9.4.2 Influencing effects of voltage and temperature

The influencing effect of the input voltage and temperature on the specified time(s) is checked; for this purpose, only one quantity as given in Table 9 will be changed whereas the other quantity has the nominal value.

The number of successive measurements shall be 10 minimum.

For checking influence to temperature, the relays are operated in an appropriate chamber until thermal equilibrium is attained at the ambient temperature as given in Table 9. Thermal equilibrium is attained when variation of less than 1 K occurs between any two out of three consecutive measurements made at an interval of 5 min.

The test shall be considered satisfactory if the relay accomplishes its function properly within the tolerance values as indicated by the manufacturer.

Table 9 – Changing of influencing quantities

Changed quantity	Value	Tolerance unit
Input voltage	110 % and 80 % or 85 % or 90 %	%/volt
Ambient temperature	–5 °C +40 °C	%/K

10 Insulation

10.1 General

The material used for insulation purposes shall possess sufficient electrical, thermal and mechanical properties.

The dielectric properties are based on basic safety publication IEC 60664-1.

The rules for dimensioning basic and reinforced insulation as stated in IEC 60664 series apply.

The insulation of circuits within a relay shall be tested in accordance with the maximum reference voltage and overvoltage category of the relay.

10.2 Preconditioning

The tests of 10.3 shall be started immediately after the preconditioning and finished without unnecessary delay. The time to complete the test shall be indicated in the test report.

The preconditioning comprises the dry heat and damp heat tests.

The dry heat test is carried out in a heat chamber. The air temperature is maintained at 55 ºC with an accuracy of ± 2 K in the area where the specimens are mounted. The specimens are kept in the chamber for 48 h.

The damp heat test is carried out in a climatic test cabinet at a relative humidity of (93 ± 3) % RH. The air temperature shall be maintained at (40 ± 2) °C with an accuracy of ± 5 K in the area where the specimens are mounted. The specimens are kept in the chamber for 4 days. There shall be no condensation.

10.3 Dielectric strength

10.3.1 General

In order to obtain adequate dielectric strength, the creepage distances and clearances shall be as specified in Clause 13 and the relay shall withstand the application of impulse withstand test and dielectric test as specified in Table 10 and Table 11 or Table 12.

Dielectric tests shall be performed

a) between each circuit and the exposed conductive parts, the terminals of each independent circuit being connected together (for type tests on relays with an insulating enclosure, the exposed conductive parts shall be represented by a metal foil covering the whole enclosure except the terminals around which a suitable gap shall be left to avoid flashover to the terminals);
b) between independent circuits, the terminals of each independent circuit being connected together.

Unless obvious, the independent circuits are those which are so described by the manufacturer.

Circuits having the same rated insulation voltage may be connected together when being tested to the exposed conductive parts.

The test voltages shall be applied directly to the terminals.

The test shall be considered satisfactory if neither a breakdown nor a flashover occurs. The influence of the relay under test, if any, is ignored.

10.3.2 Impulse withstand test

The impulse withstand test is carried out with a voltage having a 1,2/50 μs waveform (Figure 5 of IEC 60060-1:2010). The test shall be conducted for a minimum of three pulses of each polarity with an interval of at least 1 s between pulses.

Table 10 – Impulse test for basic insulation

Voltage line to earth a.c. r.m.s. or d.c.	Residential Overvoltage category II		Industrial Overvoltage category III	
V	Rated impulse withstand voltage V	Impulse withstand test voltage at sea level V	Rated impulse withstand voltage V	Impulse withstand test voltage at sea level V
Up to 50	500	541	800	934
Up to 100	800	934	1 500	1 751
Up to 150	1 500	1 751	2 500	2 920
Up to 300	2 500	2 920	4 000	4 923
Up to 600	4 000	4 923	6 000	7 385

NOTE 1 The impulse withstand test voltage values are given for sea-level. When using these values, no further altitude correction is necessary. If for test locations above sea-level a correction is required, the correction factor as given in 6.1.2.2.1.3 of IEC 60664-1:2007 applies.

NOTE 2 Unearthed voltage systems have to be treated like corner-earthed systems.

10.3.3 Dielectric a.c. power frequency voltage test

The solid insulation is subjected to a voltage of substantially sine wave form, having a frequency of 50 Hz or 60 Hz. The test voltage shall be raised uniformly from 0 V to the value specified in Table 11 or Table 12, within not more than 5 s and held at that value for at least 60 s. The test shall be considered satisfactory if neither a breakdown nor a flashover occurs and the function remains unchanged. A current of not more than 3 mA is permitted.

If an alternating test voltage cannot be applied, for example due to EMC filter components, a d.c. test voltage may be used having the value of Table 11, third column. The uncertainty of measurement of the test voltage shall not exceed ± 3 %.

Table 11 – Dielectric test voltage for devices suitable for use in single-phase three or two-wire a.c. and d.c. systems

Nominal voltage of the supply system (U_N) V	a.c. test voltage, 60 s (r.m.s.) V	d.c. test voltage [a] V
60	1 260	1 781
100/200	1 400	1 980
120/240	1 440	2 037
220/440	1 640	2 320
480	1 680	2 376

NOTE 1 Test voltage values for double insulation should be twice than those for basic insulation (5.3.3.2.3 and 6.1.3.4.1 of IEC 60664-1:2007).

NOTE 2 For supply system topology, see Annex B of IEC 60664-1:2007.

NOTE 3 The values for a.c. test voltages are derived by the formula U_N+1 200 V (5.3.3.2 of IEC 60664-1:2007).

[a] Test voltages based on 6.1.3.4.1, fifth paragraph of IEC 60664-1:2007.

Table 12 – Dielectric test voltage for devices suitable for use in three-phase four or three-wire a.c. systems

Nominal voltage of the supply system (U_N) V	Test voltage, 60 s V
66/115	1 315
120/208	1 408
230/400	1 600
260/440	1 640
277/480	1 680

NOTE 1 Test voltage values for double insulation should be twice than those for basic insulation (5.3.3.2.3 and 6.1.3.4.1 of IEC 60664-1:2007).

NOTE 2 For supply system topology see Annex B of IEC 60664-1:2007.

NOTE 3 The values are derived by the formula U_N+1 200 V (5.3.3.2 of IEC 60664-1:2007).

10.4 Protection against direct contact

For relays being operated as in normal use, e.g. in the case of time setting, all accessible parts which carry voltages shall have a sufficient direct contact protection.

NOTE This applies e.g. in case of terminals with degree of protection IP 20 in accordance with IEC 60529.

This requirement does not apply where the rated voltages do not exceed 50 V a.c. (r.m.s. value) / 60 V d.c.

Protection is regarded as ensured where the test for protection of fingers in accordance with the test finger in IEC 60529 is considered satisfactory and the degree of protection IP 1X.

11 Electrical endurance

11.1 General

Electrical endurance determines the resistance of relays against electrical wear. It is characterized by the number of operating cycles under load conditions as indicated by the manufacturer which the relay is capable to carry out properly without maintenance, repair or replacement of components. If not otherwise specified by the manufacturer, the load shall be applied to both the make and break side of a change-over contact.

The electrical endurance test shall be performed in accordance with the relevant product standard (e.g. IEC 61810-1 for electromechanical relays or IEC 62314 for solid state output). The test will be performed using one of the nominal time relay ratings, as defined by the manufacturer and indicated in the test report.

If the internal relay has no rating or if the time relay has a more severe rating than the internal relay, the electrical endurance test shall be performed on 3 samples minimum; if the time relay will be given the same rating or less severe rating than the internal relay, the test will be performed on 1 sample minimum.

11.2 Resistive loads, inductive loads, and special loads

The test is performed on each contact load and each contact material as specified by the manufacturer.

Unless otherwise explicitly stated by the manufacturer, this test is carried out at room temperature and the relay shall be energized with rated input voltage or an appropriate value within the rated input voltage range.

11.3 Low energy loads

Low energy loads (e.g. electronic systems and programmable controllers) shall be tested in accordance with IEC 60947-5-4.

The manufacturer's documentation shall include characteristics of the test results as prescribed in IEC 60947-5-4.

12 Conditional short-circuit current

12.1 General

The switching element of the relay shall withstand the stresses resulting from short-circuit currents as specified in 5.5.5.

12.2 Test procedure

The switching element may be operated several times before the test, at no load or at any current not exceeding the rated current.

The test is performed by making the current with the separate making switch and the current shall be maintained until the short-circuit protective device (SCPD) operates.

12.3 Test circuit electromechanical output circuit

The switching element shall be connected in series with the short-circuit protective device of type and rating stated by the manufacturer; it shall also be in series with the switching device intended to close the circuit as shown in Figure 17.

The test circuit load impedance shall be an air-cored inductor in series with a resistor, adjusted to a prospective current of 1 000 A, or another value if stated by the manufacturer but not less than 100 A, at a power factor of between 0,5 and 0,7 and at the rated operational voltage.

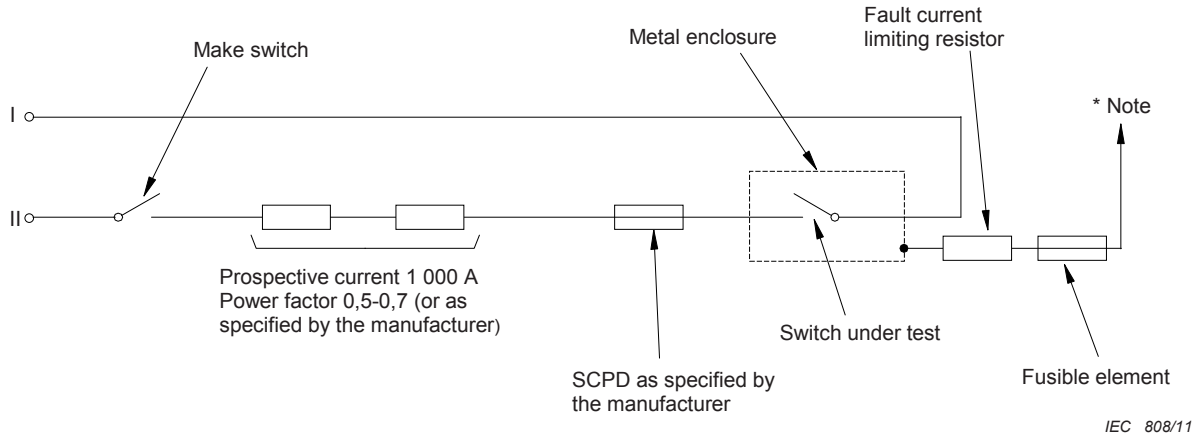
The test shall be performed three times on the same contact element, the SCPD being reset or replaced after each test. The time interval between the tests shall be not less than 3 min. The actual time interval shall be stated in the test report.

For change-over contact elements, the above test shall be made separately on both the normally closed and normally open contacts.

NOTE For control switches with both two terminals and change-over contact elements, both types should be tested.

A separate control circuit device may be used for each contact element.

The switching element shall be connected in the circuit using 1 m total length of cable corresponding to the operational current of the switching element.



NOTE To be connected alternatively to I or II on successive tests.

Figure 17 – Test circuit electromechanical output, conditional short-circuit current

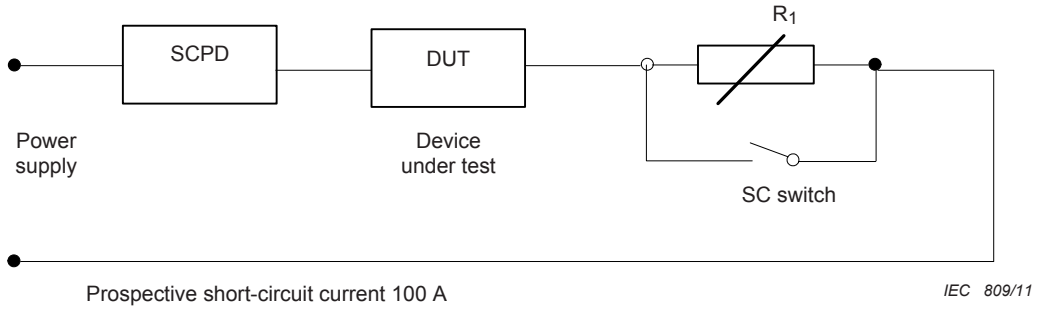
12.4 Test circuit solid state output circuit

The device under test (DUT) in new condition shall be mounted as in service, in free air, and connected to the test circuit with the same size wire as used in service as shown in Figure 18.

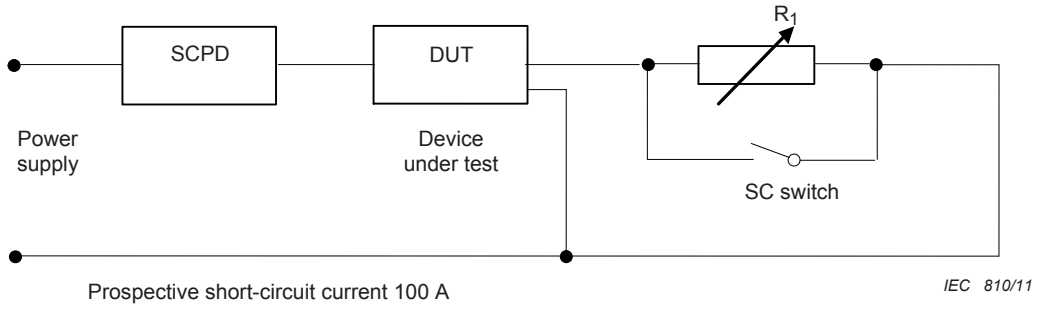
The short-circuit protective device (SCPD) shall be of the type and rating stated by the manufacturer.

The switching element is in the ON-state, R1 is selected so that the current flowing through the static output is equal to its rated operational current. The supply shall be adjusted to 100 A prospective short-circuit current. The SC switch, parallel with R1 load, is intended to cause the short circuit. The open circuit voltage shall be 1,1 times the rated operational voltage or the maximum value of the voltage range.

The test shall be performed three times by randomly closing the SC switch. The test current is maintained until the SCPD has operated. The interval between each of the three tests shall be not less than 3 min. The actual time between tests shall be stated in the test report. After each test, the SCPD shall be replaced or reset.



a) 2 terminal a.c. or 2 terminal d.c.



b) 3 terminal a.c. or 3 terminal d.c.

Figure 18 – Test circuit solid state output, conditional short-circuit current

12.5 Condition of switching element after test

a) After the short-circuit test the time relay shall be able to switch to release condition.

b) After the test the device shall withstand the dielectric strength test according to 10.3.

13 Clearances and creepage distances

13.1 General

Clearances and creepage distances shall be dimensioned in conformity with reference voltages, overvoltage category and pollution degree according to IEC 60664-1 depending on the type of use.

NOTE 1 According to IEC 60664-1 the direct surroundings are decisive for the dimensioning of creepage distances and clearances. Thus the environmental conditions in the respective location where the relay is mounted apply and not those in the factory to which the location belongs.

Where relays or parts of relays are protected against conductive pollution, distances and clearances may be dimensioned in accordance with immediate environmental conditions. The manufacturer shall state the degree of protection to be provided in the installation environment (e.g. by use of a suitable enclosure). For example, when using an enclosure that provides IP 54 protection (reference IEC 60529) the immediate environment inside the enclosure is suitable for pollution degree 1.

Should the printed circuit board(s) be coated with varnish or a protective layer which is resistant to ageing, the creepage distances of the coated areas may also be considered in accordance with pollution degree 1 (reference IEC 60664-3).

Clearances between mutually insulated circuits (e.g. between input circuit and output circuit) shall be dimensioned in accordance with the higher reference voltage.

The clearances specified do not apply over open contacts. Clearances and creepage distances specified for pollution degree 2 or 3 do not apply in the case of electronic components either (e.g. triac), that is to say both inside these components and on electrical terminals and soldered joints at the printed circuit board.

When conductors are completely enclosed or sealed by solid insulation including coatings, the clearances and creepage distances are not applicable.

According to clauses of IEC 60664 series, the basic safety standards in the field of low voltage insulation coordination, the manufacturer may select to apply one or more of the following options a) to c):

a) When all the conditions of IEC 60664-5 are fulfilled, the dimensioning of clearances and creepage distances for spacings up to 2 mm as given in that standard may be applied instead.

   NOTE 2 IEC 60664-5 applies in the case of printed wiring boards and similar constructions where the clearances and creepage distances are identical and along the surface of solid insulation. Smaller dimensioning than that based on IEC 60664-1 can be achieved dependent on the water absorption characteristics of the solid insulating material.

b) For constructions in accordance with IEC 60664-3, where protection against pollution is achieved by using adequate coating, potting or moulding, the reduced clearances and creepage distances as specified in IEC 60664-3 may be used. All the requirements and tests of IEC 60664-3 shall be fulfilled. The following items apply:

   - value for lower temperature under 5.7.1 of IEC 60664-3:2003 –10 °C;
   - temperature cycle under 5.7.3 of IEC 60664-3:2003 Severity 1;
   - the partial discharge test under 5.8.5 of IEC 60664-3:2003 is not required;
   - no additional tests under 5.9 of IEC 60664-3:2003 are required.

c) In the case of relays to be used for frequencies of the working voltage above 30 kHz, it is strongly recommended to apply the provisions for insulation coordination as given in IEC 60664-4.

13.2 Creepage distances

Creepage distances shall be selected from Table 13.

Table 13 – Minimum creepage distances for basic insulation

Voltage r.m.s. or d.c. [a] V	Creepage distances in millimetres								
	Printed wiring material		Other materials						
	Pollution degree		Pollution degree						
	1	2	1	2			3		
				Material group			Material group		
	[b]	[c]	[b]	I	II	III	I	II	III
Up to 50	0,025	0,04	0,18	0,6	0,85	1,2	1,5	1,7	1,9
Up to 100	0,1	0,16	0,25	0,71	1,0	1,4	1,8	2,0	2,2
Up to 160	0,25	0,4	0,32	0,8	1,1	1,6	2,0	2,2	2,5
Up to 250	0,56	1,0	0,56	1,25	1,8	2,5	3,2	3,6	4,0
Up to 320	0,75	1,6	0,75	1,6	2,2	3,2	4,0	4,5	5,0
Up to 400	1,0	2,0	1,0	2,0	2,8	4,0	5,0	5,6	6,3
Up to 500	1,3	2,5	1,3	2,5	3,6	5,0	6,3	7,1	8,0
Up to 630	1,8	3,2	1,8	3,2	4,5	6,3	8,0	9,0	10,0

[a] This voltage is the rated voltage or the highest voltage which can occur in the internal circuit when supplied at rated voltage and under the most onerous combination of conditions of operation within the relay rating.

[b] Material groups I, II, IIIa, IIIb.

[c] Material groups I, II, IIIa.

Materials are separated into groups according to their comparative tracking index (CTI) values, as follows:

- material group I 600 ≤ CTI;
- material group II 400 ≤ CTI ≤ 600;
- material group IIIa 175 ≤ CTI ≤ 400;
- material group IIIb 100 ≤ CTI ≤ 175.

The proof tracking index (PTI) is used to verify the tracking characteristics of materials. A material may be included in one of these four groups on the basis that the PTI, verified by the method of IEC 60112 using solution A, is not less than the lower value specified for the group.

13.3 Clearances

The clearance values differ depending on residential or industrial applications. Residential applications shall fulfil the requirements of overvoltage category II, and industrial applications shall fulfil the requirements of overvoltage category III. Clearances shall be selected from Table 14.

Table 14 – Minimum clearances for basic insulation

Voltage line to earth (a.c. r.m.s. or d.c.)		Rated Impulse withstand voltage	Minimum clearances up to 2 000 m above sea level [a]		
Cat II	Cat III		Pollution degree		
			1	2	3
V	V	V	mm	mm	mm
50	---	500	0,04	0,2	0,8
100	50	800	0,1	0,2	0,8
150	100	1 500	0,5		0,8
300	150	2 500	1,5		
600	300	4 000	3,0		
---	600	6 000	5,5		

[a] As the dimensions in this table are valid for altitudes up to and including 2 000 m above sea level, clearances for altitudes above 2 000 m should be multiplied by the altitude correction factor specified in Table A.2 of IEC 60664-1:2007.

When an overvoltage control component is used (e.g. surge suppressor), clearances may be defined in accordance with Table 15.

Table 15 – Minimum clearances in controlled overvoltage conditions for internal circuits

Voltage [a]	Minimum clearances in millimetres		
	Pollution degree		
V	1	2	3
330	0,01	0,20	0,80
400	0,02	0,20	0,80
500	0,04	0,20	0,80
600	0,06	0,20	0,80
800	0,10	0,20	0,80
1 000	0,15	0,20	0,80

[a] This voltage is the clamping voltage of the overvoltage control device.

13.4 Measurement of creepage distances and clearances

The shortest creepage distances between circuit conductors at different voltages and live and exposed conductive parts shall be measured.

The methods of measuring creepage distances and clearances shall be in accordance with IEC 60664-1.

14 Mechanical strength

14.1 General

Parts and connections shall have adequate strength and be reliably fixed. Adjusting elements shall not change their position due to vibrations as in normal use and shall be secured, where required.

Internal connecting lines shall be designed so that they are not damaged by sharp edges and the like.

Relays shall meet the requirements as written above, even after appropriate transport. Unless this can be achieved by constructional measures, protection against mechanical damage shall

be ensured through precautionary measures during transport. In special cases instructions for package and transport shall be attached.

14.2 Mechanical strength of terminals and current-carrying parts

14.2.1 General

Current-carrying parts including the terminals shall be of a metal having strength adequate for their intended use according to the following subclauses.

14.2.2 Mechanical strength of screw terminals and screwless terminals

Screw terminals and screwless terminals shall comply with the requirements and tests of IEC 60999-1. The test current shall be the rated current for the relay (not that of the terminal, which might be higher) as specified by the manufacturer.

14.2.3 Mechanical strength of flat quick-connect terminations

Flat quick-connect terminations shall comply with the requirements and tests of IEC 61210 as regards dimension, temperature rise and mechanical force. Deviating dimensions of a male tab are permitted provided the connection to a standard female connector ensures the insertion and withdrawal forces as specified in IEC 61210.

Male tabs shall have sufficient distance between one another to ensure the required clearances and creepage distances when non-isolated female connectors are mounted; in case these requirements can only be fulfilled with isolated female connectors, this shall be explicitly stated in the manufacturer's documentation.

14.2.4 Mechanical strength of sockets

Sockets shall comply with the requirements and tests of IEC 61984.

However, the corrosion test of IEC 61984 is replaced by a dry heat steady state test in accordance with IEC 60068-2-2 Test Bb at 70 °C for 240 h.

NOTE 1 This ageing test is intended to ensure the mechanical and electrical properties of the combination of relay and socket.

For the measurement of the resistance across relay and socket terminations it is permissible to use a relay dummy (e.g. with short-circuited relay contacts).

The tests shall be made with the sockets specified by the manufacturer and stated in the documentation of the relay.

NOTE 2 Within the scope of this standard the combination only of a relay and mating socket can be assessed.

14.2.5 Mechanical strength of alternative termination types

Other termination types are permitted to the extent that they are not in conflict with this standard and comply with their relevant IEC standard (if any).

15 Heat and fire resistance

Relays shall be constructed so they provide resistance to abnormal heat and fire.

Parts of insulating materials which might be exposed to thermal stresses due to electrical effects, and the deterioration of which might impair the safety of the equipment, shall not be adversely affected by abnormal heat and by fire.

The glow-wire test is carried out to verify that the requirements regarding resistance of solid insulating materials to heat and fire are met. As an alternative, the relay manufacturer may provide test reports for the materials.

Insulation materials shall meet the following requirements, at a minimum, according to IEC 60695-2-11:

- housing: 750 °C;
- supporting current-carrying parts: 850 °C;
- duration of application: 30 s.

The test is considered to be satisfactory if flame or glowing of the tested part is extinguished within 30 s after removal.

16 Vibration and shock

16.1 Vibration

The relay shall be tested with the output in the operated and in the non-operated condition.

During the test in the operated condition, the relay shall be energized preferably at the lower limit of the operative range according to 5.2, that is to say with 80 %, 85 % or 90 % of the rated input voltage.

During the test the contact action should be monitored. Contact openings up to 3 ms are not considered as failures.

The test shall be carried out according to IEC 60068-2-6, under the following conditions (unless otherwise specified by the manufacturer, for example shipbuilder standards, etc.):

- frequency range: 10 Hz to 150 Hz;
- transition frequency: 60 Hz;
- $f <$ 60 Hz constant amplitude of movement $\pm$ 0,15 mm;
- $f >$ 60 Hz constant acceleration 20 m/s^2 (2 g);
- number of sweep cycles per axis: 10;
- sweep speed: 1 octave/min.

The setting of specified time shall not have been changed due to vibration stress; insulators shall show no damage.

At the end of the test a visual inspection and a functional test shall be carried out on the device.

16.2 Shock

A mechanical shock value is to be specified by the manufacturer. The test shall be carried out in accordance with IEC 60068-2-27. At the end of the test a visual inspection and a functional test shall be carried out on the device. Other tests may be specified by the manufacturer, for example shipbuilder standards, etc.

17 Electromagnetic compatibility (EMC)

17.1 General

For products falling within the scope of this standard, two sets of environmental conditions are considered in Table 16 and are referred to as:

a) industrial networks/locations/installations;

b) residential, commercial and light-industrial environments.

Table 16 – Environmental conditions influencing EMC

	High emission	Low emission
Low immunity	Not applicable	Residential (b)
High immunity	Industrial (a)	Industrial and residential

Industrial examples of such equipment are switches in the fixed installation and equipment for industrial use with permanent connection to the fixed installation.

Industrial locations are in addition characterised by the existence of one or more of the following:

- industrial, scientific and medical (ISM) apparatus (as defined in CISPR 11);
- heavy inductive or capacitive loads that are frequently switched;
- high currents levels associated magnetic fields.

Residential examples of such equipment include appliances and similar loads.

17.2 EMC immunity

The EMC requirements have been selected so as to ensure an adequate immunity against electromagnetic disturbances for time relays. Tests shall be carried out in accordance with the basic standards given in Table 17 for industrial environments and Table 18 for residential, commercial and light-industrial environments.

The tests shall be carried out within the operating ranges of temperature, humidity and pressure specified for the time relay and at the rated supply voltage. It is not always possible to test every function and every specified time of a time relay; in such cases the most critical mode of operation shall be selected.

The behaviour of the relay submitted to the immunity tests shall be monitored with suitable measuring equipment during and after the specified time.

Performance criterion A: No disturbance of function is allowed in that the adjusted time function (e.g. operate time delay, release time delay) shall not be changed, nor shall the time function be restarted. This applies during as well as after the specified time. The time deviation during the test shall not exceed 10 % of the value for undisturbed condition. No disturbance of a display (such as flickering of a LED, display illegible) is allowed. No disturbance of the output of the time relay is allowed.

Performance criterion B: No degradation of function is allowed in that the adjusted time function (e.g. operate time delay, release time delay) shall not be changed, nor shall the time function be re-started. This applies during as well as after the specified time. The time deviation during the test shall not exceed 10 % of the value for undisturbed condition. Short disturbances of a display (such as undesired LED illumination, loss of display information) shall not be considered as failures. During the tests, the output state of the switching element shall not change.

Performance criterion C: Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by system reset.

The configuration and mode of operation during the tests shall be precisely noted in the test report. For each test, the manufacturer shall state the respective test level.

Table 17 – Immunity tests for industrial environments

Type of test	Test level required	Performance criteria
Electrostatic discharge IEC 61000-4-2	± 8 kV / air discharge enclosure port and ± 4 kV / contact discharge enclosure port	B
Radiated radio-frequency electromagnetic field, IEC 61000-4-3 80 MHz to 1 GHz 1,4 GHz to 2 GHz 2 GHz to 2,7 GHz	 10 V/m enclosure port 3 V/m enclosure port 1 V/m enclosure port	A
Electrical fast transient/burst IEC 61000-4-4	± 2 kV a.c., d.c. power port ± 1 kV control port using the capacitive coupling clamp [a, b]	B
Surges (1,2/50 μs – 8/20 μs) IEC 61000-4-5	± 2 kV required for > 50 V a.c./d.c. power ports (line to earth)[f] ± 1 kV required for < 50 V control port, a.c./d.c. power ports (line to earth)[f] ± 1 kV required for > 50 V a.c./d.c. power ports (line to line) ± 0,5 kV required for < 50 V a.c./d.c. power ports (line to line)	B
Conducted radio-frequency at 150 kHz to 80 MHz IEC 61000-4-6	10 V [b] control ports, a.c./d.c. power ports	A
Immunity to power-frequency magnetic fields IEC 61000-4-8 [c]	not applicable	A
Voltage dips [e] IEC 61000-4-11	Class 2 [d] 0 % residual voltage during 1 cycle a.c. power ports 70 % residual voltage during 25/30 cycles a.c. power ports	B
Voltage interruptions [e] IEC 61000-4-11	0 % residual voltage during 250/300 cycles a.c. power ports[d]	C

a ± 2 kV direct when control port is connected to the power supply during the test.

b Control ports – applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m.

c Equipment containing devices susceptible to power frequency magnetic fields as declared by the manufacturer, shall be tested with 30 A/m.

d Class 2 applies to points of common coupling and in-plant points of common coupling in the industrial environment in general.

e If the functional interruption times are different from the required test level, this shall be acceptable and noted in the test report.

f Applicable also to control ports interfacing with cables whose total length according to the manufacturer's functional specifications may exceed 30 m.

Table 18 – Immunity tests for residential, commercial and light-industrial environments

Type of test	Test level required	Performance criteria
Electrostatic discharge IEC 61000-4-2	± 8 kV / air discharge enclosure port and ± 4 kV / contact discharge enclosure port	B
Radiated radio-frequency electromagnetic field, IEC 61000-4-3 80 MHz to 1 GHz 1,4 GHz to 2 GHz 2 GHz to 2,7 GHz	 3 V/m enclosure port 3 V/m enclosure port 1 V/m enclosure port	A
Electrical fast transient/burst IEC 61000-4-4	± 1 kV a.c. power port ± 0,5 kV d.c. power port ± 0,5 kV control port using the capacitive coupling clamp[a]	B
Surges (1,2/50 μs – 8/20 μs) IEC 61000-4-5	± 2 kV required for > 50 V a.c./d.c. power ports (line to earth)[d] ± 1 kV required for < 50 V a.c./d.c. power ports (line to earth)[d] ± 1 kV required for > 50 V a.c./d.c. power ports (line to line) ± 0,5 kV required for < 50 V a.c./d.c. power ports (line to line)	B
Conducted radio-frequency at 150 kHz to 80 MHz IEC 61000-4-6	3 V r.m.s control ports[d], a.c./d.c. power ports	A
Immunity to power-frequency magnetic fields IEC 61000-4-8 [b]	not applicable	A
Voltage dips [c] IEC 61000-4-11	0 % residual voltage during 10 cycles a.c. power ports 40 % residual voltage during 10 cycles a.c. power ports 70 % residual voltage during 10 cycles a.c. power ports	C
Voltage interruptions [c] IEC 61000-4-11	0 % residual voltage during 250/300 cycles a.c. power ports	C

[a] ± 1 kV direct when control port is connected to the power supply during the test.

[b] Equipment containing devices susceptible to power frequency magnetic fields as declared by the manufacturer, shall be tested with 3 A/m.

[c] If the functional interruption times are different from the required test level, this shall be acceptable and noted in the test report.

[d] Applicable also to control ports interfacing with cables whose total length according to the manufacturers functional specifications may exceed 3 m.

17.3 EMC radiated and conducted emission

The time relay shall comply with the limits of disturbances corresponding to CISPR 11 or CISPR 22.

Time relays intended for use in industrial installation shall fulfill class A industrial requirements.

Time relays intended for use in residential installation shall fulfill class B residential, commercial and light-industrial environments.

Annex A
(informative)

Ball pressure test

The purpose of the ball pressure test is to assess the ability of materials to withstand mechanical pressure at elevated temperatures without undue deformation.

The test is performed, according to IEC 60695-10-2, in a heating cabinet at a temperature of 20 °C plus the value of the maximum temperature determined during the heating tests, or at

- 75 °C for external parts,
- 125 °C for parts that support active parts,

whichever is the highest.

The surface of the part to be tested is placed in the horizontal position supported on a 3 mm thick steel plate. The thickness of the specimen shall not be less than 2,5 mm; if necessary, two or more layers of the part subjected to the test shall be used.

A steel ball of 5 mm diameter is pressed against the surface of the specimen by a force of 20 N. Care should be taken that the ball does not move during the test.

After 1 h, the ball is removed from the specimen which is then cooled down to approximately room temperature; the diameter of the impression caused by the ball is measured with an accuracy of 0,1 mm and shall not exceed 2 mm. With the exception of the impression caused by the ball, there shall be no other deformations of the specimen in the surrounding area.

NOTE The test is not made on parts of ceramic material.

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