

INTERNATIONAL STANDARD



**Time relays and coupling relays for industrial and residential use –
Part 1: Requirements and tests**

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**Time relays and coupling relays for industrial and residential use –
Part 1: Requirements and tests**

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**TIME RELAYS AND COUPLING RELAYS FOR
INDUSTRIAL AND RESIDENTIAL USE –****Part 1: Requirements and tests**

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61812-1:2011. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 61812-1 has been prepared by IEC technical committee 94: Electrical relays. It is an International Standard.

This third edition cancels and replaces the second edition published in 2011. This edition constitutes a technical revision.

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

- a) update of references;
- b) addition of requirements for risk assessment;
- c) addition of requirements for routine test;
- d) renumbering of clauses to bring them into a more logical order;
- e) clarification of the requirement for shock;
- f) addition of cybersecurity requirements for industrial automation and control systems;
- g) addition of environmentally conscious design requirement;
- h) addition of common data dictionary reference;
- i) addition of terms and definitions of relay types;
- j) addition of coupling relays in title;
- k) addition of coupling relays in scope.

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

FDIS	Report on voting
94/843/FDIS	94/889/RVD

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

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

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

A list of all parts of the IEC 61812 series can be found, under the general title *Time relays and coupling relays for industrial and residential use*, on the IEC website.

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

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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TIME RELAYS AND COUPLING 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.~~

This part of IEC 61812 applies to time relays and coupling relays for industrial applications (for example control, automation, signal and industrial equipment) and 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 document comprises all types of time relays and coupling relays, other than measuring relays.

NOTE 1 Time relays and coupling relays can be used for industrial application (for example control, automation, signal and industrial equipment) and for automatic electrical controls for use in, on, or in association with equipment for residential and similar use.”

NOTE 2 Measuring relays are handled by the IEC TC95.

This document defines type test and routine test to confirm the service condition. Subclause 3.2 provides definitions for different types of time relays in use in the IEC 61812 series.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60050-445:2010, *International Electrotechnical Vocabulary (IEV) – 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 60112:2003/2020, *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 60529:1989/AMD1:1999

IEC 60529:1989/AMD2:2013

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

IEC 60664-1:2007/2020, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3:2003/2016, *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 60695-2-11:2000/2021, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end products (GWEPT)*

IEC 60695-10-2:2003/2014, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60947-5-1:2016, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

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 60947-5-4:2002/AMD1:2019

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

IEC 61000-4-3:2006/2020, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4:2004/2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2005/2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:~~2008~~2013, *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~~2020, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase*

IEC 61000-4-34:2005, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with mains current more than 16 A per phase*
IEC 61000-4-34:2005/AMD1:2009

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

IEC 61810-1:~~2008~~2015, *Electromechanical elementary relays – Part 1: General and safety requirements*
IEC 61810-1:2015/AMD1:2019

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

IEC 62314:~~2006~~2022, *Solid-state relays – Safety requirements*

CISPR 11:~~2009~~2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
~~Amendment 1 (2010)~~

CISPR 11:2015/AMD1:2016

CISPR 11:2015/AMD2:2019

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

ISO 9223:2012, *Corrosion of metals and alloys – Corrosivity of atmospheres – Classification, determination and estimation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-444 and IEC 60050-445 and 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.~~

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 Terms and definitions related to general terms

3.1.1

time relay

specified-time relay

all-or-nothing relay (IEV 444-01-02) with one or more time functions

[SOURCE: IEC 60050-445:2010, 445-01-01, modified – in the definition, the reference to the IEV entry has been added.]

3.1.2

coupling relay

all-or-nothing electrical relay incorporated into a housing or mounted on a socket (for example IEC 60715 mounting rail) with no specified time or logic function for industrial or residential use intended for incorporation into cabinets.

Note 1 to entry: Typically this is a relay according to the IEC 61810 series or IEC 62314 incorporated into a housing or mounted on a socket (for example IEC 60715 mounting rail) for installation in industrial or residential cabinets.

3.1.3

specified time

specified characteristic of the time relay at given type of function, for example operate time, release time, pulse on time, interval time

[SOURCE: IEC 60050-445:2010, 445-05-01, modified – the note has been removed.]

3.1.4

setting accuracy

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

Note 1 to entry: For analogue setting this value relates to the maximum setting value.

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

3.1.5

effect of influence (on specified time)

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

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

3.1.6

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

[SOURCE: IEC 60050-445:2010, 445-05-04, modified – “must be removed” and “must be applied” have been replaced by “is removed” and “is applied”, respectively.]

3.1.7

minimum control impulse time

shortest duration of the power supply or control signal to fulfil the specified function

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

3.1.8 repeatability

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

Note 1 to entry: Preferably the repeatability is indicated as a percentage of the mean value of all measured values.

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

3.1.9 power supply

energizing quantity

electrical quantity (for example electric current, voltage) which has to be applied or removed from the input circuit of the time relay or coupling relay in order to enable it to fulfil its purpose

[SOURCE: IEC 60050-445:2010, 445-03-01, modified – in the definition, “or coupling relay” has been added.]

3.1.10 input voltage

input current

electrical quantity that can be applied to (or removed from) ~~to~~ the power supply, ~~and to~~ the control signal or both

3.1.11 control signal

DEPRECATED: trigger signal

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

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

3.1.12 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

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

3.1.13 on-state voltage drop of a solid-state output circuit

DEPRECATED: voltage drop of a solid-state output circuit

voltage measured across the effectively conducting solid-state output of the time relay or coupling relay, when carrying the given load current

[SOURCE: IEC 60050-445:2010, 445-04-04, modified – in the definition, “or coupling relay” has been added.]

3.1.14 leakage current of a solid-state output

DEPRECATED: off-state current of a solid-state output

electric current which flows through the effectively non-conducting solid-state output of the time relay or coupling relay at a specified voltage

[SOURCE: IEC 60050-445:2010, 445-04-05, modified – in the definition “or coupling relay” has been added.]

3.1.15**power port**

port at which the supply voltage (either AC or DC) is connected to the time relay or coupling relay

[SOURCE: IEC 60050-445:2010, 445-07-01, modified – in the definition “or coupling relay” has been added.]

3.1.16**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 1 to entry: There are control ports for floating (potential-free) and non-floating control.

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

3.1.17**output port**

port at which a load is connected to the time relay or coupling relay

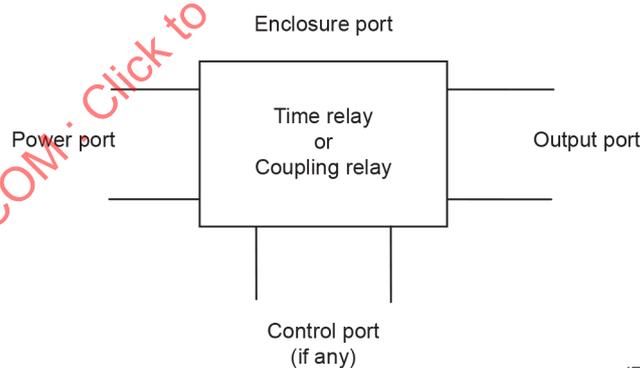
Note 1 to entry: The output port could consist of electromechanical contacts or be a solid-state output.

[SOURCE: IEC 60050-445:2010, 445-07-03, modified – in the definition “or coupling relay” has been added.]

3.1.18**enclosure port**

physical boundary of the time relay or coupling relay through which electromagnetic fields can radiate or impinge

Note 1 to entry: See Figure 1.



IEC

Figure 1 – Definition of ports

[SOURCE: IEC 60050-445:2010, 445-07-04, modified – in the definition “or coupling relay” and the note and reference to Figure 1 have been added.]

3.1.19**type test**

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

[SOURCE: IEC 61810-1:2015, 3.1.7]

**3.1.20
routine test**

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

[SOURCE: IEC 61810-1:2015, 3.1.8]

**3.1.21
sampling test**

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

[SOURCE: IEC 61810-1:2015, 3.1.9]

**3.1.22
operative range**

range of values of power supply for which the time relay or coupling relay is able to perform its specified function

[SOURCE: IEC 61810-1:2015, 3.4.5, modified – in the definition, “coil voltage” has been replaced with “power supply”, and “relay” has been replaced with “time relay or coupling relay”.]

**3.1.23
rated input voltage range**

range of input voltages used for specification purposes, established for a specified set of operating conditions

**3.1.24
functional insulation**

insulation between conductive parts which is necessary only for the proper functioning of the equipment

[SOURCE: IEC 60050-195:2021, 195-02-41, modified – “necessary” has been replaced with “which is necessary only”.]

**3.1.25
basic insulation**

insulation of hazardous-live-parts which provides basic protection

Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 60050-195:2021, 195-06-06, modified – in the definition, “of hazardous live-parts” has been added.]

**3.1.26
supplementary insulation**

independent insulation applied in addition to basic insulation for fault protection

[SOURCE: IEC 60050-195:2021, 195-06-07]

**3.1.27
double insulation**

insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-195:2021, 195-06-08]

**3.1.28
reinforced insulation**

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

Note 1 to entry: Reinforced insulation may comprise several layers which cannot be tested singly as basic insulation or supplementary insulation.

[SOURCE: IEC 60050-195:2021, 195-06-09, modified – in the definition “of hazardous-live parts” has been added.]

3.1.29 live part

conductive part intended to be energized under normal operating conditions, including the neutral conductor and mid-point conductor, but excluding the PEN conductor, PEM conductor and PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

[SOURCE: IEC 60050-195:2021, 195-02-19, modified – the note has been added.]

3.1.30 rated operating voltage

nominal voltage of the power supply intended to be used

3.1.31 rated operating current

nominal current of the power supply intended to be used

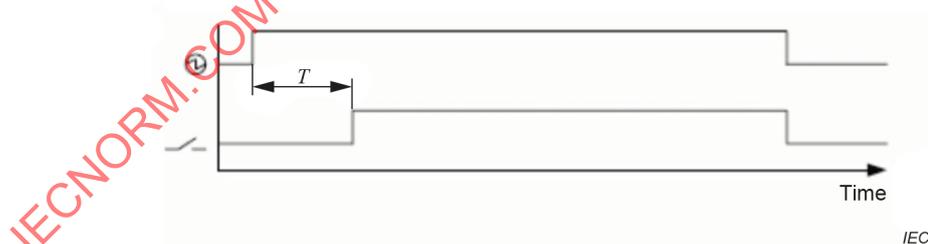
3.1.32 power consumption

electric energy a relay uses in or for operation, given in VA for AC and W for DC coils, and including other electric circuits

3.2 Terms and definitions of time relay types

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)



Key

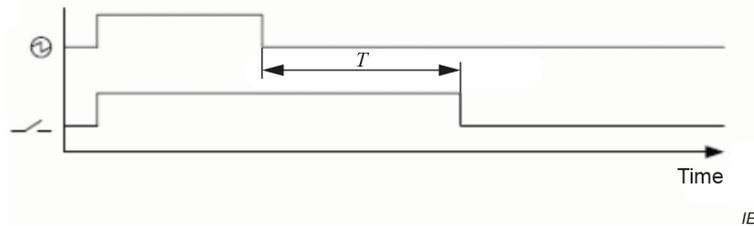
-  Power supply
- T Setting time
-  Make contact

Figure 2 – Power ON-delay relay

[SOURCE: 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 3)



Key

- Ⓢ Power supply
- T Setting time
- Ⓜ Make contact

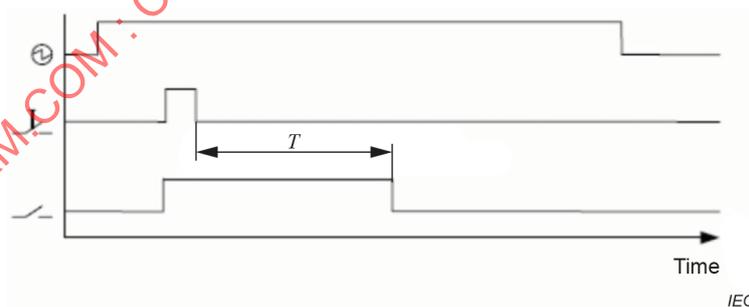
Figure 3 – Power OFF-delay relay

[SOURCE: 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 4)

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



Key

- Ⓢ Power supply
- Ⓜ Control signal
- T Setting time
- Ⓜ Make contact

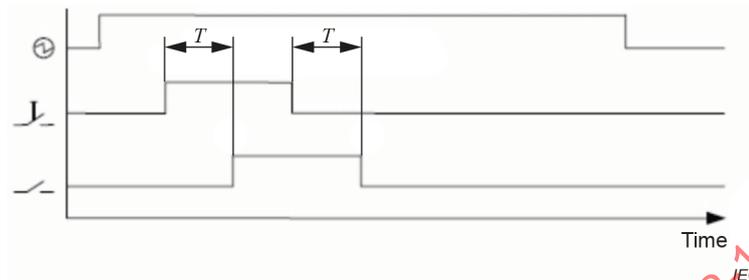
Figure 4 – OFF-delay relay with control signal

[SOURCE: IEC 60050-445:2010, 445-01-04, modified – the note has been deleted.]

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 5)

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

**Key**

Ⓢ Power supply

Ⓜ Control signal

T Setting time

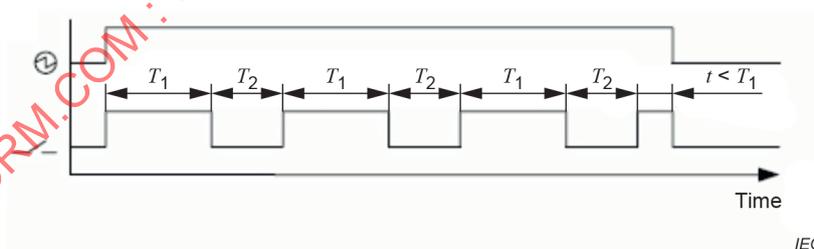
Ⓜ Make contact

Figure 5 – ON- and OFF-delay relay with control signal

[SOURCE: IEC 60050-445:2010, 445-01-05, modified – the note has been deleted.]

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 6)

**Key**

Ⓢ Power supply

T_1 Pulse on time

T_2 Pulse off time

Ⓜ Make contact

Figure 6 – Flasher relay

Note 1 to entry: Depending on the relay type, the output starts with "pulse on" or "pulse off".

Note 2 to entry: Flasher relay **may** can also be initiated with a control signal.

[SOURCE: 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

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

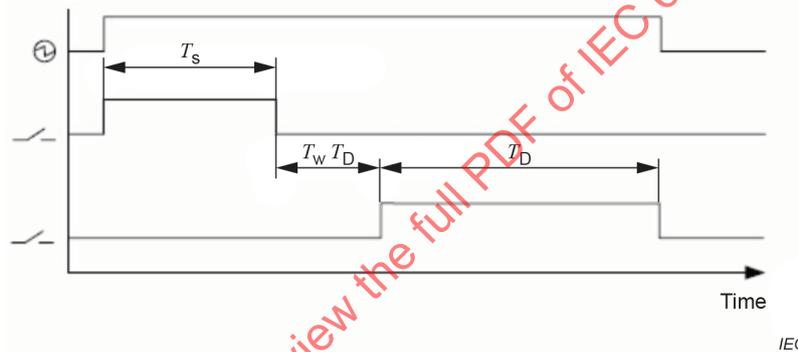
3.2.7
asymmetrical flasher relay
asymmetrical repeat cycle relay

flasher relay in which the pulse on time and pulse off time are selectable separately

[SOURCE: 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 7)



Key

-  Power supply
- T_s Star setting time
- $T_w T_D$ Delta transfer time
-  Make contact

Figure 7 – Star-delta relay

Note 1 to entry: The star and delta connections are defined in IEC 60034-1:2011, 141-02-06 and IEC 60034-1:2011, 141-02-09 respectively.

Note 2 to entry: T_s is the time during which motor starts and runs in the “star” connection.

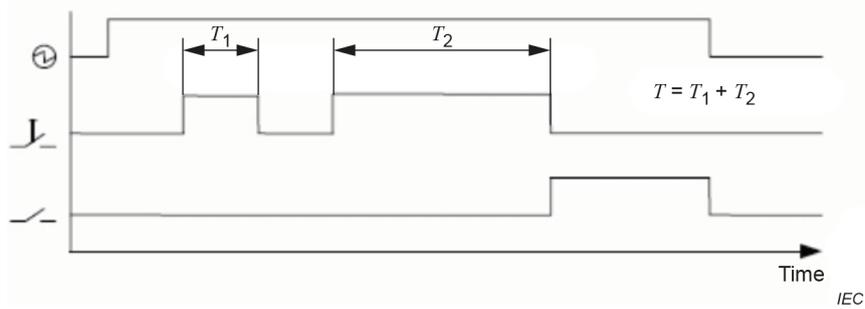
Note 3 to entry: T_w is the dwelling time after disconnecting the motor in the star and reconnecting in the delta.

Note 4 to entry: T_D is the time during which the motor runs in the “delta” connection.

[SOURCE: IEC 60050-445:2010, 445-01-09, modified – Note 2, Note 3 and Note 4 have been added.]

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 8)

**Key**

- ⊕ Power supply
- J Control signal
- T Setting time
- ⌞ Make contact

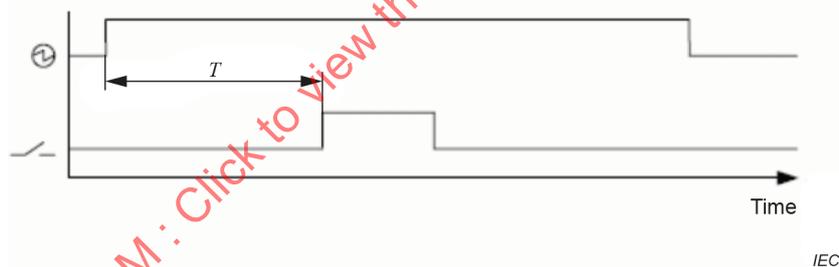
Figure 8 – Summation time relay

[SOURCE: 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 9)

~~NOTE—Manufacturer should specify if interval is fixed or variable.~~

**Key**

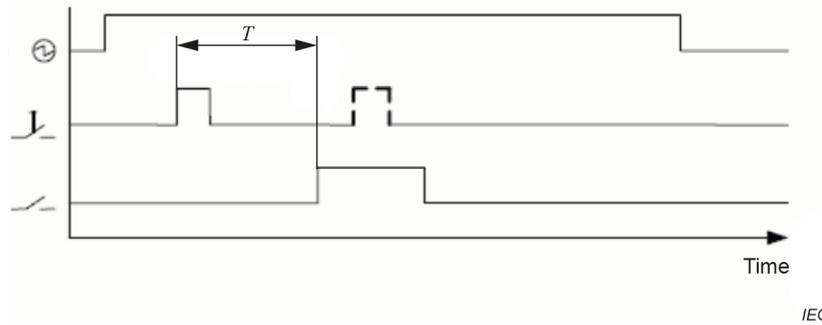
- ⊕ Power supply
- T Setting time
- ⌞ Make contact

Figure 9 – Pulse delayed relay

[SOURCE: 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 10)



Key

- ⊕ Power supply
- J Control signal
- T Setting time
- ⌞ Make contact

Figure 10 – Pulse delayed relay with control signal

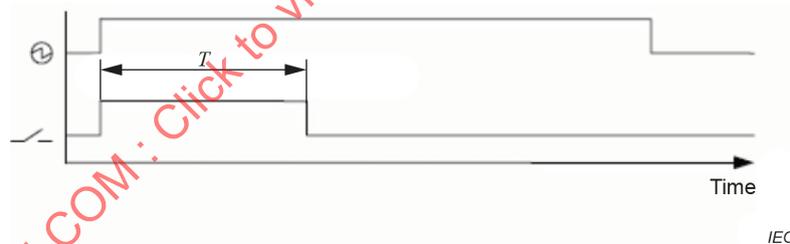
Note 1 to entry: Cycling the control signal during the time delay will not retrigger the time delay.

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

[SOURCE: 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 11)



Key

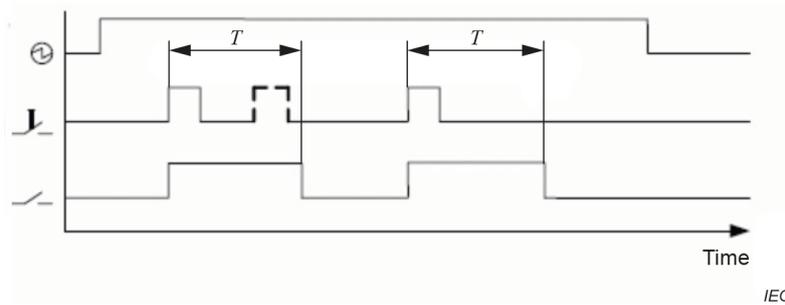
- ⊕ Power supply
- T Setting time
- ⌞ Make contact

Figure 11 – Interval relay

[SOURCE: 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 12)

**Key**

- Ⓢ Power supply
- Ⓜ Control signal
- T Setting time
- Ⓚ Make contact

Figure 12 – Interval relay with control signal

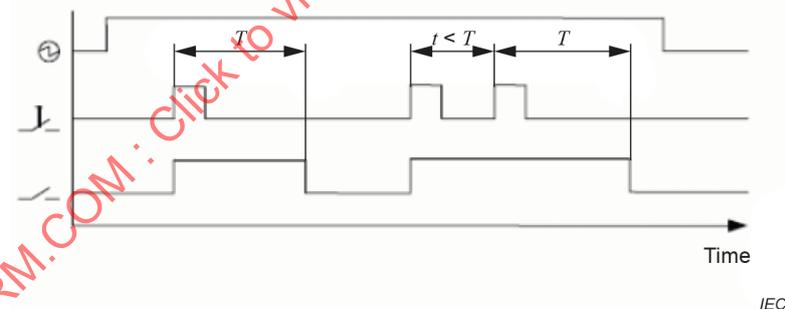
Note 1 to entry: Cycling the control signal during the time delay will not retrigger the time delay.

[SOURCE: 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 13)

**Key**

- Ⓢ Power supply
- Ⓜ Control signal
- T Setting time
- Ⓚ Make contact

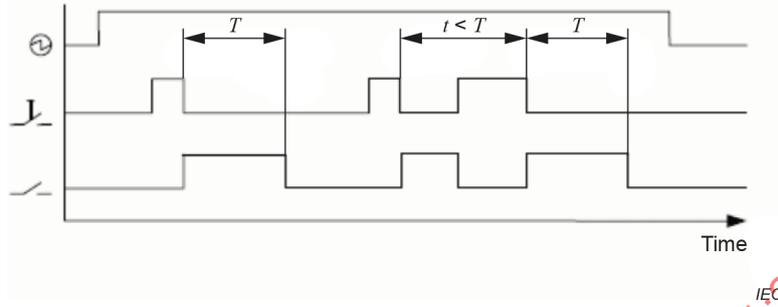
Figure 13 – Retriggerable interval relay with control signal ON

Note 1 to entry: Cycling the control signal during the time delay will retrigger the time delay.

[SOURCE: 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 14)



Key

- Ⓢ Power supply
- Ⓜ Control signal
- T Setting time
- Ⓚ Make contact

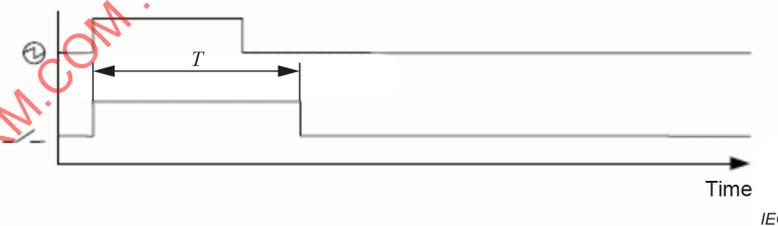
Figure 14 – Retriggerable interval relay with control signal OFF

Note 1 to entry: Cycling the control signal during the time delay will retrigger the time delay.

[SOURCE: 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~~ until the time interval has elapsed, even with the removal of the power supply (see Figure 15)



Key

- Ⓢ Power supply
- T Setting time
- Ⓚ Make contact

Figure 15 – Maintained time relay

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

4 Classification

4.1 Switching element

Time relays and coupling relays may be classified according to the switching element, for example electromechanical output circuit or solid-state output circuit.

4.2 Mechanical construction

Time relays and coupling relays may be classified according to the mechanical construction, for example monobloc (non modular) relay or plug-in (modular) relay.

4.3 Device mounting

Time relays and coupling relays may be classified according to the mounting capabilities, for example IEC 60715 mounting rail or panel mounting.

4.4 Connection

Time relays and coupling relays may be classified according to the connection facilities, for example screw type or spring type.

4.5 Environment

Time relays and coupling relays in the scope of 18.1 shall be classified according to the application environment. They can be subjected to the impulse withstand test in 11.3.2, clearance in Clause 14 or EMC in Clause 18 and Annex C, as the requirement levels are different according to each environment, industrial or residential, commercial and light industrial.

5 Influence quantities

The specified performance of the time relay or coupling relay shall be given with respect to the reference conditions, for example 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 unless otherwise specified.

Table 1 – Influence quantities and reference values

Influence quantities	Reference values for tests	Tolerances during tests
Ambient temperature	23 °C	± 5 °C 18 °C to 28 °C
Air pressure	96 kPa	± 10 kPa 86 kPa to 106 kPa
Relative humidity	50 %	± 25 % 25 % to 75 %
Position Mounting direction	As indicated by the manufacturer As specified	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 As specified	±1 %
Waveform	Sinusoidal	Maximum distortion factor 5 % ^b
Direct component in AC	As indicated by input voltage	Maximum 2 % of peak value
Alternating component in DC (ripple)	As indicated by input voltage	Maximum 6 % ^c

Influence quantities	Reference values for tests	Tolerances during tests
Shock and vibration	As indicated by the manufacturer As specified	Maximum 1 m/s ²
Industrial and other atmospheres	Clean air	Clean air (pollution moderate, not exceeding class 3C2 of IEC 60721-3-3 category C3 of ISO 9223)
<p>^a In so far as they are regarded as influencing quantities in the case of time errors tolerance of ±1 %.</p> <p>^b Distortion factor: ratio of the harmonic content obtained by subtracting the fundamental wave from a non-sinusoidal harmonic quantity and the RMS value of the non-sinusoidal quantity. It is usually expressed as a percentage.</p> <p>^c For calculating the ripple content of d.c. (expressed as a percentage) the following formula applies:</p> $\frac{\text{maximum instantaneous value} - \text{minimum instantaneous value}}{\text{d. c. value}} \times 100$ <p>The alternating component (ripple content) of a DC supply, expressed as a percentage, is defined as follows:</p> $\frac{\text{maximum value} - \text{mimimum value}}{\text{DC component}} \times 100$		

6 Rated values

6.1 General

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

6.2 Input voltage and frequency

- The recommended AC rated input voltage RMS is to be specified according to one of the following values:
12 V; 20 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.
- The recommended DC rated input voltage is to be specified according to one of the following values:
5 V; 6 V; 12 V; 20 V; 24 V; 48 V; 60 V; 100 V; 110 V; 125 V; 220 V; 240 V; 250 V; 360 V.
- Rated frequency, recommended values: 50 Hz, 60 Hz, 400 Hz.
- 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~~.
- The recommended ~~operating~~ operative range is to be specified ~~according to~~ as one of the following values:
 - 80 % to 110 % or
 - 85 % to 110 % or
 - 90 % to 110 % of rated input voltage or rated input voltage range (where applicable).

The above values apply over the full ambient temperature range ~~as declared by the manufacturer~~, see 6.6.

~~Where the manufacturer deviates~~ In case of a deviation from the recommended range, both the rated input voltage (or range) and the corresponding operative range shall be specified.

6.3 Release voltage

The release voltage shall not be less than 10 % of the minimum rated input voltage that is specified in 6.2.

~~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~~, see 6.6.

6.4 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.~~

The maximum power consumption of the time relay or coupling relay shall be given in VA or in W at rated input voltage or rated input voltage range (where applicable). In case of time relays or coupling relays with several input circuits, the respective maximum power consumption shall be given.

NOTE 1 For time relays or coupling relays with an input which varies depending on the position of the moved parts or for any other reason, the higher value is given.

NOTE 2 In the case of alternating current the power factor is optional.

NOTE 3 The power consumption value in W is useful for calculation of total power dissipation in cabinet.

NOTE 4 Maximum power consumption is determined using the worst steady-state case and influence quantities of the time relay or coupling relay.

6.5 Output circuit

6.5.1 General

Output load ratings shall be specified ~~by the manufacturer~~.

6.5.2 Electromechanical output circuit

6.5.2.1 General

a) Resistive loads, inductive loads, and special loads (for example lamp loads, cable loads) shall be specified in accordance with IEC 61810-1:2015, 5.7, Annex B and Annex D ~~of IEC 61810-1:2008~~ or IEC 60947-5-1:2016, Table 4 and Table 5.

~~The manufacturer shall state~~ The following shall be stated:

- 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) shall be stated. 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~~ such as 5 V/10 mA or 10 V/5 mA), meaning that with 5 V the current shall be at least 10 mA, or with 5 mA the voltage shall be at least 10 V.

6.5.2.2 Mechanical endurance

The 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.~~

As an alternative, the mechanical endurance test in accordance with IEC 61810-1:2015, Clause 12, shall be applied.

The following shall be stated:

- number of cycles for mechanical endurance;
- frequency of operation.

6.5.3 Solid state output circuit

Load categories shall be specified in accordance with IEC 62314:2006/2022, 5.2, as applicable.

~~The manufacturer shall state the maximum value of~~ The following values shall be specified:

- the maximum value of voltage drop at rated load current;
- the maximum value of leakage current at maximum specified ambient temperature and at rated (or maximum) switching voltage.

6.5.4 Endurance and operating frequency

The preferred values of the endurance and operating frequency are given in Table 2 and the load is given in 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 the maximum load conditions specified in 6.5.2 (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.

6.5.5 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.~~

The rated conditional short-circuit current of the time relay or coupling relay is the value of the prospective current, see 13.3 and 13.4. The equipment, protected by a short-circuit protective device specified by the manufacturer, can withstand satisfactorily for the operating time of this device under the test conditions specified.

NOTE For AC, the rated conditional short-circuit current is expressed by the RMS value of the AC component.

6.6 Ambient temperature

~~Unless otherwise stated, the preferred ambient temperature range is -10 °C to $+40\text{ °C}$ for the operation of relays.~~

The ambient temperature range shall be 0 °C to $+40\text{ °C}$ for the operation of time relays or coupling relays. Other ambient temperature ranges may be specified.

6.7 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.

The following values shall be specified:

- temperature range for storage: -25 °C to $+55\text{ °C}$;
- temperature range for transport: -40 °C to $+70\text{ °C}$.

6.8 Humidity

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

6.9 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.~~

Unless otherwise stated, the time relay or coupling relay is used in pollution degree 3 for industrial environment and used in pollution degree 2 for residential, commercial and light-industrial environment in accordance with IEC 60664-1. However, other pollution degrees can be considered to apply, depending upon the micro-environment. The pollution degree of the micro-environment of the time relay or coupling relay is influenced by installation in an enclosure. For example time relay or coupling relay mounting in the enclosure with IP54, time relay or coupling relay can at least meet pollution degree 2 design.

NOTE 1 The pollution degree of the micro-environment of the time relay or coupling relay ~~may~~ can 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 time relay or coupling relay ~~may~~ can be different from the micro-environment of the relay.

6.10 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.~~

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 or the altitude correction factors for clearances according to IEC 60664-1.

6.11 Timing circuit function

6.11.1 General

Subclause 6.11 does not apply to coupling relays. 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	0,1	0,5	0,6	1	1,2	3	5	6	10	12	18	20	24	30	50	60	72	100	300	500	600
Minutes	0,1	0,5	0,6	1	1,2	3	5	6	10	12	18	20	24	30	50	60	72	100	300	500	600
Hours	0,1	0,5	0,6	1	1,2	3	5	6	10	12	18	20	24	30	50	60	72	100	300	500	600

For digital time relays, ~~final values of the setting range are additionally recommended consisting of the digit 9~~ the values of the setting range ending with digit 9 are additionally recommended (for example 999 min).

6.11.2 Setting accuracy

The setting accuracy will be given:

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

6.11.3 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, for example 0,01 % or 10 ms.

6.11.4 Recovery time and minimum control impulse

To be stated by the manufacturer.

7 Provisions for testing

7.1 General

Hazards considered in this document are hazards from heating, electrical shock, ignition, EMC and foreseeable misuse before the end of life. Hazards shall not exceed a tolerable level. For the device, compliance with the tests specified in Table 5 are considered to represent a tolerable level. For the application of the time relay or coupling relay, a risk assessment shall be carried out according to Annex B.

The risk evaluation for the device and for the application follows the same assessment rules. For the device itself, the risk evaluation could be shown via this document. However, for the application this is done once more to determine the interaction of the single devices and the foreseeable misuse, for example when various time relays can be used in combination with a single socket.

7.2 Type test

In Clause 8 to Clause 18, 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.~~

The type tests specified are listed in Table 5.

If a specimen does not pass a test, this test shall be repeated once with an additional specimen of the same design. Additional specimens shall pass the test. In case ~~the manufacturer modifies the relays~~ of a modification of the time relay or coupling relay, all tests technically influenced by this modification shall also be repeated.

Unless otherwise stated in this document, 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 or subclause	Minimum number of test specimens	Inspection lot	Additional references
Basic operating function	10	3	1	
Marking and documentation Documentation and marking	8	1	1	
Heating	9	1	1	IEC 60085
Clearances and creepage distances	14	1	1	IEC 60664-1
Vibration and shock	17.1	1	1	
Shock	17.2	1	1	
Insulation	40	4	2	
Dielectric strength and impulse withstand	11	1	2	
Electrical endurance	12	1 ^a	3	
Conditional short-circuit current	13	1	4	
Mechanical strength	15	1	5	
Heat and fire resistance	16	1	6	IEC 60695-2-11
EMC	18	1	7	
^a See 12.1.				

7.3 Routine test

Routine tests (see Table 6) are intended to detect faults in materials and workmanship and to ascertain proper functioning of the equipment. They shall be made on each individual piece of equipment.

Routine tests shall comprise:

- a) functional test;
- b) dielectric strength test.

Table 6 – Routine testing

Inspection lot	Tests	Subclause	Additional references
All	Functional test – operation	10.2	Only for coupling relay
All	Functional test – time function	10.4.2.2 10.4.2.3	Only for time relay ^a
All	Dielectric strength test	11.3.3	^b
NOTE The test can be performed at room temperature with no contacts load.			
^a For time function testing, the rated input voltage or the upper limit of the rated input voltage range specified in 6.2 shall be applied. The lower limit of the time range shall be verified. In case of fixed values, the lowest value shall be tested. If this value is longer than 1 min, the time function testing may be replaced by a sampling test. The test may be performed with unloaded output circuits.			
^b The dielectric strength test is performed according to 11.3.3 except for the following: <ul style="list-style-type: none"> • the duration of the dielectric strength test is reduced to 1 s; • the test specified in 11.3.1.a) may be omitted. 			

7.4 Sampling test

The routine test can be applied to the sampling test with at least 1 for the number of test specimens and 1 for the number of inspection lots.

8 Documentation and marking

8.1 Data

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

NOTE Product description and related properties of time relays can be found in the ACC536 class of IEC 62683 domain of IEC CDD (<https://cdd.iec.ch>).

Table 7 – Required time relay or coupling relay information

N°	Information	Notes	Place of indication
1 Identification data			
1a	Manufacturer's name, identification code or trademark		Time relay or coupling relay
1b	Type designation	It shall be unambiguous and ensure identification of the product by respective according to the corresponding documentation	Time relay or coupling relay
1c	Date of manufacture	May be coded if specified in the documentation	Time relay or coupling relay (preferred) or package
2 Input data			
2a	Range of rated input voltage(s) with symbol for DC or AC voltages		Time relay or coupling relay
2b	Frequency for AC		Time relay or coupling relay (preferred) or catalogue or instruction sheet
2c	Rated Maximum 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 load definition according to 12.2, 12.3 or both as applicable	Time relay or coupling 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 of an electromechanical output circuit	If applicable	Catalogue or instruction sheet
3e	Electromechanical contact material(s)	If applicable	Catalogue or instruction sheet
3f	Low energy reliability – characteristics of the test results	If applicable	Manufacturer documentation
3f	Low energy loads	If applicable, voltage, current, operating cycles	Catalogue or instruction sheet
3g	On-state voltage drop of a solid-state output circuit	If applicable	Catalogue or instruction sheet
3h	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 a) and b) of 14.2.1	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

N°	Information	Notes	Place of indication
5 General data			
5a	Ambient temperature range		Catalogue or instruction sheet
5b	Relative humidity range		Catalogue or instruction sheet
5c	Mounting position direction	If applicable	Catalogue or instruction sheet
5d	Data to permit suitable connection of the time relay or coupling relay	Including polarity	Catalogue or instruction sheet
5e	Identification of connections and circuits		Time relay or coupling relay
5f	Accessories	If essential to the time relay or coupling relay installation or to its performance	Catalogue or instruction sheet
5g	Indications for earthing or grounding of metal parts	If applicable	Time relay or coupling relay
5h	Mounting distance	If applicable	Catalogue or instruction sheet
5i	EMC immunity test levels	If Clause 18, electromagnetic compatibility (EMC) applies	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 time relay and mating socket or coupling relay	Manufacturer documentation
5l	Prospective current value (if less than 1 000 A)	For conditional short-circuit current test	Catalogue or instruction sheet
5m	Type and rating of short-circuit protective device (SCPD)	For conditional short-circuit current test	Catalogue or instruction sheet
5n	Minimum and maximum size of conductor to be clamped		Catalogue or instruction sheet
5o	Length of insulation to be removed before insertion of the conductor into the terminal		Catalogue or instruction sheet
5p	Maximum number of conductors which may be clamped		Catalogue or instruction sheet
5q	Type of conductors for non-universal screwless terminals:	<ul style="list-style-type: none"> – "s", "sol" or "solid" for terminals declared for solid conductors; – "str" or "stranded" for terminals declared for stranded conductors; – "r" or "solid or stranded" for terminals declared for solid and stranded conductors; – "f" or "flexible" for terminals declared for flexible conductors. 	Catalogue or instruction sheet
5r	Torque range for screw terminals	If applicable	Catalogue or instruction sheet
6 Time function data for time relay			

N°	Information	Notes	Place of indication
6a	Specified time (nominal range of time)	Item 6a does not apply to coupling relays	Time relay (preferred) or catalogue or instruction sheet
6b	Type of function of the time relay	According to 3.2	Catalogue or instruction sheet
6c	Recovery time		Catalogue or instruction sheet
6d	Minimum control impulse time		Catalogue or instruction sheet
6e	Setting accuracy	According to Annex A	Catalogue or instruction sheet
6f	Repeatability	According to Annex A	Catalogue or instruction sheet
6g	Effect of influence	Voltage, temperature recommended According to Annex A	Catalogue or instruction sheet or manufacturer documentation
6h	Effects of subsequent operating or resetting of the control signal	According to 3.2.3 and 3.2.4	Catalogue or instruction sheet
6i	Interval time	According to 3.2.10 and 3.2.11	Catalogue or instruction sheet

NOTE Different type of insulation can be applied between circuits of a time relay, for example, between input and output circuit, between two contacts, contact gap and accessible surface.

8.2 Marking

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

The data of 1a, 1b, 2a, 3a, 5e, 5g and 6a of Table 7 shall be marked on the time relay so that they are legible and durable.

The data of 1a, 1b, 2a, 3a, 5e and 5g of Table 7 shall be marked on the coupling relay so that they are legible and durable.

The test indicated below is carried out when only additional material(s) is(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:

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

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.

9 Heating

9.1 General

Time relays or coupling relays shall be constructed so they do not attain excessive temperatures in normal use. The time relay or coupling relay manufacturer shall select the thermal

classification of materials in accordance with Table 8 and indicate this classification for the respective tests.

Table 8 – Thermal classification

Thermal classification (coil insulation system)	Maximum temperature
Y	90 °C
A	105 °C
E	120 °C
B	130 °C
F	155 °C
H	180 °C
200(N)	200 °C
220(R)	220 °C
250(C)	250 °C

Table 8 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.

NOTE The thermal classification is in accordance with IEC 60085.

9.2 Test conditions

The time relay or coupling relay is operated in an appropriate heating chamber until ~~temperature~~ thermal equilibrium is attained with the following conditions:

- The ambient temperature shall be equal to the upper limit of the ~~operating~~ ambient temperature range.
- The output circuit is loaded with the resistive limiting ~~continuous~~ rated operating 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.
- The input circuit is supplied by the maximum rated voltage.
- The operating mode is set to the maximum power loss which occurs during operation as in normal use.
- Temperature of the different parts shall be measured at those points most likely to attain the maximum temperature; these points shall be stated in the test report. The temperature sensing means shall not significantly affect the temperature rise.

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 is carried out with one time relay or coupling relay. In case it is specified that the time relay or coupling relay is suitable for mounting in rows, the test is carried out with three time relays or coupling relays mounted side by side in the same direction, with a mounting distance as specified according to IEC 61810-1:2015, Annex E.

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 9.5 or other suitable test methods.

9.3 Heating of terminals

9.3.1 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.~~ The measuring points of fine wire thermocouples are positioned on the terminals as close as possible to the body of the time relay or coupling relay to avoid negligible effect on the temperature. 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. Areas and lengths of conductors for the terminal are according to Table 9.

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

9.3.2 Heating 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.

The electrical connections of the time relay or coupling relay to the voltage or current source(s) are realized with ~~flexible~~ conductors according to Table 9 within the specified torque range.

The maximum permissible steady-state temperature of the terminals as indicated shall not be exceeded in thermal equilibrium.

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

Table 9 – Cross-sectional 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.~~

9.3.3 Heating of quick-connect terminations

The electrical connections of the time relay or coupling 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 9.

NOTE 4 It is ~~recommended~~ common practice 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 time relay or coupling relay without significant influence from either the female connector or the quality of the crimping.

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

The temperature rise at the flat quick-connect terminations in thermal equilibrium shall not exceed 45 K. This ~~may~~ can be verified without the temperature rise influence of the time relay or coupling relay contacts and the coil (for example bridged or short-circuited or soldered relay contacts).

NOTE 2—The ~~following~~ nominal dimensions of quick-connect terminations according to Table 10 are recommended.

Table 10 – Maximum steady state current dependent on the connector size

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

9.3.4 Heating of sockets

The maximum steady-state temperature limits permissible for the connections between the time relay or coupling relay and socket, as well as for the insulating materials (see 9.2) of both the time relay or coupling relay and socket, adjacent to the connection in thermal equilibrium shall not ~~be exceeded~~ exceed 45 K.

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

The electrical connection between the time relay and socket, or coupling relay, shall be properly checked in order to exclude any type of overheating which could lead, overtime, to a degradation of the connection itself.

The electrical interconnections between the sockets are made with conductors according to Table 9. The electrical connections of the time relay or coupling relay to the voltage or current source(s) are realized with ~~flexible~~ conductors according to Table 9.

9.3.5 Heating of alternative termination types

Time relay or coupling relay to the voltage or current source(s) are connected with conductors according to Table 9.

The maximum permissible steady-state temperature of the terminals as specified shall not be exceeded in thermal equilibrium.

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

9.4 Heating of accessible parts

The temperature rise of accessible parts in thermal equilibrium shall not exceed the values stated in Table 11.

Table 11 – 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.~~

~~Now 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.~~

9.5 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. As an alternative, the time relay or coupling relay manufacturer may provide test reports for the materials.

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 supporting live parts,

whichever is the highest.

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.

10 Basic operating function

10.1 General

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

10.2 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.~~

The time relay or coupling relay shall be preconditioned by the following conditions for this test until thermal equilibrium is reached:

- a) at the maximum permissible ambient temperature specified;
- b) shall be applied with the rated input voltage as indicated, or the upper limit of the rated input voltage range specified in 6.2;
- c) the contacts (contact set) are loaded with the maximum rated operating current(s) specified.

Immediately after removal of the input voltage and related arrival at the release condition, the time relay or coupling relay shall operate again when energized at the lower limit of the operative range.

10.3 Release

~~The relays~~ time relay or coupling relay 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.~~ After establishing the operate condition with a brief energizing coil of the operate voltage, the input voltage shall be immediately reduced to the relevant value specified in 6.3.

When this occurs, the time relay or coupling relay shall release.

10.4 Time function

10.4.1 General

Subclause 10.4 does not apply to coupling relays.

10.4.2 Functional test at reference values of input quantities

10.4.2.1 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. For the time relay with multiple setting range functions, the shorter time setting range may be used.

For calculation of the setting accuracy, repeatability and influence effect of voltage and temperature, see Annex A.

10.4.2.2 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 according to 6.11.2 ~~by the manufacturer.~~

10.4.2.3 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.~~

The difference between at least five consecutive measured values shall be within the repeatability indicated according to 6.11.3.

10.4.3 ~~Influencing effects~~ Effect of influence of voltage and temperature

The effect of the influence of the input voltage and temperature on the specified time(s) is checked; for this purpose, only one quantity as given in Table 12 will be changed whereas the other quantity has the nominal value.

The number of successive measurements shall be 10 minimum. For the time relay with multiple setting range functions, the shorter time setting range may be used.

To check the influence of the temperature, time relays are operated in an appropriate chamber until thermal equilibrium is attained at the ambient temperature as given in Table 12. 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 time relay accomplishes its function properly within the specified tolerance values ~~as indicated by the manufacturer~~.

Table 12 – Changing of influencing quantities

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

11 ~~Insulation~~ Dielectric strength and impulse withstand

11.1 General

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

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

The rules for dimensioning basic, double and reinforced insulation as stated in ~~IEC 60664 series~~ IEC 60664-1 and IEC 60664-3 apply, based on overvoltage category, pollution degree and rated voltage stated by the manufacturer according to the requirements of this document.

The rules for dimensioning functional insulation as stated in IEC 60664-1 apply, based on overvoltage category, pollution degree and rated voltage stated by the manufacturer according to the requirements of this document.

The insulation of circuits within the time relay or coupling relay shall be tested in accordance with the maximum ~~reference~~ rated insulation voltage and overvoltage category of the time relay or coupling relay.

11.2 Preconditioning

The tests of 11.3 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 °C 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~~ 90 to 96) % RH. The air temperature shall be maintained at (~~40 ± 2~~ 38 to 42) °C with an accuracy of ± 2 K in the area where the specimens are mounted. The specimens are kept in the chamber for 4 days. There shall be no condensation.

11.3 Dielectric strength Insulation test

11.3.1 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.~~

The time relay or coupling relay shall withstand the impulse withstand test and dielectric test as specified in Table 13 and Table 14 or Table 15 in order to meet the requirements of the clearances and creepage distances in Clause 14.

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 time relays or coupling 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 criteria shall be ~~considered satisfactory~~ acceptable if neither a breakdown nor a flashover occurs. The influence of the time relay or coupling relay under test, if any, is ignored.

11.3.2 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.~~

The 1,2/50 µs impulse voltage shall be applied as defined in IEC 61180. The output is then connected to the equipment to be tested and the impulse applied three times for each polarity at intervals of 1 s minimum. The influence of the equipment under test on the waveshape, if any, is ignored.

Therefore the measurement of the test voltage and determination of the impulse shape according to IEC 61180:2016, 7.1.4, and the verification of the waveshape according to IEC 61180:2016, 7.2.1, may be omitted; in such case the waveshape has to be monitored by oscillographic means in order to detect the disruptive discharges.

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 IEC 60664-1:2020, 6.2.2.1.4, applies.

Unearthed voltage systems have to be treated as corner-earthed systems.

Table 13 – Impulse test for basic insulation

Voltage line to earth AC RMS or DC	Residential Overvoltage category II		Industrial Overvoltage category III	
	Rated impulse withstand voltage	Impulse withstand test voltage at sea level	Rated impulse withstand voltage	Impulse withstand test voltage at sea level
V	V	V	V	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.~~

11.3.3 Dielectric AC 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 for basic insulation shall be raised uniformly from 0 V to the value specified in Table 14 or Table 15, within not more than 5 s and held at that value for at least 60 s. The test criteria shall be ~~considered satisfactory~~ acceptable if neither a breakdown nor a flashover occurs and the function remains unchanged. A current of not more than 3 mA is permitted.

The test voltage values for double insulation or reinforced insulation should be twice those for basic insulation (see IEC 60664-1:2020, 5.4.3 and 6.4.5.1).

If an alternating test voltage cannot be applied, for example due to EMC filter components, a DC test voltage may be used having the value of Table 14, third column. The ~~uncertainty of~~ measurement accuracy of the test voltage shall not exceed ± 3 %.

Table 14 – Dielectric test voltage for basic insulation for devices suitable for use in single-phase three- or two-wire AC and DC systems

Nominal voltage of the supply system (U_N) V	AC test voltage, 60 s (RMS) V	DC 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 1 For supply system topology, see IEC 60664-1:20072020, Annex B.~~

~~NOTE 3 2 The values for AC test voltages are derived from the formula $U_N + 1\ 200\ V$ (see IEC 60664-1:20072020, 5.4.3).~~

^a Test voltages are based on IEC 60664-1:20072020, 6.4.5.1, fifth paragraph.

Table 15 – Dielectric test voltage for basic insulation for devices suitable for use in three-phase four or three-wire AC 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 1 For supply system topology see IEC 60664-1:20072020, Annex B.~~

~~NOTE 3 2 The values are derived from the formula $U_N + 1\ 200\ V$ (see IEC 60664-1:20072020, 5.4.3).~~

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.~~

12 Electrical endurance

12.1 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 ~~time relay or coupling 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.~~

The electrical endurance test shall be performed in accordance with IEC 61810-1:2015, Clause 11, for electromechanical outputs or with IEC 62314:2022, Clause 10, for solid state outputs. The test will be performed using one of the nominal time relay or coupling relay ratings, as defined in the test report. Unless otherwise specified, the minimum requirement is 6 000 cycles.

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

12.2 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~~ ambient temperature, and the ~~time relay or coupling relay~~ shall be energized with the rated input voltage or an appropriate value within the rated input voltage range.

Resistive loads, inductive loads, and special loads (for example Lamp loads, cable loads) shall be specified in accordance with IEC 61810-1:2015, 5.7, Annex B and Annex D, or IEC 60947-5-1:2016, Table 4 and Table 5.

12.3 Low energy loads

Low energy loads ~~(e.g. electronic systems and programmable controllers)~~ as specified 6.5.2.1 b) shall be tested in accordance with IEC 60947-5-4.

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

13 Conditional short-circuit current of an output circuit

13.1 General

The switching element of the ~~time relay or coupling relay~~ shall withstand the stresses resulting from short-circuit currents as specified in 6.5.5.

13.2 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.

13.3 Test circuit electromechanical output circuit

The ~~switching element~~ output terminals shall be connected in series with the short-circuit protective device of the type and rating stated ~~by the manufacturer~~; it shall also be in series with the ~~switching device~~ make switch intended to close the circuit as shown in Figure 16. The switching element shall be mounted in the time relay or coupling relay.

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 open circuit voltage shall be 1,1 times the maximum rated operational voltage of the switching element.

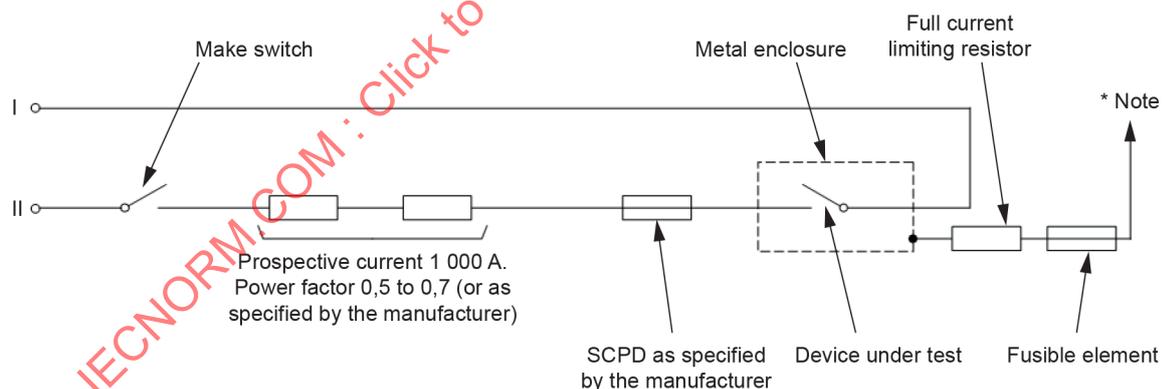
The test shall be performed three times on the same contact element, the SCPD being reset or replaced after each test. The time interval between the tests shall be not less than 3 min. The actual time interval shall be stated in the test report.

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~~ shall be tested.

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

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



IEC

NOTE ~~To be~~ The fusible element is connected alternatively to I or II on successive tests.

Figure 16 – Test circuit electromechanical output, conditional short-circuit current

13.4 Test circuit solid state output circuit

The ~~device under test (DUT)~~ time relay or coupling relay in the 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 17.

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, and R_1 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 the R_1 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.

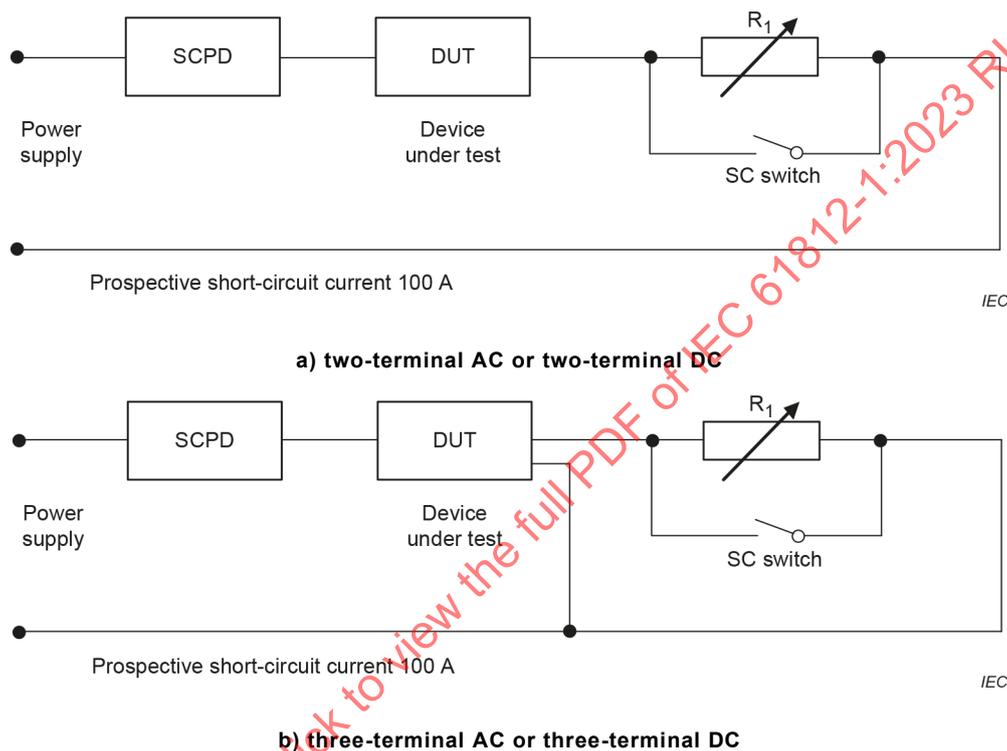


Figure 17 – Test circuit solid state output, conditional short-circuit current

13.5 Condition of switching element after test

- After the short-circuit test the time relay or coupling relay shall be able to switch to the release condition.
- After the test the device shall withstand the dielectric strength test according to 11.3.

14 Insulation coordination and protection against electric shock

14.1 General

Insulation coordination reflects clearances, creepage distances, solid insulation and protection against direct contact.

14.2 Clearances and creepage distances

14.2.1 General

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

NOTE 4 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 time relay or coupling relay is mounted apply and not those in the factory to which the location belongs.

Where time relays or parts of time relays, or coupling relays or parts of coupling relays are protected against conductive pollution, creepage 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.~~ The degree of protection to be provided in the installation environment (for example by use of a suitable enclosure) shall be stated.

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 (see IEC 60664-3).

Clearances and creepage distances between mutually insulated circuits (for example 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 unless full disconnection according to IEC 61810-1 is specified. Clearances and creepage distances specified for pollution degree 2 or 3 do not apply in the case of electronic components either (for example 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 manufacture 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.~~

According to IEC 60664-1 and IEC 60664-3, the basic safety standards in the field of low voltage insulation coordination, one or both of the following options a) and b) shall be selected:

a) 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 according to IEC 60664-3:2016, 5.7.2: –10 °C;
 - temperature cycle according to IEC 60664-3:2016, 5.7.4: severity 1;
 - partial discharge test according to IEC 60664-3:2016, 5.8.5, is not required;
 - no additional tests according to IEC 60664-3:2016, 5.9, are required.
- b) In the case of time relays or coupling 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.

14.2.2 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.~~

The clearance values for time relays and coupling relays shall fulfil the requirements of overvoltage category III. When time relays and coupling relays are permanently connected to the power distribution network, the applicable overvoltage category shall be determined according to IEC 60664-1:2020, 4.3.2. Clearances shall be selected from Table 16. For double and reinforced insulation the values of the next higher rated impulse withstand voltage from Table 16 are applicable.

Table 16 – Minimum clearances for basic insulation

Voltage line to earth (AC RMS or DC)		Rated impulse withstand voltage	Minimum clearances up to 2 000 m above sea level ^a		
Cat II	Cat III		Pollution degree		
			1	2	3
			mm	mm	mm
V	---	V	0,04	0,2	0,8
50	---	500	0,1	0,2	0,8
100	50	800	0,5		0,8
150	100	1 500	1,5		
300	150	2 500	3,0		
600	300	4 000	5,5		
---	600	6 000			

^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 IEC 60664-1:2007/2020, Table A.2.

When an overvoltage control component is used (for example surge suppressor), clearances may be defined in accordance with Table 17.

Table 17 – Minimum clearances in controlled overvoltage conditions for internal circuits

Voltage ^a	Minimum clearances in millimetres		
	Pollution degree		
	1	2	3
V			
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.

14.2.3 Creepage distances

Creepage distances shall be selected from Table 18.

Table 18 – Minimum creepage distances for basic insulation

Voltage ^a	Creepage distances in millimetres								
	Printed wiring material		Other materials						
	Pollution degree		Pollution degree						
	1	2	1	2			3		
	b	c	b	Material group			Material group		
V	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 time relay or coupling 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 $600 \leq CTI$;
- material group II $400 \leq CTI < 600$;
- material group IIIa $175 \leq CTI < 400$;
- material group IIIb $100 \leq CTI < 175$.

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.

For reinforced and double insulation, twice the values from Table 18 are applicable.

~~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.~~

14.3 Solid insulation

Solid insulation shall be capable of durably withstanding electrical and mechanical stresses as well as thermal and environmental influences which can occur during the anticipated life of the relay.

The qualification of the solid insulation shall be verified by tests according to the insulation, vibration and shock test (see 11.3, 17.1 and 17.2).

There is no dimensional requirement for the thickness of solid insulation.

Test voltage values for double insulation and reinforced insulation shall be twice those for basic insulation for the power frequency test (see Table 14 and Table 15), and the test voltage for the impulse withstand test shall be one level higher than that for basic insulation (see Table 13).

The basic insulation is always directly adjacent to the hazardous potential.

This requirement, however, is not applicable where the insulation consists of thin layers, except for mica and similar scaling material, and if

- for supplementary insulation, the insulation consists of at least two layers, provided that each of the layers withstands the dielectric strength test of 11.3 for supplementary insulation;
- for reinforced insulation, the insulation consists of at least three layers, provided that any two layers withstands the dielectric strength test of 11.3 for reinforced insulation.

14.4 Protection against direct contact

For time relays or coupling relays being operated as in normal use, for example in the case of time setting for the time relay, all accessible parts which carry voltages shall have a sufficient direct contact protection with a minimum degree of protection of IP20 in accordance with IEC 60529.

This requirement does not apply where insulated by reinforced insulation or double insulation from hazardous live parts with the rated voltage not exceeding 50 V AC (RMS value)/60 V DC.

NOTE SELV circuits can be considered to meet this exception.

Protection is regarded as ensured where the degree of protection of enclosure is IP 2X or better according to IEC 60529.

15 Mechanical strength

15.1 General

Parts and connections shall have adequate strength and be reliably fixed. Adjusting elements shall not change their position ~~due to~~ with vibrations ~~as~~ and shock 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~~ in such a way that they cannot be damaged by elements such as sharp edges.

Compliance is checked by the test of Clause 18.

Time relays or coupling relays shall meet the above requirements, even after appropriate transport. Unless ~~this can be achieved by~~ constructional measures can meet the above requirements, protection against mechanical damage shall be ensured through precautionary measures during transport. In special cases instructions for package and transport shall be attached.

15.2 Mechanical strength of terminals and current-carrying parts

15.2.1 General

Current-carrying parts including the terminals shall be ~~of a metal having strength~~ provided with adequate metals for their intended use according to 15.2.2 to 15.2.5.

15.2.2 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 time relay or coupling relay (not that of the terminal, which might be higher) as specified ~~by the manufacturer~~.

15.2.3 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 even if non-isolated female connectors are mounted on the male tabs~~; in case these requirements can only be fulfilled with isolated female connectors, this shall be explicitly stated in the ~~manufacturer's~~ product documentation.

15.2.4 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 60068-2-2:2007, 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 the time relay or coupling relay and socket.

For the measurement of the resistance across the time relay or coupling relay and socket terminations it is permissible to use the time relay or coupling relay dummy (for example with short-circuited relay contacts).

The tests shall be ~~made~~ performed with the sockets specified ~~by the manufacturer~~ and stated in the documentation of the time relay or coupling relay.

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

15.2.5 Mechanical strength of alternative termination types

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

16 Heat and fire resistance

16.1 General

Time relays or coupling relays shall be constructed ~~so they provide~~ with 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. Compliance is checked by the test of 16.2.

16.2 Glow-wire test

The glow-wire test is carried out to verify that the requirements regarding the 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~~ passed if the flame or glowing of the tested part is extinguished within 30 s after removal of the glow wire.

17 Vibration and shock

17.1 Vibration

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

During the test in the operated condition, the time relay or coupling relay shall be energized preferably at the lower limit of the operative range according to 6.2, that is to say with 80 %, 85 % or 90 % of the rated input voltage.

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

The test shall be carried out in accordance with 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~~ cross-over frequency: 60 Hz;
- $f < 60$ Hz constant amplitude of movement $\pm 0,15$ mm;
- $f > 60$ Hz constant acceleration 20 m/s² (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.

The test shall be considered satisfactory if the time relays or coupling relays

- a) comply with the dielectric voltage test according to 11.3.3;
- b) function properly within the specified tolerance values;
- c) show no rupture nor deformation.

17.2 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.~~

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

During the test in the operated condition, the time relay or coupling relay shall be energized preferably at the lower limit of the operative range according to 6.2, that is to say with 80 %, 85 % or 90 % of the rated input voltage.

During the test the contact openings should be monitored, unless otherwise specified, up to 100 m/s² only. Contact openings up to 3 ms are not considered as failures.

Unless otherwise specified, the test shall be carried out in accordance with IEC 60068-2-27 under the following conditions:

- mechanical shock value for endurance: 300 m/s²;
- axis in both the positive and negative senses: 6;
- number of mechanical shock per each direction: 3.

The setting time shall not have been changed due to shock 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. ~~Other tests may be specified by the manufacturer, for example shipbuilder standards, etc.~~

18 Electromagnetic compatibility (EMC)

18.1 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.~~

Time relays or coupling relays not incorporating electronic circuits with active components are not sensitive to electromagnetic disturbances in normal service conditions, and therefore no EMC tests are required.

18.2 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	10 V/m enclosure port 3 V/m enclosure port	A

2 GHz to 2,7 GHz	1 V/m enclosure port	
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
<p>^a ± 2 kV direct when control port is connected to the power supply during the test.</p> <p>^b Control ports — applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m.</p> <p>^c Equipment containing devices susceptible to power frequency magnetic fields as declared by the manufacturer, shall be tested with 30 A/m.</p> <p>^d Class 2 applies to points of common coupling and in-plant points of common coupling in the industrial environment in general.</p> <p>^e If the functional interruption times are different from the required test level, this shall be acceptable and noted in the test report.</p> <p>^f Applicable also to control ports interfacing with cables whose total length according to the manufacturer's functional specifications may exceed 30 m.</p>		

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 $\pm 0,5$ kV d.c. power port $\pm 0,5$ kV control port using the capacitive coupling clamp ^a	B
Surges (1,2/50 μ s – 8/20 μ s) 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) $\pm 0,5$ 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.		

The behaviour of the time relay or coupling relay submitted to the immunity tests shall be in accordance with the requirements in Table C.2 for industrial environments and Table C.3 for residential, commercial and light-industrial environments according to the specification.

The appropriate tests to verify the compliance with these requirements are given in Clause C.2.

The time relay or coupling relay shall be placed as a single device under test in the test setup according to the cited document and connected on all ports as specified. The test may be performed with no load for output ports. Each test of the time or coupling relay shall be done

- in operate condition with rated values applied, and
- in release condition, with all supplies except the control voltage at rated value. This exception is only for the OFF delay function.

For the evaluation of the tests the performance criteria as defined in Table C.2 shall be used.

It is not always possible to test every function and every specified time of the time relay; in such cases the most critical mode of operation shall be selected.

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

18.3 ~~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.~~

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

Time relays or coupling relays intended for use in industrial installation shall fulfill class A requirements in accordance with CISPR 11:2015, Clause 5, for industrial requirements.

Time relays or coupling relays intended for use in residential installation shall fulfill class B requirements in accordance with CISPR 11:2015, Clause 5, for residential, commercial and light-industrial environments.

The appropriate tests to verify the compliance with these requirements are given in Clause C.3.

All emission tests shall be performed with the time relay or coupling relay in operate condition with rated values applied.

19 Cybersecurity for industrial automation and control systems (IACS)

If embedded firmware is involved, cyber-security aspects should be considered according to IEC 62443-4-2.

NOTE IEC TS 63208 gives guidance on security aspects in the context of low voltage switchgear and controlgear.

Moreover, embedded software should be designed according to the recommendations stated in IEC TR 63201.

20 Environmental information

20.1 Environmentally conscious design process

Environmentally conscious design process is described in IEC 62430.

20.2 Procedure to establish material declaration

When customers request a material declaration, IEC 62474 provides the framework.

NOTE IEC 60947-1:2020, Annex W, gives guidance on the material declaration in the context of low voltage switchgear and controlgear.

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.~~

Annex A
(informative)

Setting accuracy, repeatability and effect of influence calculation

A.1 General

The setting accuracy, repeatability and effect of influence are determined from the following calculation formulae in Table A.1.

Table A.1 – Calculation formulae

Accuracy / Influence effects		Formulae
Accuracy	Setting	$\left \frac{T_M - T_S}{TM_S} \right \times 100 (\%)$
	Repeatability	$\pm \frac{1}{2} \times \frac{T_{\max} - T_{\min}}{TM_S} \times 100 (\%)$
Influence effects	Voltage	$\pm \frac{TM_{x1} - TM}{TM_S} \times 100 (\%)$
	Temperature	$\pm \frac{TM_{x2} - TM}{TM_S} \times 100 (\%)$

where

T_M is the mean of the measured values;

T_S is the setting time;

TM_S is the full-scale value with analogue setting, or setting value in absolute values with digital setting;

T_{\max} is the maximum measured value;

T_{\min} is the minimum measured value;

TM_{x1} is the maximum measured value within the rated input voltage range;

TM_{x2} is the maximum measured value within the ambient temperature range.

A.2 Example of calculation

Measured values: 9,91 s, 9,95 s, 10,01 s, 9,97 s, 9,99 s, 10,05 s, 10,02 s, 9,98 s, 10,00 s, 9,93 s

TM 9,981 s

TM_S 10 s

T_S 10 s

T_{\max} 10,05 s

T_{\min} 9,91 s

Setting accuracy $\left| \frac{9,981 - 10}{10} \right| \times 100 (\%) = 0,19 \%$

Repeatability $\pm \frac{1}{2} \times \frac{10,05 - 9,91}{10} \times 100 (\%) = 0,70 \%$

Annex B (informative)

Risk assessment

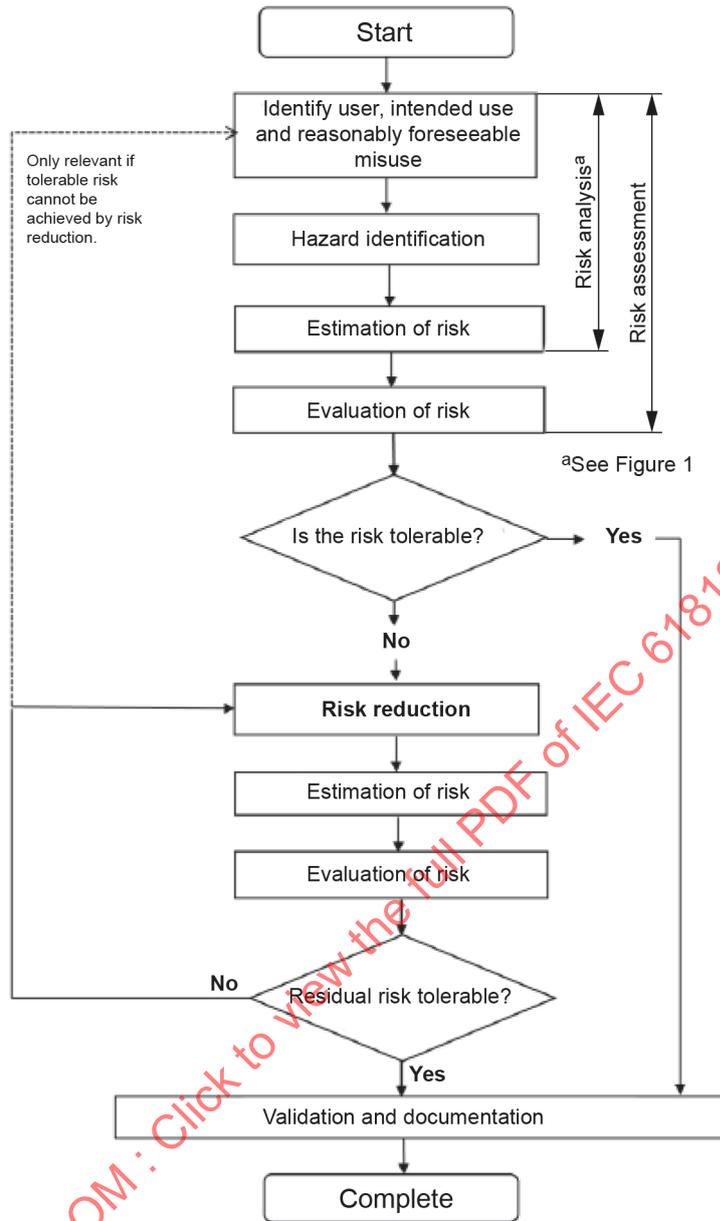
B.1 General

A risk assessment process based on ISO/IEC Guide 51 is given below. Other risk assessment procedures are contained in ISO 14971, SEMI S10, IEC 61508 series, ISO 14121-1, and ANSI TR3. Other established procedures which implement similar steps can also be used.

B.2 Risk assessment procedure

Tolerable risk is achieved by the iterative process of risk assessment (risk analysis and risk evaluation) and risk reduction (see Figure B.1).

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[SOURCE: ISO/IEC GUIDE 51:2014, Figure 2]

^a The footnote refers to ISO/IEC GUIDE 51:2014, Figure 1.

Figure B.1 – Iterative process of risk assessment and risk reduction

B.3 Achieving tolerable risk

The following procedure (see Figure B.1) should be used to reduce risks to a tolerable level:

- a) identify the likely user group(s) for the product, process, or service (including those with special needs and the elderly), and any known contact group (for example use or contact by children);
- c) identify the intended use and assess the reasonably foreseeable misuse of the product, process or service;
- d) identify each hazard (including any hazardous situation and harmful event) arising in all stages and conditions for the use of the product, process or service, including installation, maintenance, repair, and destruction or disposal;

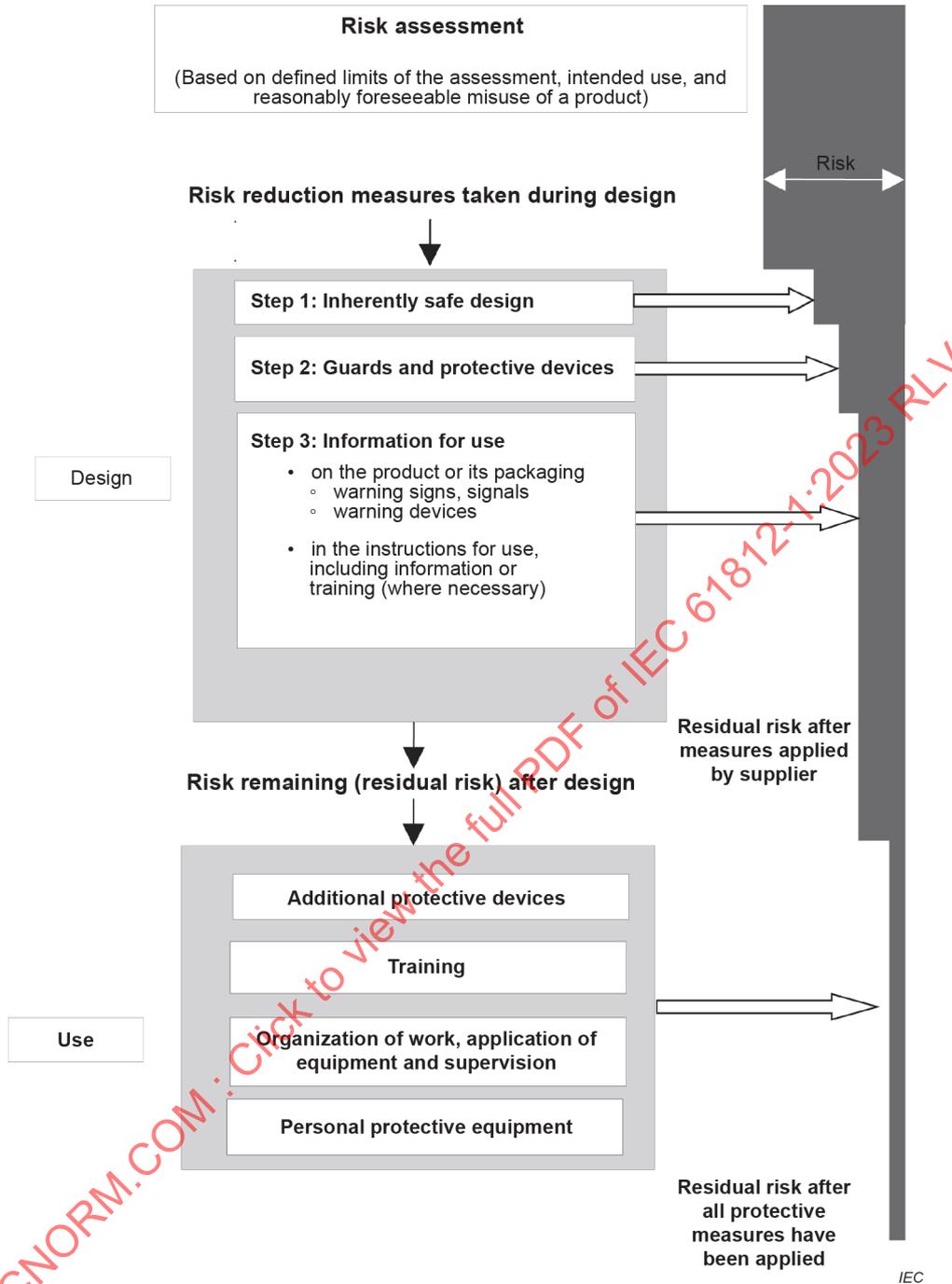
- e) estimate and evaluate the risk (see Figure B.1) to each identified user/contact group arising from each hazard identified;
- f) judge if the risk is tolerable (for example by comparison with similar products, processes or services);
- g) if the risk is not tolerable, reduce the risk until it becomes tolerable.

When reducing risks the order of priority should be as follows:

- 1) eliminate or reduce risks as far as possible (inherently safe design and construction);
- 2) take the necessary protection measures in relation to risks that cannot be eliminated (protection devices);
- 3) inform users of the remaining risk after design due to any shortcomings of the protection measures adopted, indicate whether any particular training is required, and specify any need to provide personal protection equipment (information for safety).

This procedure is based on the assumption that the user has a role to play in the risk reduction procedure by complying with the information provided by the manufacturer (see Figure B.2).

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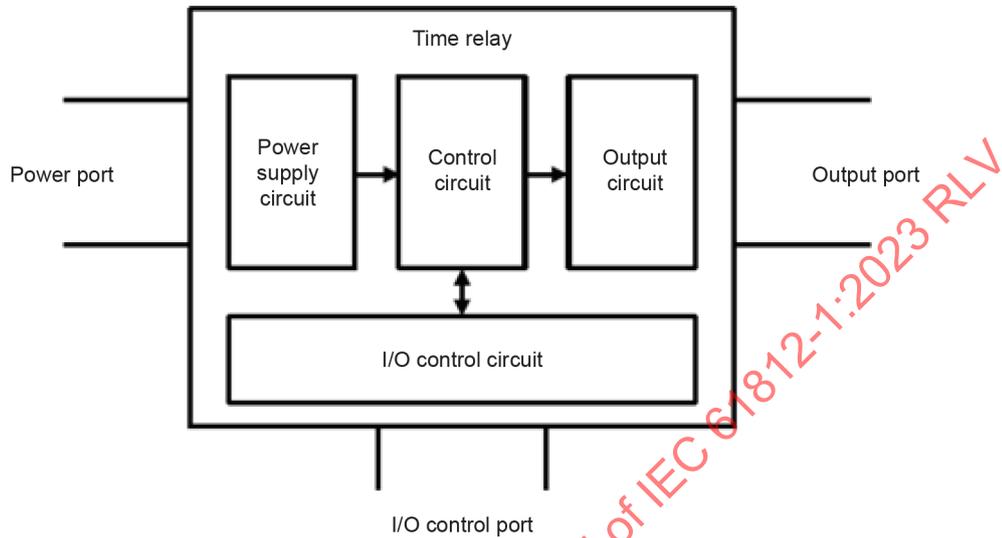
[SOURCE: IEC 62314:2022, Figure B.2.]

Figure B.2 – Risk reduction

The steps taken in the design procedure are shown in order of priority. The steps to be taken by the user are not in order of priority because this would depend on the application. It is emphasized that the additional protection devices, personal protection equipment and provision of information to users should not be used as substitutes for design improvements.

This step or procedure has to be done for each component as well for all components together (= device). The responsibility is clearly defined that for the component the responsibility has to be taken by the manufacturer. The responsibility for the assembled/complete device is on the side of the user (OEM or manufacturer/developer of the device).

For the relay as component, the considered hazards are given as examples in Table B.1 based on Figure B.3. However, users have to consider which failure modes are risky and take these or all within their risk consideration.



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Figure B.3 – Example of the time relay circuit block diagram

Table B.1 – Examples of the relation between failure mode, consequences and hazard

Failure mode	Consequences		Hazard
Failure of power supply circuit	The time relay or coupling relay will not work properly or never work, because a part, a device or a conductor of a printed board in the power supply circuit has been opened or short-circuited.	The power supply for the time relay or coupling relay is not interrupted.	Worst case: uncontrolled heating (overheating), ignition with flame.
		The power supply for the time relay is interrupted.	None (just loss of function).
Failure of I/O control circuit	The time relay or coupling relay will not work properly or never work, because a part, a device or a conductor of a printed board in the I/O control circuit has been opened or short-circuited.	Input signal for the time relay or coupling relay is not interrupted.	Degradation of performance.
		Input signal for the time relay or coupling relay is interrupted.	Loss of function.
Failure of control circuit	The time relay or coupling relay will not work properly or never work, because a part, a device or a conductor of a printed board in the control circuit has been opened or short-circuited.	The power supply for internal circuits is not interrupted.	Worst case: uncontrolled heating (overheating), ignition with flame if the power supply is not interrupted.
		The power supply for internal circuits is interrupted.	Loss of function.
		Relay coil is opened.	None (just loss of function).
Failure of output circuit	The time relay or coupling relay will not work properly or never work, because a part, a device or a conductor of a printed board in the output circuit has been opened or short-circuited.	Relay contact bridging.	Worst case: uncontrolled heating (overheating), ignition with flame if the power supply is not interrupted.

B.4 Application of risk assessment procedures (proposal for the user)

For hazards in the scope of this document, examples of severity of harm are given in Table B.2. Probability of harm is given in Table B.3. The risk category, which is selected based on severity and probability, is given in Table B.4.

Table B.2 – Severity of harm

Severity group	People	Equipment/Facility
Catastrophic	One or more fatalities	Facility loss
Severe	Disabling injuring/illness	Major system loss or facility damage
Moderate	Medical treatment or restricted work activity	Minor subsystem loss or facility damage
Minor	First aid only	Non-serious equipment or facility damage

Table B.3 – Probability of harm

Probability of harm					
Typical occurrence of failure modes (to be assessed by product and application)		Rate of occurrence			
		Frequent	Possible	Rare	Unlikely
Failure modes	Failure to break	X	X	X	X
	Failure to make			X	X
	Failure of supplementary insulation		X	X	X
	Failure of reinforced insulation (basic insulation shall remain)		X	X	X
	Failure of functional insulation		X	X	X
	Input circuit interruption			X	X
	Failure of basic insulation		X	X	X

NOTE Table B.3 is taken from IEC 62314:2022, Table B.3.

Table B.4 – Risk category

Risk assessment/risk category					
Severity of harm		Probability of harm			
		Frequent	Possible	Unlikely	
Severity	Catastrophic	3	3	2	2
	Severe	3	2	2	1
	Moderate	3	1	1	1
	Minor	2	1	1	1
Key	Category	Description			
1	Broadly acceptable	This fulfils the requirement for tolerable risk.			
2	As low as reasonably practicable	This does not automatically fulfil the requirement for tolerable risk. If possible, these risks should be reduced further to Category 1. If not possible, then the instructions should contain a description of the risk so that the responsible body can take appropriate steps to protect the safety of operators.			
3	Intolerable	This contains risks that are not tolerable risk.			

NOTE Table B.4 is taken from IEC 62314:2022, Table B.4.

Annex C (normative)

Tests for EMC

C.1 General

Annex C states the EMC tests for time relays and coupling relays where EMC tests are required.

For products falling within the scope of Annex C, Table C.1 shows two sets of environmental conditions as:

- a) industrial environments;
- b) residential, commercial and light-industrial environments.

Table C.1 – Environmental conditions influencing EMC

	High emission	Low emission
Low immunity	Not allowed	Residential (b)
High immunity	Industrial (a)	All environments

Industrial examples of such equipment are switches in the power distribution network and equipment for industrial use with permanent connection to the power distribution network.

Time relays or coupling relays shall be specified for industrial environments when one or more of the following is expected:

- 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.

C.2 EMC immunity

C.2.1 General

The EMC requirements have been selected to ensure a satisfactory immunity against electromagnetic disturbances of time relays and coupling relays. Tests shall be carried out in accordance with the basic standards given in Annex C and with the specified conditions of Table C.2 for industrial environments and Table C.3 for residential, commercial and light-industrial environments.

The behaviour of the time relay or coupling relay submitted to the immunity tests shall be in accordance with the requirements in Table C.2 for industrial environments and Table C.3 for residential, commercial and light-industrial environments.

C.2.2 Performance criteria

C.2.2.1 General

The performance criteria are defined in detail in C.2.2.

- Performance criterion A: No disturbance of function is allowed in that the adjusted time function (for example 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 according to 3.1.3. The nominal values of the specified time, such as 10 s, are given in Table 4. 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 (for example 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 condition 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.

C.2.2.2 Electrostatic discharges

This test shall be performed according to IEC 61000-4-2:2008, Clause 7 and Clause 8, with the values given in Table C.2 or Table C.3. See IEC 61000-4-2 for applicability of contact or air discharge tests or both.

C.2.2.3 Radiated radio-frequency electromagnetic fields

This test shall be performed according to IEC 61000-4-3:2020, Clause 7 and Clause 8, with the values given in Table C.2 or Table C.3.

C.2.2.4 Electrical fast transients/bursts

This test shall be performed according IEC 61000-4-4:2012, Clause 7 and Clause 8, with the values given in Table C.2 or Table C.3. The test shall be performed at repetition frequencies of 5 kHz. As an alternative, 100 kHz may be selected.

C.2.2.5 Surges

This test shall be performed according to IEC 61000-4-5:2014 and IEC 61000-4-5:2014/AMD1:2017, Clause 7 and Clause 8, with the values given in Table C.2 or Table C.3.

C.2.2.6 Conducted disturbances induced by radio-frequency fields

This test shall be performed according to IEC 61000-4-6:2013, Clause 7 and Clause 8, with the values given in Table C.2 or Table C.3.

C.2.2.7 Immunity to power-frequency magnetic fields

The test method shall be in accordance with IEC 61000-4-8:2009, Clause 7 and Clause 8, with the test levels as defined in Table C.2 or Table C.3.

C.2.2.8 Voltage dips and voltage interruptions

This test shall be performed in accordance with IEC 61000-4-11:2020, Clause 7 and Clause 8, for solid state relays with a rated operational current less than 16 A and in accordance with IEC 61000-4-34 for time relays or coupling relays with a rated operational current higher than 16 A.

C.2.2.9 Summary of Immunity test conditions

Table C.2 and Table C.3 summarize the test conditions and requirements of immunity tests. The configuration and mode of operation during the tests shall be precisely noted in the test report. For each test, the respective test level shall be stated.

Table C.2 – 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 6 GHz	10 V/m enclosure port 3 V/m enclosure port	A
Electrical fast transient/burst ^f IEC 61000-4-4	±2 kV AC, DC power port ±1 kV control port using the capacitive coupling clamp ^a 5 kHz or 100 kHz repetition frequency	B
Surges (1,2/50 µs to 8/20 µs) ^g IEC 61000-4-5	±2 kV required for AC power ports (line to earth) ±1 kV required for control port, DC power ports (line to earth) ±1 kV required for AC power ports (line to line) ±0,5 kV required for DC power ports (line to line)	B
Conducted radio-frequency at 150 kHz to 80 MHz IEC 61000-4-6	10 V control ports, AC/DC power ports	A
Immunity to power-frequency magnetic fields IEC 61000-4-8 ^b	not applicable	A
Voltage dips ^{c, d} IEC 61000-4-11	Class 3 ^e 0 % residual voltage during 1 cycle AC power ports	B
	40 % residual voltage during 10/12 cycles AC power ports	C
	70 % residual voltage during 25/30 cycles AC power ports	C
Voltage interruptions ^{c, d} IEC 61000-4-11 for rated operational current ≤ 16 A IEC 61000-4-34 for rated operational current > 16 A	0 % residual voltage during 250/300 cycles AC power ports	C
^a ±2 kV direct current when control port is connected to the power supply during the test. ^b Equipment susceptible to power frequency magnetic fields as declared, shall be tested with 30 A/m (50 Hz, 60 Hz). ^c The value in front of the slash mark (/) is for 50 Hz and the value behind for 60 Hz tests. ^d If the functional interruption times are more severe values from the required test level, this shall be acceptable and noted in the test report. ^e Class 3 applies to points of common coupling and in-plant points of common coupling in the industrial environment in general. ^f Control ports – applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m. ^g Applicable also to control ports interfacing with cables whose total length according to the manufacturer's functional specifications may exceed 30 m.		

Table C.3 – 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 6 GHz	3 V/m enclosure port 3 V/m enclosure port	A
Electrical fast transient/burst ^e IEC 61000-4-4	±1 kV AC power port ±0,5 kV DC power port ±0,5 kV control port using the capacitive coupling clamp ^a	B
Surges (1,2/50 µs to 8/20 µs) ^f IEC 61000-4-5	±2 kV required for AC power ports (line to earth) ±1 kV required for DC power ports (line to earth) ±1 kV required for AC power ports (line to line) ±0,5 kV required for DC power ports (line to line)	B
Conducted radio-frequency at 150 kHz to 80 MHz IEC 61000-4-6	3 V RMS control ports, AC/DC power ports	A
Immunity to power-frequency magnetic fields IEC 61000-4-8 ^b	not applicable	A
Voltage dips ^{c, d} IEC 61000-4-11	0 % residual voltage during 1 cycle AC power ports	B
	70 % residual voltage during 25/30 cycles AC power ports	C
Voltage interruptions ^{c, d} IEC 61000-4-11 for rated operational current ≤ 16 A IEC 61000-4-34 for rated operational current > 16 A	0 % residual voltage during 250/300 cycles AC power ports	C
^a ±1 kV direct current when control port is connected to the power supply during the test. ^b Equipment susceptible to power frequency magnetic fields as declared, shall be tested with 3 A/m (50 Hz, 60 Hz). ^c If the functional interruption times are more severe values from the required test level, this shall be acceptable and noted in the test report. ^d The value in front of the slash mark (/) is for 50 Hz and the value behind for 60 Hz tests. ^e Control ports – applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m. ^f Applicable also to control ports interfacing with cables whose total length according to the manufacturer's functional specifications may exceed 30 m.		

C.3 EMC radiated and conducted emission

C.3.1 General

The requirements of 18.3 apply.

C.3.2 Conducted radio-frequency emission tests

The description of the test, the test method and the test set-up are given in CISPR 11:2015 and CISPR 11:2015/AMD1:2016, Clause 7. To pass the test, the equipment shall not exceed the levels given in Table C.4.

Table C.4 – Terminal disturbance voltage limits for conducted radio-frequency emission (for power port)

Frequency band MHz	Environment A dB (μV)	Environment B dB (μV)
0,15 to 0,5	79 quasi-peak 66 average	66 to 56 quasi-peak 56 to 46 average (decrease with log of frequency)
0,5 to 5	73 quasi-peak 60 average	56 quasi-peak 46 average
5 to 30	73 quasi-peak 60 average	60 quasi-peak 50 average

NOTE Limits are in accordance with CISPR 11, Group 1 for load input ports and total rated power less than 20 kVA.

C.3.3 Radiated radio-frequency emission tests

The description of the test, the test method and the test set-up are given in CISPR 11:2015 and CISPR 11:2015/AMD1:2016, Clause 7.

The emissions shall not exceed the levels given in Table C.5.

Table C.5 – Radiated emission test limits

Frequency range MHz	Environment A ^a Quasi-peak dB (μV)			Environment B ^a Quasi-peak dB (μV)	
	at 30 m	at 10 m	at 3 m	at 10 m	at 3 m
30 to 230	30	40	50	30	40
230 to 1 000	37	47	57	37	47

^a Tests may be carried out at 3 m distance only to small equipment (equipment, either positioned on a table top or standing on the floor, including its cables, fits in a cylindrical test volume of 1,2 m in diameter and 1,5 m above the ground plane).

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INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Time relays and coupling relays for industrial and residential use –
Part 1: Requirements and tests**

**Relais temporisés et relais de couplage pour applications industrielles et
résidentielles –
Partie 1: Exigences et essais**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**TIME RELAYS AND COUPLING RELAYS FOR
INDUSTRIAL AND RESIDENTIAL USE –****Part 1: Requirements and tests**

FOREWORD

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IEC 61812-1 has been prepared by IEC technical committee 94: Electrical relays. It is an International Standard.

This third edition cancels and replaces the second edition published in 2011. This edition constitutes a technical revision.

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

- a) update of references;
- b) addition of requirements for risk assessment;
- c) addition of requirements for routine test;
- d) renumbering of clauses to bring them into a more logical order;
- e) clarification of the requirement for shock;
- f) addition of cybersecurity requirements for industrial automation and control systems;

- g) addition of environmentally conscious design requirement;
- h) addition of common data dictionary reference;
- i) addition of terms and definitions of relay types;
- j) addition of coupling relays in title;
- k) addition of coupling relays in scope.

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

FDIS	Report on voting
94/843/FDIS	94/889/RVD

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

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

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

A list of all parts of the IEC 61812 series can be found, under the general title *Time relays and coupling relays for industrial and residential use*, on the IEC website.

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

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

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

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

TIME RELAYS AND COUPLING RELAYS FOR INDUSTRIAL AND RESIDENTIAL USE –

Part 1: Requirements and tests

1 Scope

This part of IEC 61812 applies to time relays and coupling relays for industrial applications (for example control, automation, signal and industrial equipment) and 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 document comprises all types of time relays and coupling relays, other than measuring relays.

NOTE 1 Time relays and coupling relays can be used for industrial application (for example control, automation, signal and industrial equipment) and for automatic electrical controls for use in, on, or in association with equipment for residential and similar use.”

NOTE 2 Measuring relays are handled by the IEC TC95.

This document defines type test and routine test to confirm the service condition. Subclause 3.2 provides definitions for different types of time relays in use in the IEC 61812 series.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

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 60112:2020, *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 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3:2016, *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 60695-2-11:2021, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end products (GWEPT)*

IEC 60695-10-2:2014, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60947-5-1:2016, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

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 60947-5-4:2002/AMD1:2019

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

IEC 61000-4-3:2020, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2013, *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 61000-4-11:2020, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase*

IEC 61000-4-34:2005, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with mains current more than 16 A per phase*

IEC 61000-4-34:2005/AMD1:2009

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

IEC 61810-1:2015, *Electromechanical elementary relays – Part 1: General and safety requirements*

IEC 61810-1:2015/AMD1:2019

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

IEC 62314:2022, *Solid-state relays – Safety requirements*

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

CISPR 11:2015/AMD1:2016

CISPR 11:2015/AMD2:2019

ISO 9223:2012, *Corrosion of metals and alloys – Corrosivity of atmospheres – Classification, determination and estimation*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 Terms and definitions related to general terms

3.1.1

time relay

specified-time relay

all-or-nothing relay (IEV 444-01-02) with one or more time functions

[SOURCE: IEC 60050-445:2010, 445-01-01, modified – in the definition, the reference to the IEV entry has been added.]

3.1.2

coupling relay

all-or-nothing electrical relay incorporated into a housing or mounted on a socket (for example IEC 60715 mounting rail) with no specified time or logic function for industrial or residential use intended for incorporation into cabinets.

Note 1 to entry: Typically this is a relay according to the IEC 61810 series or IEC 62314 incorporated into a housing or mounted on a socket (for example IEC 60715 mounting rail) for installation in industrial or residential cabinets.

3.1.3

specified time

specified characteristic of the time relay at given type of function, for example operate time, release time, pulse on time, interval time

[SOURCE: IEC 60050-445:2010, 445-05-01, modified – the note has been removed.]

3.1.4

setting accuracy

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

Note 1 to entry: For analogue setting this value relates to the maximum setting value.

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

3.1.5

effect of influence (on specified time)

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

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

3.1.6

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

[SOURCE: IEC 60050-445:2010, 445-05-04, modified – “must be removed” and “must be applied” have been replaced by “is removed” and “is applied”, respectively.]

3.1.7

minimum control impulse time

shortest duration of the power supply or control signal to fulfil the specified function

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

3.1.8

repeatability

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

Note 1 to entry: Preferably the repeatability is indicated as a percentage of the mean value of all measured values.

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

3.1.9

power supply

electrical quantity (for example electric current, voltage) which has to be applied or removed from the input circuit of the time relay or coupling relay in order to enable it to fulfil its purpose

[SOURCE: IEC 60050-445:2010, 445-03-01, modified – in the definition, “or coupling relay” has been added.]

3.1.10

input voltage

electrical quantity that can be applied to (or removed from) the power supply, the control signal or both

3.1.11

control signal

DEPRECATED: trigger signal

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

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

3.1.12**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

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

3.1.13**on-state voltage drop of a solid-state output circuit**

DEPRECATED: voltage drop of a solid-state output circuit

voltage measured across the effectively conducting solid-state output of the time relay or coupling relay, when carrying the given load current

[SOURCE: IEC 60050-445:2010, 445-04-04, modified – in the definition, “or coupling relay” has been added.]

3.1.14**leakage current of a solid-state output**

DEPRECATED: off-state current of a solid-state output

electric current which flows through the effectively non-conducting solid-state output of the time relay or coupling relay at a specified voltage

[SOURCE: IEC 60050-445:2010, 445-04-05, modified – in the definition “or coupling relay” has been added.]

3.1.15**power port**

port at which the supply voltage (either AC or DC) is connected to the time relay or coupling relay

[SOURCE: IEC 60050-445:2010, 445-07-01, modified – in the definition “or coupling relay” has been added.]

3.1.16**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 1 to entry: There are control ports for floating (potential-free) and non-floating control.

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

3.1.17**output port**

port at which a load is connected to the time relay or coupling relay

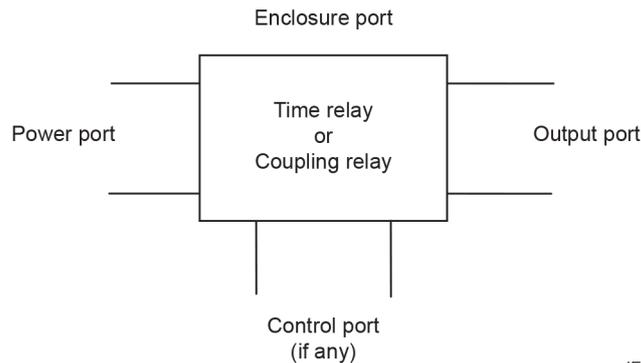
Note 1 to entry: The output port could consist of electromechanical contacts or be a solid-state output.

[SOURCE: IEC 60050-445:2010, 445-07-03, modified – in the definition “or coupling relay” has been added.]

3.1.18**enclosure port**

physical boundary of the time relay or coupling relay through which electromagnetic fields can radiate or impinge

Note 1 to entry: See Figure 1.



IEC

Figure 1 – Definition of ports

[SOURCE: IEC 60050-445:2010, 445-07-04, modified – in the definition “or coupling relay” and the note and reference to Figure 1 have been added.]

3.1.19 type test

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

[SOURCE: IEC 61810-1:2015, 3.1.7]

3.1.20 routine test

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

[SOURCE: IEC 61810-1:2015, 3.1.8]

3.1.21 sampling test

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

[SOURCE: IEC 61810-1:2015, 3.1.9]

3.1.22 operative range

range of values of power supply for which the time relay or coupling relay is able to perform its specified function

[SOURCE: IEC 61810-1:2015, 3.4.5, modified – in the definition, “coil voltage” has been replaced with “power supply”, and “relay” has been replaced with “time relay or coupling relay”.]

3.1.23 rated input voltage range

range of input voltages used for specification purposes, established for a specified set of operating conditions

3.1.24 functional insulation

insulation between conductive parts which is necessary only for the proper functioning of the equipment

[SOURCE: IEC 60050-195:2021, 195-02-41, modified – “necessary” has been replaced with “which is necessary only”.]

3.1.25

basic insulation

insulation of hazardous-live-parts which provides basic protection

Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 60050-195:2021, 195-06-06, modified – in the definition, “of hazardous live-parts” has been added.]

3.1.26

supplementary insulation

independent insulation applied in addition to basic insulation for fault protection

[SOURCE: IEC 60050-195:2021, 195-06-07]

3.1.27

double insulation

insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-195:2021, 195-06-08]

3.1.28

reinforced insulation

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

Note 1 to entry: Reinforced insulation may comprise several layers which cannot be tested singly as basic insulation or supplementary insulation.

[SOURCE: IEC 60050-195:2021, 195-06-09, modified – in the definition “of hazardous-live parts” has been added.]

3.1.29

live part

conductive part intended to be energized under normal operating conditions, including the neutral conductor and mid-point conductor, but excluding the PEN conductor, PEM conductor and PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

[SOURCE: IEC 60050-195:2021, 195-02-19, modified – the note has been added.]

3.1.30

rated operating voltage

nominal voltage of the power supply intended to be used

3.1.31

rated operating current

nominal current of the power supply intended to be used

3.1.32

power consumption

electric energy a relay uses in or for operation, given in VA for AC and W for DC coils, and including other electric circuits

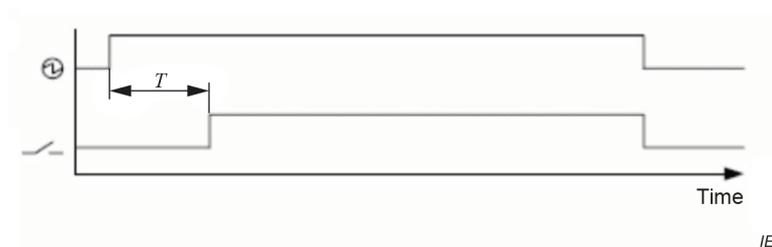
3.2 Terms and definitions of time relay types

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)



Key

Power supply

T Setting time

Make contact

Figure 2 – Power ON-delay relay

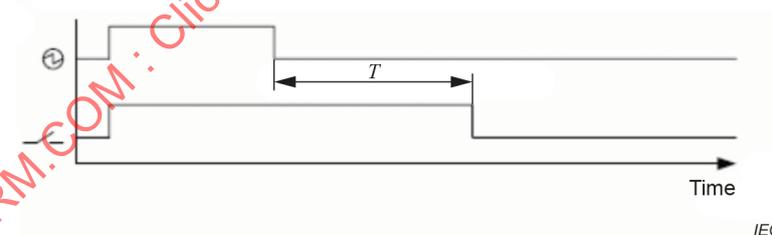
[SOURCE: IEC 60050-445:2010, 445-01-02]

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 3)



Key

Power supply

T Setting time

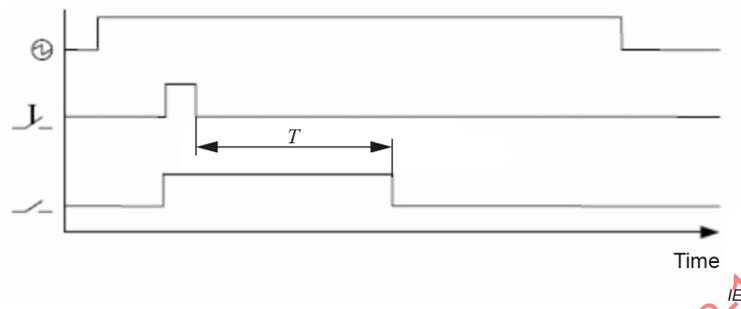
Make contact

Figure 3 – Power OFF-delay relay

[SOURCE: 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 4)



Key

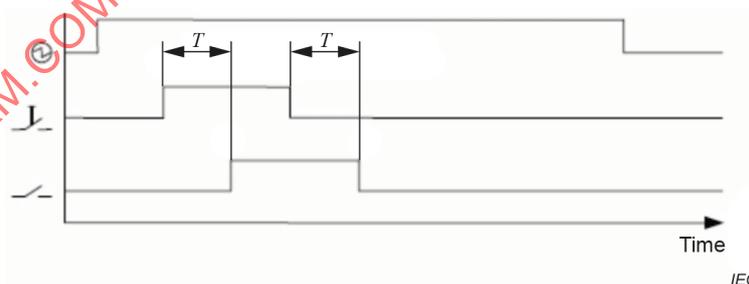
- ⊕ Power supply
- ⌋ Control signal
- T Setting time
- ⌋ Make contact

Figure 4 – OFF-delay relay with control signal

[SOURCE: IEC 60050-445:2010, 445-01-04, modified – the note has been deleted.]

**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 5)



Key

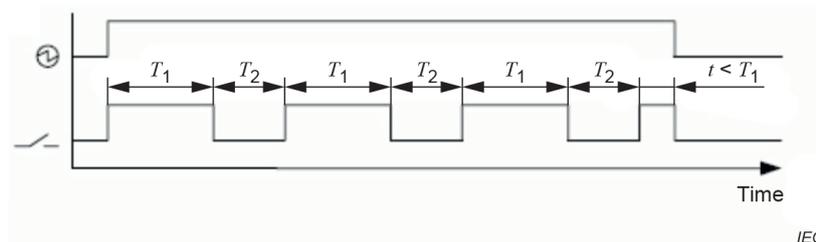
- ⊕ Power supply
- ⌋ Control signal
- T Setting time
- ⌋ Make contact

Figure 5 – ON- and OFF-delay relay with control signal

[SOURCE: IEC 60050-445:2010, 445-01-05, modified – the note has been deleted.]

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 6)



Key

- Ⓢ Power supply
- T_1 Pulse on time
- T_2 Pulse off time
- Make contact

Figure 6 – Flasher relay

Note 1 to entry: Depending on the relay type, the output starts with "pulse on" or "pulse off".

Note 2 to entry: Flasher relay can also be initiated with a control signal.

[SOURCE: 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

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

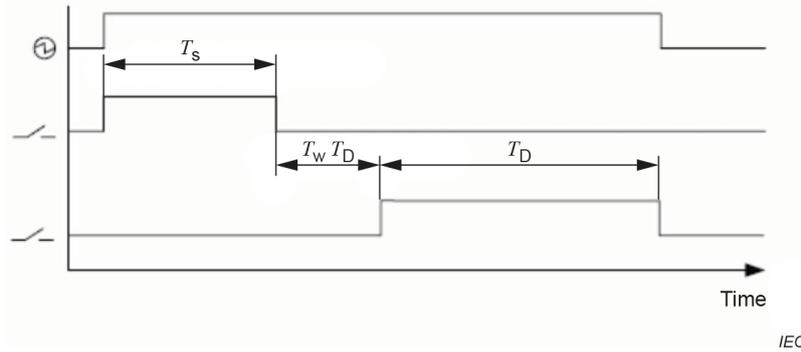
3.2.7 asymmetrical flasher relay asymmetrical repeat cycle relay

flasher relay in which the pulse on time and pulse off time are selectable separately

[SOURCE: 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 7)



IEC

Key

- Ⓢ Power supply
- T_s Star setting time
- $T_w T_D$ Delta transfer time
- ⌞ Make contact

Figure 7 – Star-delta relay

Note 1 to entry: The star and delta connections are defined in IEC 60050-445:2010, 445-01-09 and IEC 60050-445:2010, 445-01-09 respectively.

Note 2 to entry: T_s is the time during which motor starts and runs in the “star” connection.

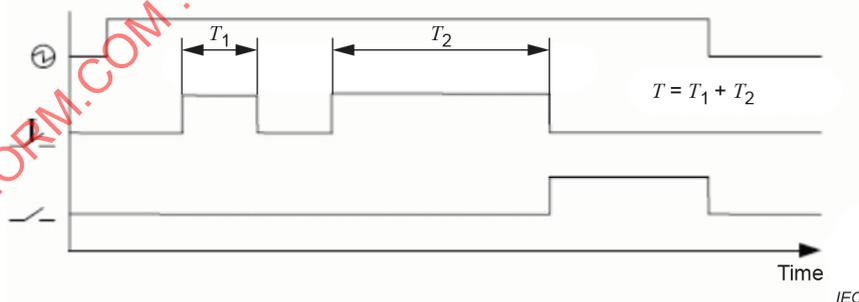
Note 3 to entry: T_w is the dwelling time after disconnecting the motor in the star and reconnecting in the delta.

Note 4 to entry: T_D is the time during which the motor runs in the “delta” connection.

[SOURCE: IEC 60050-445:2010, 445-01-09, modified – Note 2, Note 3 and Note 4 have been added.]

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 8)



IEC

Key

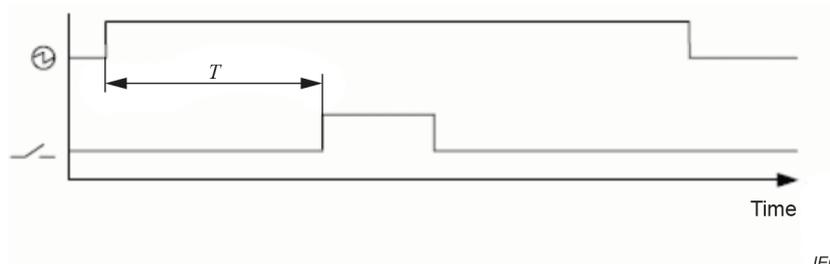
- Ⓢ Power supply
- ⌞ Control signal
- T Setting time
- ⌞ Make contact

Figure 8 – Summation time relay

[SOURCE: 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 9)



IEC

Key

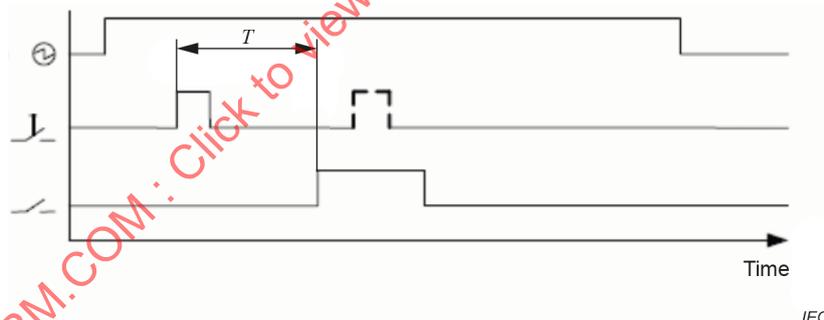
- Ⓢ Power supply
- T Setting time
- Ⓜ Make contact

Figure 9 – Pulse delayed relay

[SOURCE: 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 10)



IEC

Key

- Ⓢ Power supply
- Ⓜ Control signal
- T Setting time
- Ⓜ Make contact

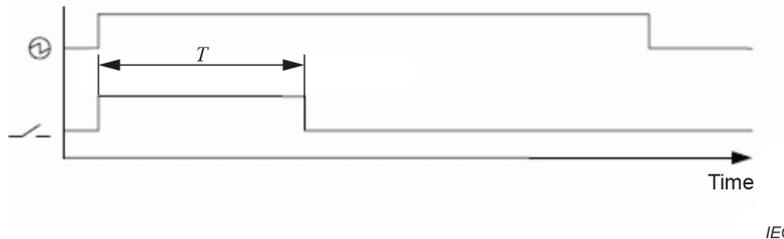
Figure 10 – Pulse delayed relay with control signal

Note 1 to entry: Cycling the control signal during the time delay will not retrigger the time delay.

[SOURCE: 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 11)



Key

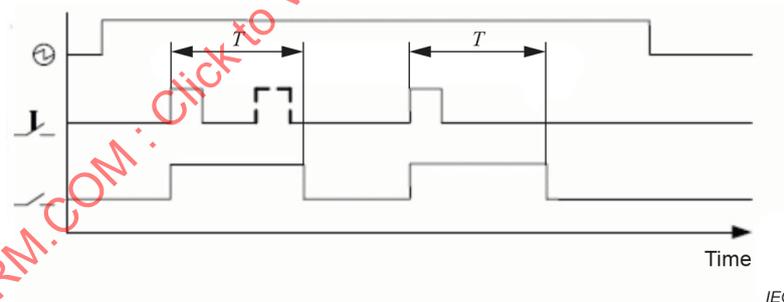
- ⚡ Power supply
- T Setting time
- ↗ Make contact

Figure 11 – Interval relay

[SOURCE: 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 12)



Key

- ⚡ Power supply
- ⌋ Control signal
- T Setting time
- ↗ Make contact

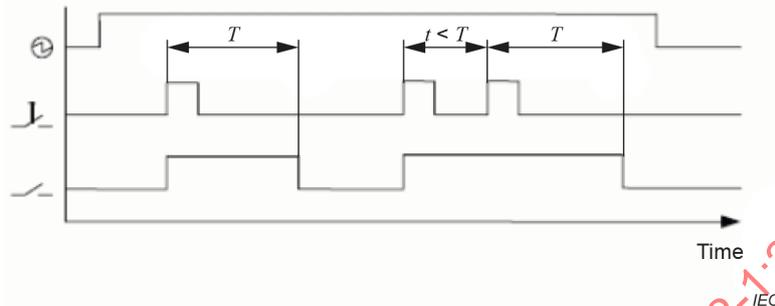
Figure 12 – Interval relay with control signal

Note 1 to entry: Cycling the control signal during the time delay will not retrigger the time delay.

[SOURCE: 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 13)



Key

- ⊕ Power supply
- ⌋ Control signal
- T Setting time
- ⌋ Make contact

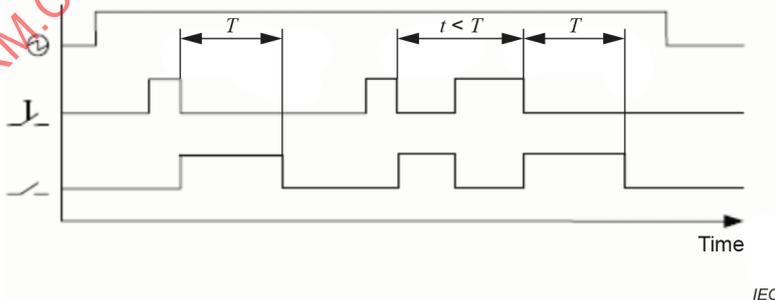
Figure 13 – Retriggerable interval relay with control signal ON

Note 1 to entry: Cycling the control signal during the time delay will retrigger the time delay.

[SOURCE: 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 14)



Key

- ⊕ Power supply
- ⌋ Control signal
- T Setting time
- ⌋ Make contact

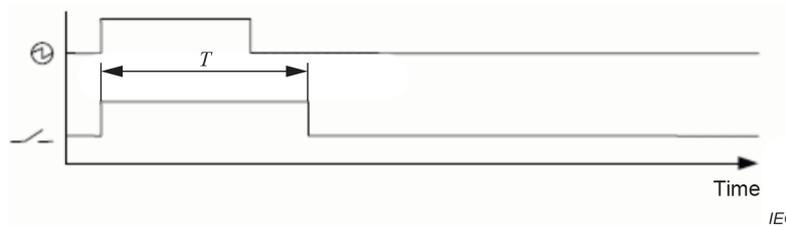
Figure 14 – Retriggerable interval relay with control signal OFF

Note 1 to entry: Cycling the control signal during the time delay will retrigger the time delay.

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

**3.2.16
maintained time relay**

time relay which does not release until the time interval has elapsed, even with the removal of the power supply (see Figure 15)



Key

- Ⓢ Power supply
- T* Setting time
- Make contact

Figure 15 – Maintained time relay

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

4 Classification

4.1 Switching element

Time relays and coupling relays may be classified according to the switching element, for example electromechanical output circuit or solid-state output circuit.

4.2 Mechanical construction

Time relays and coupling relays may be classified according to the mechanical construction, for example monobloc (non modular) relay or plug-in (modular) relay.

4.3 Device mounting

Time relays and coupling relays may be classified according to the mounting capabilities, for example IEC 60715 mounting rail or panel mounting.

4.4 Connection

Time relays and coupling relays may be classified according to the connection facilities, for example screw type or spring type.

4.5 Environment

Time relays and coupling relays in the scope of 18.1 shall be classified according to the application environment. They can be subjected to the impulse withstand test in 11.3.2, clearance in Clause 14 or EMC in Clause 18 and Annex C, as the requirement levels are different according to each environment, industrial or residential, commercial and light industrial.

5 Influence quantities

The specified performance of the time relay or coupling relay shall be given with respect to the reference conditions, for example the set of reference values of all influence quantities.

The values and tolerance ranges listed in Table 1 apply unless otherwise specified.

Table 1 – Influence quantities and reference values

Influence quantities	Reference values for tests	Tolerances during tests
Ambient temperature	23 °C	18 °C to 28 °C
Air pressure	96 kPa	86 kPa to 106 kPa
Relative humidity	50 %	25 % to 75 %
Mounting direction	As specified	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 specified	±1 %
Waveform	Sinusoidal	Maximum distortion factor 5 % ^b
Direct component in AC	As indicated by input voltage	Maximum 2 % of peak value
Alternating component in DC (ripple)	As indicated by input voltage	Maximum 6 % ^c
Shock and vibration	As specified	Maximum 1 m/s ²
Industrial and other atmospheres	Clean air	Clean air (pollution moderate, not exceeding category C3 of ISO 9223)
<p>^a In so far as they are regarded as influencing quantities in the case of time errors tolerance of ±1 %.</p> <p>^b Distortion factor: ratio of the harmonic content obtained by subtracting the fundamental wave from a non-sinusoidal harmonic quantity and the RMS value of the non-sinusoidal quantity. It is usually expressed as a percentage.</p> <p>^c The alternating component (ripple content) of a DC supply, expressed as a percentage, is defined as follows:</p> $\frac{\text{maximum value} - \text{minimum value}}{\text{DC component}} \times 100$		

6 Rated values

6.1 General

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

6.2 Input voltage and frequency

- The recommended AC rated input voltage RMS is to be specified according to one of the following values:
12 V; 20 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.
- The recommended DC rated input voltage is to be specified according to one of the following values:
5 V; 6 V; 12 V; 20 V; 24 V; 48 V; 60 V; 100 V; 110 V; 125 V; 220 V; 240 V; 250 V; 360 V.
- Rated frequency, recommended values: 50 Hz, 60 Hz, 400 Hz.
- Rated input voltage range (for example 220 V to 240 V) and corresponding frequencies (for example 50 Hz/60 Hz) shall be specified.
- The recommended operative range is to be specified as one of the following values:
 - 80 % to 110 % or

- 85 % to 110 % or
- 90 % to 110 % of rated input voltage or rated input voltage range (where applicable).

The above values apply over the full ambient temperature range, see 6.6.

In case of a deviation from the recommended range, both the rated input voltage (or range) and the corresponding operative range shall be specified.

6.3 Release voltage

The release voltage shall not be less than 10 % of the minimum rated input voltage that is specified in 6.2.

The release voltages apply over the full ambient temperature range, see 6.6.

6.4 Power consumption

The maximum power consumption of the time relay or coupling relay shall be given in VA or in W at rated input voltage or rated input voltage range (where applicable). In case of time relays or coupling relays with several input circuits, the respective maximum power consumption shall be given.

NOTE 1 For time relays or coupling relays with an input which varies depending on the position of the moved parts or for any other reason, the higher value is given.

NOTE 2 In the case of alternating current the power factor is optional.

NOTE 3 The power consumption value in W is useful for calculation of total power dissipation in cabinet.

NOTE 4 Maximum power consumption is determined using the worst steady-state case and influence quantities of the time relay or coupling relay.

6.5 Output circuit

6.5.1 General

Output load ratings shall be specified.

6.5.2 Electromechanical output circuit

6.5.2.1 General

- a) Resistive loads, inductive loads, and special loads (for example lamp loads, cable loads) shall be specified in accordance with IEC 61810-1:2015, 5.7, Annex B and Annex D or IEC 60947-5-1:2016, Table 4 and Table 5.

The following shall be stated:

- rated load values for the output circuits;
- number of cycles for electrical 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 rated load values and statistical assessed constant mean number of operating cycles (m_c) shall be stated. 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, such as 5 V/10 mA or 10 V/5 mA), meaning that with 5 V the current shall be at least 10 mA, or with 5 mA the voltage shall be at least 10 V.

6.5.2.2 Mechanical endurance

The mechanical endurance value of the internal relay shall be used. As an alternative, the mechanical endurance test in accordance with IEC 61810-1:2015, Clause 12, shall be applied.

The following shall be stated:

- number of cycles for mechanical endurance;
- frequency of operation.

6.5.3 Solid state output circuit

Load categories shall be specified in accordance with IEC 62314:2022, 5.2, as applicable.

The following values shall be specified:

- the maximum value of voltage drop at rated load current;
- the maximum value of leakage current at maximum specified ambient temperature and at rated (or maximum) switching voltage.

6.5.4 Endurance and operating frequency

The preferred values of the endurance and operating frequency are given in Table 2 and the load is given in 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 the maximum load conditions specified in 6.5.2 (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.

6.5.5 Conditional short-circuit current

The rated conditional short-circuit current of the time relay or coupling relay is the value of the prospective current, see 13.3 and 13.4. The equipment, protected by a short-circuit protective device specified by the manufacturer, can withstand satisfactorily for the operating time of this device under the test conditions specified.

NOTE For AC, the rated conditional short-circuit current is expressed by the RMS value of the AC component.

6.6 Ambient temperature

The ambient temperature range shall be 0 °C to +40 °C for the operation of time relays or coupling relays. Other ambient temperature ranges may be specified.

6.7 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.

The following values shall be specified:

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

6.8 Humidity

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

6.9 Pollution degree

Unless otherwise stated, the time relay or coupling relay is used in pollution degree 3 for industrial environment and used in pollution degree 2 for residential, commercial and light-industrial environment in accordance with IEC 60664-1. However, other pollution degrees can be considered to apply, depending upon the micro-environment. The pollution degree of the micro-environment of the time relay or coupling relay is influenced by installation in an enclosure. For example time relay or coupling relay mounting in the enclosure with IP54, time relay or coupling relay can at least meet pollution degree 2 design.

NOTE 1 The pollution degree of the micro-environment of the time relay or coupling relay can 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 time relay or coupling relay can be different from the micro-environment of the relay.

6.10 Altitude

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

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 or the altitude correction factors for clearances according to IEC 60664-1.

6.11 Timing circuit function

6.11.1 General

Subclause 6.11 does not apply to coupling relays. 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	0,1	0,5	0,6	1	1,2	3	5	6	10	12	18	20	24	30	50	60	72	100	300	500	600
Minutes	0,1	0,5	0,6	1	1,2	3	5	6	10	12	18	20	24	30	50	60	72	100	300	500	600
Hours	0,1	0,5	0,6	1	1,2	3	5	6	10	12	18	20	24	30	50	60	72	100	300	500	600

For digital time relays, the values of the setting range ending with digit 9 are additionally recommended (for example 999 min).

6.11.2 Setting accuracy

The setting accuracy will be given:

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

6.11.3 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 either a percentage value or an absolute value, for example 0,01 % or 10 ms.

6.11.4 Recovery time and minimum control impulse

To be stated by the manufacturer.

7 Provisions for testing

7.1 General

Hazards considered in this document are hazards from heating, electrical shock, ignition, EMC and foreseeable misuse before the end of life. Hazards shall not exceed a tolerable level. For the device, compliance with the tests specified in Table 5 are considered to represent a tolerable level. For the application of the time relay or coupling relay, a risk assessment shall be carried out according to Annex B.

The risk evaluation for the device and for the application follows the same assessment rules. For the device itself, the risk evaluation could be shown via this document. However, for the application this is done once more to determine the interaction of the single devices and the foreseeable misuse, for example when various time relays can be used in combination with a single socket.

7.2 Type test

In Clause 8 to Clause 18, the requirements to be checked as well as the related tests are specified.

The type tests specified are listed in Table 5.

If a specimen does not pass a test, this test shall be repeated once with an additional specimen of the same design. Additional specimens shall pass the test. In case of a modification of the time relay or coupling relay, all tests technically influenced by this modification shall also be repeated.

Unless otherwise stated in this document, 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.

Table 5 – Type testing

Type test	Clause or subclause	Minimum number of test specimens	Inspection lot	Additional references
Basic operating function	10	3	1	
Documentation and marking	8	1	1	
Heating	9	1	1	IEC 60085
Clearances and creepage distances	14	1	1	IEC 60664-1
Vibration	17.1	1	1	
Shock	17.2	1	1	
Dielectric strength and impulse withstand	11	1	2	
Electrical endurance	12	1 ^a	3	
Conditional short-circuit current	13	1	4	
Mechanical strength	15	1	5	
Heat and fire resistance	16	1	6	IEC 60695-2-11
EMC	18	1	7	
^a See 12.1.				

7.3 Routine test

Routine tests (see Table 6) are intended to detect faults in materials and workmanship and to ascertain proper functioning of the equipment. They shall be made on each individual piece of equipment.

Routine tests shall comprise:

- a) functional test;
- b) dielectric strength test.

Table 6 – Routine testing

Inspection lot	Tests	Subclause	Additional references
All	Functional test – operation	10.2	Only for coupling relay
All	Functional test – time function	10.4.2.2 10.4.2.3	Only for time relay ^a
All	Dielectric strength test	11.3.3	^b
NOTE The test can be performed at room temperature with no contacts load.			
^a For time function testing, the rated input voltage or the upper limit of the rated input voltage range specified in 6.2 shall be applied. The lower limit of the time range shall be verified. In case of fixed values, the lowest value shall be tested. If this value is longer than 1 min, the time function testing may be replaced by a sampling test. The test may be performed with unloaded output circuits.			
^b The dielectric strength test is performed according to 11.3.3 except for the following: <ul style="list-style-type: none"> • the duration of the dielectric strength test is reduced to 1 s; • the test specified in 11.3.1.a) may be omitted. 			

7.4 Sampling test

The routine test can be applied to the sampling test with at least 1 for the number of test specimens and 1 for the number of inspection lots.

8 Documentation and marking

8.1 Data

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

NOTE Product description and related properties of time relays can be found in the ACC536 class of IEC 62683 domain of IEC CDD (<https://cdd.iec.ch>).

Table 7 – Required time relay or coupling relay information

N°	Information	Notes	Place of indication
1 Identification data			
1a	Manufacturer's name, identification code or trademark		Time relay or coupling relay
1b	Type designation	It shall be unambiguous and ensure identification of the product according to the corresponding documentation	Time relay or coupling relay
1c	Date of manufacture	May be coded if specified in the documentation	Time relay or coupling relay (preferred) or package
2 Input data			
2a	Range of rated input voltage(s) with symbol for DC or AC voltages		Time relay or coupling relay
2b	Frequency for AC		Time relay or coupling relay (preferred) or catalogue or instruction sheet
2c	Maximum power consumption		Catalogue or instruction sheet
2d	Release value of input voltage		Catalogue or instruction sheet
3 Output data			

N°	Information	Notes	Place of indication
3a	Output circuit data	Rated operating voltage, rated operating current and load definition according to 12.2, 12.3 or both as applicable	Time relay or coupling 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 of an electromechanical output circuit	If applicable	Catalogue or instruction sheet
3e	Electromechanical contact material(s)	If applicable	Catalogue or instruction sheet
3f	Low energy loads	If applicable, voltage, current, operating cycles	Catalogue or instruction sheet
3g	On-state voltage drop of a solid-state output circuit	If applicable	Catalogue or instruction sheet
3h	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) and b) of 14.2.1	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 direction	If applicable	Catalogue or instruction sheet
5d	Data to permit suitable connection of the time relay or coupling relay	Including polarity	Catalogue or instruction sheet
5e	Identification of connections		Time relay or coupling relay
5f	Accessories	If essential to the time relay or coupling relay installation or to its performance	Catalogue or instruction sheet
5g	Indications for earthing or grounding of metal parts	If applicable	Time relay or coupling relay
5h	Mounting distance	If applicable	Catalogue or instruction sheet
5i	EMC immunity test levels	If Clause 18, electromagnetic compatibility (EMC) applies	Catalogue or instruction sheet
5j	Degree of protection in accordance with IEC 60529		Catalogue or instruction sheet

N°	Information	Notes	Place of indication
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 time relay and mating socket or coupling relay	Manufacturer documentation
5l	Prospective current value (if less than 1 000 A)	For conditional short-circuit current test	Catalogue or instruction sheet
5m	Type and rating of short-circuit protective device (SCPD)	For conditional short-circuit current test	Catalogue or instruction sheet
5n	Minimum and maximum size of conductor to be clamped		Catalogue or instruction sheet
5o	Length of insulation to be removed before insertion of the conductor into the terminal		Catalogue or instruction sheet
5p	Maximum number of conductors which may be clamped		Catalogue or instruction sheet
5q	Type of conductors for non-universal screwless terminals:	<ul style="list-style-type: none"> – "s", "sol" or "solid" for terminals declared for solid conductors; – "str" or "stranded" for terminals declared for stranded conductors; – "r" or "solid or stranded" for terminals declared for solid and stranded conductors; – "f" or "flexible" for terminals declared for flexible conductors. 	Catalogue or instruction sheet
5r	Torque range for screw terminals	If applicable	Catalogue or instruction sheet
6 Time function data for time relay			
6a	Specified time (nominal range of time)	Item 6a does not apply to coupling relays	Time relay (preferred) or catalogue or instruction sheet
6b	Type of function of the time relay	According to 3.2	Catalogue or instruction sheet
6c	Recovery time		Catalogue or instruction sheet
6d	Minimum control impulse time		Catalogue or instruction sheet
6e	Setting accuracy	According to Annex A	Catalogue or instruction sheet
6f	Repeatability	According to Annex A	Catalogue or instruction sheet
6g	Effect of influence	Voltage, temperature recommended According to Annex A	Catalogue or instruction sheet or manufacturer documentation
6h	Effects of subsequent operating or resetting of the control signal	According to 3.2.3 and 3.2.4	Catalogue or instruction sheet
6i	Interval time	According to 3.2.10 and 3.2.11	Catalogue or instruction sheet
NOTE Different type of insulation can be applied between circuits of a time relay, for example, between input and output circuit, between two contacts, contact gap and accessible surface.			

8.2 Marking

The data of 1a, 1b, 2a, 3a, 5e, 5g and 6a of Table 7 shall be marked on the time relay so that they are legible and durable.

The data of 1a, 1b, 2a, 3a, 5e and 5g of Table 7 shall be marked on the coupling relay so that they are legible and durable.

The test indicated below is carried out when only additional material(s) is(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/cm².

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.

9 Heating

9.1 General

Time relays or coupling relays shall be constructed so they do not attain excessive temperatures in normal use. The time relay or coupling relay manufacturer shall select the thermal classification of materials in accordance with Table 8 and indicate this classification for the respective tests.

Table 8 – Thermal classification

Thermal classification (coil insulation system)	Maximum temperature
Y	90 °C
A	105 °C
E	120 °C
B	130 °C
F	155 °C
H	180 °C
200(N)	200 °C
220(R)	220 °C
250(C)	250 °C

Table 8 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.

NOTE The thermal classification is in accordance with IEC 60085.

9.2 Test conditions

The time relay or coupling relay is operated in an appropriate heating chamber until thermal equilibrium is attained with the following conditions:

- a) The ambient temperature shall be equal to the upper limit of the ambient temperature range.
- b) The output circuit is loaded with the resistive limiting rated operating current as specified. 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.
- e) Temperature of the different parts shall be measured at those points most likely to attain the maximum temperature; these points shall be stated in the test report. The temperature sensing means shall not significantly affect the temperature rise.

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 is carried out with one time relay or coupling relay. In case it is specified that the time relay or coupling relay is suitable for mounting in rows, the test is carried out with three time relays or coupling relays mounted side by side in the same direction, with a mounting distance as specified according to IEC 61810-1:2015, Annex E.

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 9.5 or other suitable test methods.

9.3 Heating of terminals

9.3.1 General

The measuring points of fine wire thermocouples are positioned on the terminals as close as possible to the body of the time relay or coupling relay to avoid negligible effect on the temperature. 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. Areas and lengths of conductors for the terminal are according to Table 9.

9.3.2 Heating 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.

The electrical connections of the time relay or coupling relay to the voltage or current source(s) are realized with conductors according to Table 9 within the specified torque range.

The maximum permissible steady-state temperature of the terminals as indicated shall not be exceeded in thermal equilibrium.

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

Table 9 – Cross-sectional 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

9.3.3 Heating of quick-connect terminations

The electrical connections of the time relay or coupling relay to the voltage or current source(s) are realized with conductors, using female connectors according to IEC 61210 and with conductors according to Table 9.

NOTE It is common practice 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 time relay or coupling relay without significant influence from either the female connector or the quality of the crimping.

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

The temperature rise at the flat quick-connect terminations in thermal equilibrium shall not exceed 45 K. This can be verified without the temperature rise influence of the time relay or coupling relay contacts and the coil (for example bridged or short-circuited or soldered relay contacts).

The nominal dimensions of quick-connect terminations according to Table 10 are recommended.

Table 10 – Maximum steady state current dependent on the connector size

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

9.3.4 Heating of sockets

The maximum steady-state temperature limits permissible for the connections between the time relay or coupling relay and socket, as well as for the insulating materials (see 9.2) of both the time relay or coupling relay and socket, adjacent to the connection in thermal equilibrium shall not exceed 45 K.

The electrical connection between the time relay and socket, or coupling relay, shall be properly checked in order to exclude any type of overheating which could lead, overtime, to a degradation of the connection itself.

The electrical interconnections between the sockets are made with conductors according to Table 9. The electrical connections of the time relay or coupling relay to the voltage or current source(s) are realized with conductors according to Table 9.

9.3.5 Heating of alternative termination types

Time relay or coupling relay to the voltage or current source(s) are connected with conductors according to Table 9.

The maximum permissible steady-state temperature of the terminals as specified shall not be exceeded in thermal equilibrium.

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

9.4 Heating of accessible parts

The temperature rise of accessible parts in thermal equilibrium shall not exceed the values stated in Table 11.

Table 11 – Temperature rise limits of accessible parts

Accessible parts	Temperature rise limits
	K
<ul style="list-style-type: none"> Manual operating means: 	
Metallic	15
Non-metallic	25
<ul style="list-style-type: none"> Parts intended to be touched but not hand-held: 	
Metallic	30
Non-metallic	40
<ul style="list-style-type: none"> Exteriors of enclosures adjacent to cable entries: 	
Metallic	40
Non-metallic	50

9.5 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. As an alternative, the time relay or coupling relay manufacturer may provide test reports for the materials.

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 supporting live parts,

whichever is the highest.

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.

10 Basic operating function

10.1 General

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

10.2 Operate

The time relay or coupling relay shall be preconditioned by the following conditions for this test until thermal equilibrium is reached:

- a) at the maximum permissible ambient temperature specified;
- b) shall be applied with the rated input voltage as indicated, or the upper limit of the rated input voltage range specified in 6.2;
- c) the contacts (contact set) are loaded with the maximum rated operating current(s) specified.

Immediately after removal of the input voltage and related arrival at the release condition, the time relay or coupling relay shall operate again when energized at the lower limit of the operative range.

10.3 Release

The time relay or coupling relay shall reach thermal equilibrium at the minimum permissible ambient temperature. After establishing the operate condition with a brief energizing coil of the operate voltage, the input voltage shall be immediately reduced to the relevant value specified in 6.3.

When this occurs, the time relay or coupling relay shall release.

10.4 Time function

10.4.1 General

Subclause 10.4 does not apply to coupling relays.

10.4.2 Functional test at reference values of input quantities

10.4.2.1 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. For the time relay with multiple setting range functions, the shorter time setting range may be used.

For calculation of the setting accuracy, repeatability and influence effect of voltage and temperature, see Annex A.

10.4.2.2 Determination of the setting accuracy

The difference between the measured values and the setting value shall be within the tolerances of the setting accuracy indicated according to 6.11.2.

10.4.2.3 Determination of the repeatability

The difference between at least five consecutive measured values shall be within the repeatability indicated according to 6.11.3.

10.4.3 Effect of influence of voltage and temperature

The effect of the influence of the input voltage and temperature on the specified time(s) is checked; for this purpose, only one quantity as given in Table 12 will be changed whereas the other quantity has the nominal value.

The number of successive measurements shall be 10 minimum. For the time relay with multiple setting range functions, the shorter time setting range may be used.

To check the influence of the temperature, time relays are operated in an appropriate chamber until thermal equilibrium is attained at the ambient temperature as given in Table 12. 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 time relay accomplishes its function properly within the specified tolerance values.

Table 12 – Changing of influencing quantities

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

11 Dielectric strength and impulse withstand

11.1 General

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

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

The rules for dimensioning basic, double and reinforced insulation as stated in IEC 60664-1 and IEC 60664-3 apply, based on overvoltage category, pollution degree and rated voltage stated by the manufacturer according to the requirements of this document.

The rules for dimensioning functional insulation as stated in IEC 60664-1 apply, based on overvoltage category, pollution degree and rated voltage stated by the manufacturer according to the requirements of this document.

The insulation of circuits within the time relay or coupling relay shall be tested in accordance with the maximum rated insulation voltage and overvoltage category of the time relay or coupling relay.

11.2 Preconditioning

The tests of 11.3 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 °C 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 (90 to 96) % RH. The air temperature shall be maintained at (38 to 42) °C with an accuracy of ± 2 K in the area where the specimens are mounted. The specimens are kept in the chamber for 4 days. There shall be no condensation.

11.3 Insulation test

11.3.1 General

The time relay or coupling relay shall withstand the impulse withstand test and dielectric test as specified in Table 13 and Table 14 or Table 15 in order to meet the requirements of the clearances and creepage distances in Clause 14.

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 time relays or coupling 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.

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 criteria shall be acceptable if neither a breakdown nor a flashover occurs. The influence of the time relay or coupling relay under test, if any, is ignored.

11.3.2 Impulse withstand test

The 1,2/50 μ s impulse voltage shall be applied as defined in IEC 61180. The output is then connected to the equipment to be tested and the impulse applied three times for each polarity at intervals of 1 s minimum. The influence of the equipment under test on the waveshape, if any, is ignored.

Therefore the measurement of the test voltage and determination of the impulse shape according to IEC 61180:2016, 7.1.4, and the verification of the waveshape according to IEC 61180:2016, 7.2.1, may be omitted; in such case the waveshape has to be monitored by oscillographic means in order to detect the disruptive discharges.

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 IEC 60664-1:2020, 6.2.2.1.4, applies.

Unearthed voltage systems have to be treated as corner-earthed systems.

Table 13 – Impulse test for basic insulation

Voltage line to earth AC RMS or DC	Residential Overvoltage category II		Industrial Overvoltage category III	
	Rated impulse withstand voltage	Impulse withstand test voltage at sea level	Rated impulse withstand voltage	Impulse withstand test voltage at sea level
V	V	V	V	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

11.3.3 Dielectric AC 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 for basic insulation shall be raised uniformly from 0 V to the value specified in Table 14 or Table 15, within not more than 5 s and held at that value for at least 60 s. The test criteria shall be acceptable if neither a breakdown nor a flashover occurs and the function remains unchanged. A current of not more than 3 mA is permitted.

The test voltage values for double insulation or reinforced insulation should be twice those for basic insulation (see IEC 60664-1:2020, 5.4.3 and 6.4.5.1).

If an alternating test voltage cannot be applied, for example due to EMC filter components, a DC test voltage may be used having the value of Table 14, third column. The measurement accuracy of the test voltage shall not exceed $\pm 3\%$.

Table 14 – Dielectric test voltage for basic insulation for devices suitable for use in single-phase three- or two-wire AC and DC systems

Nominal voltage of the supply system (U_N)	AC test voltage, 60 s (RMS)	DC test voltage ^a
V	V	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 For supply system topology, see IEC 60664-1:2020, Annex B.		
NOTE 2 The values for AC test voltages are derived from the formula $U_N + 1\,200$ V (see IEC 60664-1:2020, 5.4.3).		
^a Test voltages are based on IEC 60664-1:2020, 6.4.5.1, fifth paragraph.		

Table 15 – Dielectric test voltage for basic insulation for devices suitable for use in three-phase four or three-wire AC 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 For supply system topology see IEC 60664-1:2020, Annex B.

NOTE 2 The values are derived from the formula $U_N+1\ 200$ V (see IEC 60664-1:2020, 5.4.3).

12 Electrical endurance

12.1 General

Electrical endurance determines the resistance of relays against electrical wear. It is characterized by the number of operating cycles under load conditions which the time relay or coupling relay is capable to carry out properly without maintenance, repair or replacement of components. If not otherwise specified, 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 IEC 61810-1:2015, Clause 11, for electromechanical outputs or with IEC 62314:2022, Clause 10, for solid state outputs. The test will be performed using one of the nominal time relay or coupling relay ratings, as defined in the test report. Unless otherwise specified, the minimum requirement is 6 000 cycles.

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

12.2 Resistive loads, inductive loads, and special loads

The test is performed on each contact load and each contact material.

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

Resistive loads, inductive loads, and special loads (for example Lamp loads, cable loads) shall be specified in accordance with IEC 61810-1:2015, 5.7, Annex B and Annex D, or IEC 60947-5-1:2016, Table 4 and Table 5.

12.3 Low energy loads

Low energy loads as specified 6.5.2.1 b) shall be tested in accordance with IEC 60947-5-4.

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

13 Conditional short-circuit current of an output circuit

13.1 General

The switching element of the time relay or coupling relay shall withstand the stresses resulting from short-circuit currents as specified in 6.5.5.

13.2 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.

13.3 Test circuit electromechanical output circuit

The output terminals shall be connected in series with the short-circuit protective device of the type and rating stated; it shall also be in series with the make switch intended to close the circuit as shown in Figure 16. The switching element shall be mounted in the time relay or coupling relay.

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 but not less than 100 A, at a power factor of between 0,5 and 0,7 and at the rated operational voltage. The open circuit voltage shall be 1,1 times the maximum rated operational voltage of the switching element.

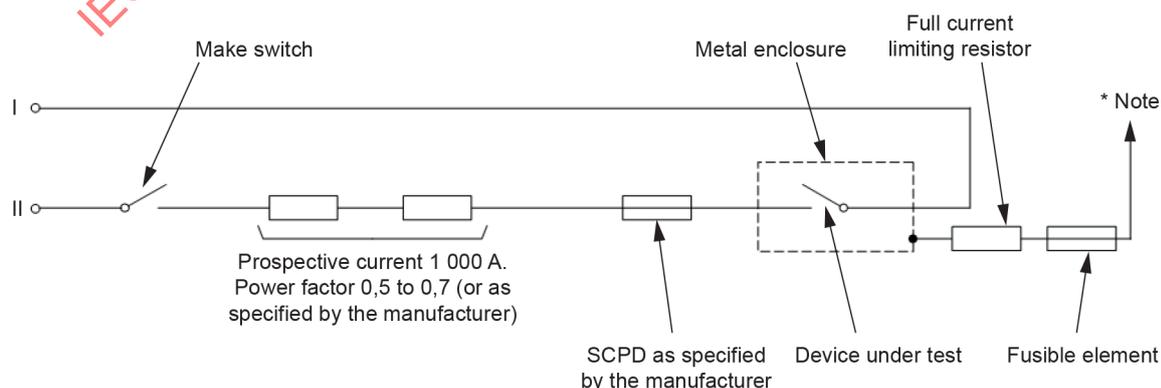
The test shall be performed three times on the same contact element, the SCPD being reset or replaced after each test. The time interval between the tests shall be not less than 3 min. The actual time interval shall be stated in the test report.

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

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

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

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



IEC

NOTE The fusible element is connected alternatively to I or II on successive tests.

Figure 16 – Test circuit electromechanical output, conditional short-circuit current

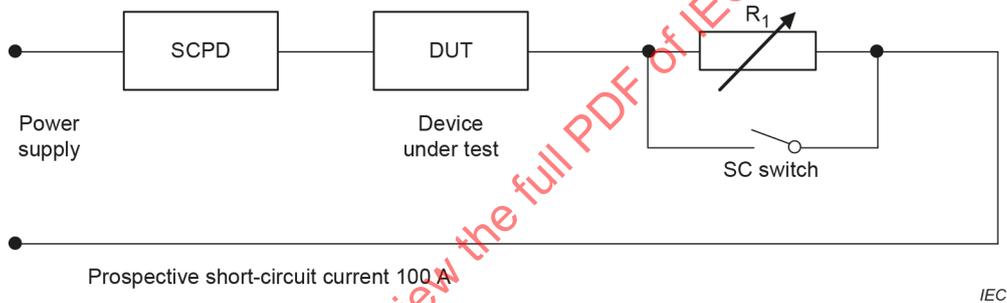
13.4 Test circuit solid state output circuit

The time relay or coupling relay in the 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 17.

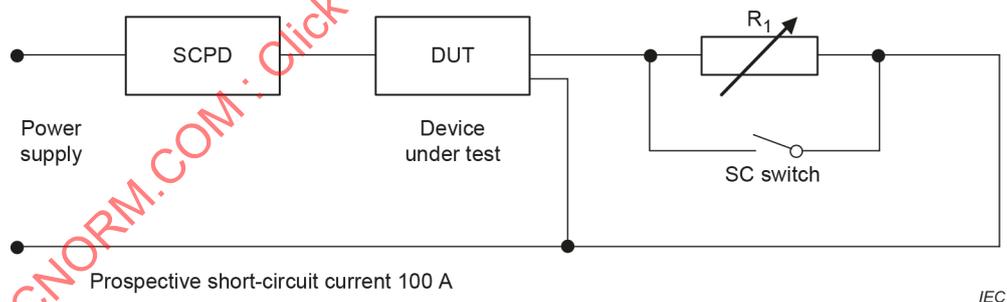
The short-circuit protective device (SCPD) shall be of the type and rating stated.

The switching element is in the ON-state, and R_1 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 the R_1 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) two-terminal AC or two-terminal DC



b) three-terminal AC or three-terminal DC

Figure 17 – Test circuit solid state output, conditional short-circuit current

13.5 Condition of switching element after test

- a) After the short-circuit test the time relay or coupling relay shall be able to switch to the release condition.
- b) After the test the device shall withstand the dielectric strength test according to 11.3.

14 Insulation coordination and protection against electric shock

14.1 General

Insulation coordination reflects clearances, creepage distances, solid insulation and protection against direct contact.

14.2 Clearances and creepage distances

14.2.1 General

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

NOTE 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 time relay or coupling relay is mounted apply and not those in the factory to which the location belongs.

Where time relays or parts of time relays, or coupling relays or parts of coupling relays are protected against conductive pollution, creepage distances and clearances may be dimensioned in accordance with immediate environmental conditions. The degree of protection to be provided in the installation environment (for example by use of a suitable enclosure) shall be stated.

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 (see IEC 60664-3).

Clearances and creepage distances between mutually insulated circuits (for example 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 unless full disconnection according to IEC 61810-1 is specified. Clearances and creepage distances specified for pollution degree 2 or 3 do not apply in the case of electronic components either (for example 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 IEC 60664-1 and IEC 60664-3, the basic safety standards in the field of low voltage insulation coordination, one or both of the following options a) and b) shall be selected:

- a) 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 according to IEC 60664-3:2016, 5.7.2: -10 °C ;
 - temperature cycle according to IEC 60664-3:2016, 5.7.4: severity 1;
 - partial discharge test according to IEC 60664-3:2016, 5.8.5, is not required;
 - no additional tests according to IEC 60664-3:2016, 5.9, are required.
- b) In the case of time relays or coupling 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.

14.2.2 Clearances

The clearance values for time relays and coupling relays shall fulfil the requirements of overvoltage category III. When time relays and coupling relays are permanently connected to the power distribution network, the applicable overvoltage category shall be determined according to IEC 60664-1:2020, 4.3.2. Clearances shall be selected from Table 16. For double and reinforced insulation the values of the next higher rated impulse withstand voltage from Table 16 are applicable.

Table 16 – Minimum clearances for basic insulation

Voltage line to earth (AC RMS or DC)		Rated impulse withstand voltage	Minimum clearances up to 2 000 m above sea level ^a		
Cat II	Cat III		Pollution degree		
			1	2	3
			mm	mm	mm
V	---	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 IEC 60664-1:2020, Table A.2.

When an overvoltage control component is used (for example surge suppressor), clearances may be defined in accordance with Table 17.

Table 17 – Minimum clearances in controlled overvoltage conditions

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.

14.2.3 Creepage distances

Creepage distances shall be selected from Table 18.

Table 18 – Minimum creepage distances for basic insulation

Voltage ^a RMS or DC V	Creepage distances in millimetres								
	Printed wiring material		Other materials						
	Pollution degree		Pollution degree						
	1	2	1	2 Material group			3 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 time relay or coupling 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 $600 \leq \text{CTI}$;
- material group II $400 \leq \text{CTI} < 600$;
- material group IIIa $175 \leq \text{CTI} < 400$;
- material group IIIb $100 \leq \text{CTI} < 175$.

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.

For reinforced and double insulation, twice the values from Table 18 are applicable.

14.3 Solid insulation

Solid insulation shall be capable of durably withstanding electrical and mechanical stresses as well as thermal and environmental influences which can occur during the anticipated life of the relay.

The qualification of the solid insulation shall be verified by tests according to the insulation, vibration and shock test (see 11.3, 17.1 and 17.2).

There is no dimensional requirement for the thickness of solid insulation.

Test voltage values for double insulation and reinforced insulation shall be twice those for basic insulation for the power frequency test (see Table 14 and Table 15), and the test voltage for the impulse withstand test shall be one level higher than that for basic insulation (see Table 13).

The basic insulation is always directly adjacent to the hazardous potential.

This requirement, however, is not applicable where the insulation consists of thin layers, except for mica and similar scaling material, and if

- for supplementary insulation, the insulation consists of at least two layers, provided that each of the layers withstands the dielectric strength test of 11.3 for supplementary insulation;
- for reinforced insulation, the insulation consists of at least three layers, provided that any two layers withstands the dielectric strength test of 11.3 for reinforced insulation.

14.4 Protection against direct contact

For time relays or coupling relays being operated as in normal use, for example in the case of time setting for the time relay, all accessible parts which carry voltages shall have a sufficient direct contact protection with a minimum degree of protection of IP20 in accordance with IEC 60529.

This requirement does not apply where insulated by reinforced insulation or double insulation from hazardous live parts with the rated voltage not exceeding 50 V AC (RMS value)/60 V DC.

NOTE SELV circuits can be considered to meet this exception.

Protection is regarded as ensured where the degree of protection of enclosure is IP 2X or better according to IEC 60529.

15 Mechanical strength

15.1 General

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

Internal connecting lines shall be designed in such a way that they cannot be damaged by elements such as sharp edges.

Compliance is checked by the test of Clause 18.

Time relays or coupling relays shall meet the above requirements, even after appropriate transport. Unless constructional measures can meet the above requirements, protection against mechanical damage shall be ensured through precautionary measures during transport. In special cases instructions for package and transport shall be attached.

15.2 Mechanical strength of terminals and current-carrying parts

15.2.1 General

Current-carrying parts including the terminals shall be provided with adequate metals for their intended use according to 15.2.2 to 15.2.5.

15.2.2 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 time relay or coupling relay (not that of the terminal, which might be higher) as specified.

15.2.3 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 even if non-isolated female connectors are mounted on the male tabs; in case these requirements can only be fulfilled with isolated female connectors, this shall be explicitly stated in the product documentation.

15.2.4 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 60068-2-2:2007, 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 the time relay or coupling relay and socket.

For the measurement of the resistance across the time relay or coupling relay and socket terminations it is permissible to use the time relay or coupling relay dummy (for example with short-circuited relay contacts).

The tests shall be performed with the sockets specified and stated in the documentation of the time relay or coupling relay.

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

15.2.5 Mechanical strength of alternative termination types

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

16 Heat and fire resistance

16.1 General

Time relays or coupling relays shall be constructed with resistance to abnormal heat and fire.

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. Compliance is checked by the test of 16.2.

16.2 Glow-wire test

The glow-wire test is carried out to verify that the requirements regarding the resistance of solid insulating materials to heat and fire are met.

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 passed if the flame or glowing of the tested part is extinguished within 30 s after removal of the glow wire.

17 Vibration and shock

17.1 Vibration

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

During the test in the operated condition, the time relay or coupling relay shall be energized preferably at the lower limit of the operative range according to 6.2, that is to say with 80 %, 85 % or 90 % of the rated input voltage.

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

The test shall be carried out in accordance with IEC 60068-2-6, under the following conditions unless otherwise specified:

- frequency range: 10 Hz to 150 Hz;
- cross-over frequency: 60 Hz;
- $f < 60$ Hz constant amplitude of movement 0,15 mm;
- $f > 60$ Hz constant acceleration 20 m/s² (2 g);
- number of sweep cycles per axis: 10;
- sweep speed: 1 octave/min.

The setting 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.

The test shall be considered satisfactory if the time relays or coupling relays

- a) comply with the dielectric voltage test according to 11.3.3;
- b) function properly within the specified tolerance values;
- c) show no rupture nor deformation.

17.2 Shock

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

During the test in the operated condition, the time relay or coupling relay shall be energized preferably at the lower limit of the operative range according to 6.2, that is to say with 80 %, 85 % or 90 % of the rated input voltage.

During the test the contact openings should be monitored, unless otherwise specified, up to 100 m/s² only. Contact openings up to 3 ms are not considered as failures.

Unless otherwise specified, the test shall be carried out in accordance with IEC 60068-2-27 under the following conditions:

- mechanical shock value for endurance: 300 m/s²;
- axis in both the positive and negative senses: 6;
- number of mechanical shock per each direction: 3.

The setting time shall not have been changed due to shock 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.

18 Electromagnetic compatibility (EMC)

18.1 General

Time relays or coupling relays not incorporating electronic circuits with active components are not sensitive to electromagnetic disturbances in normal service conditions, and therefore no EMC tests are required.

18.2 Immunity

The behaviour of the time relay or coupling relay submitted to the immunity tests shall be in accordance with the requirements in Table C.2 for industrial environments and Table C.3 for residential, commercial and light-industrial environments according to the specification.

The appropriate tests to verify the compliance with these requirements are given in Clause C.2.

The time relay or coupling relay shall be placed as a single device under test in the test setup according to the cited document and connected on all ports as specified. The test may be performed with no load for output ports. Each test of the time or coupling relay shall be done

- a) in operate condition with rated values applied, and
- b) in release condition, with all supplies except the control voltage at rated value. This exception is only for the OFF delay function.

For the evaluation of the tests the performance criteria as defined in Table C.2 shall be used.

It is not always possible to test every function and every specified time of the time relay; in such cases the most critical mode of operation shall be selected.

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

18.3 Radiated and conducted emission

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

Time relays or coupling relays intended for use in industrial installation shall fulfill class A requirements in accordance with CISPR 11:2015, Clause 5, for industrial requirements.

Time relays or coupling relays intended for use in residential installation shall fulfill class B requirements in accordance with CISPR 11:2015, Clause 5, for residential, commercial and light-industrial environments.

The appropriate tests to verify the compliance with these requirements are given in Clause C.3.

All emission tests shall be performed with the time relay or coupling relay in operate condition with rated values applied.

19 Cybersecurity for industrial automation and control systems (IACS)

If embedded firmware is involved, cyber-security aspects should be considered according to IEC 62443-4-2.

NOTE IEC TS 63208 gives guidance on security aspects in the context of low voltage switchgear and controlgear.

Moreover, embedded software should be designed according to the recommendations stated in IEC TR 63201.

20 Environmental information

20.1 Environmentally conscious design process

Environmentally conscious design process is described in IEC 62430.

20.2 Procedure to establish material declaration

When customers request a material declaration, IEC 62474 provides the framework.

NOTE IEC 60947-1:2020, Annex W, gives guidance on the material declaration in the context of low voltage switchgear and controlgear.

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Annex A (informative)

Setting accuracy, repeatability and effect of influence calculation

A.1 General

The setting accuracy, repeatability and effect of influence are determined from the following calculation formulae in Table A.1.

Table A.1 – Calculation formulae

Accuracy / Influence effects		Formulae
Accuracy	Setting	$\left \frac{T_M - T_S}{TM_S} \right \times 100 (\%)$
	Repeatability	$\pm \frac{1}{2} \times \frac{T_{\max} - T_{\min}}{TM_S} \times 100 (\%)$
Influence effects	Voltage	$\pm \frac{TM_{x1} - TM}{TM_S} \times 100 (\%)$
	Temperature	$\pm \frac{TM_{x2} - TM}{TM_S} \times 100 (\%)$
<p>where</p> <p>T_M is the mean of the measured values;</p> <p>T_S is the setting time;</p> <p>TM_S is the full-scale value with analogue setting, or setting value in absolute values with digital setting;</p> <p>T_{\max} is the maximum measured value;</p> <p>T_{\min} is the minimum measured value;</p> <p>TM_{x1} is the maximum measured value within the rated input voltage range;</p> <p>TM_{x2} is the maximum measured value within the ambient temperature range.</p>		

A.2 Example of calculation

Measured values: 9,91 s, 9,95 s, 10,01 s, 9,97 s, 9,99 s, 10,05 s, 10,02 s, 9,98 s, 10,00 s, 9,93 s

$$TM = 9,981 \text{ s}$$

$$TM_S = 10 \text{ s}$$

$$T_S = 10 \text{ s}$$

$$T_{\max} = 10,05 \text{ s}$$

$$T_{\min} = 9,91 \text{ s}$$

$$\text{Setting accuracy} = \left| \frac{9,981 - 10}{10} \right| \times 100 (\%) = 0,19 \%$$

$$\text{Repeatability} = \pm \frac{1}{2} \times \frac{10,05 - 9,91}{10} \times 100 (\%) = 0,70 \%$$

Annex B (informative)

Risk assessment

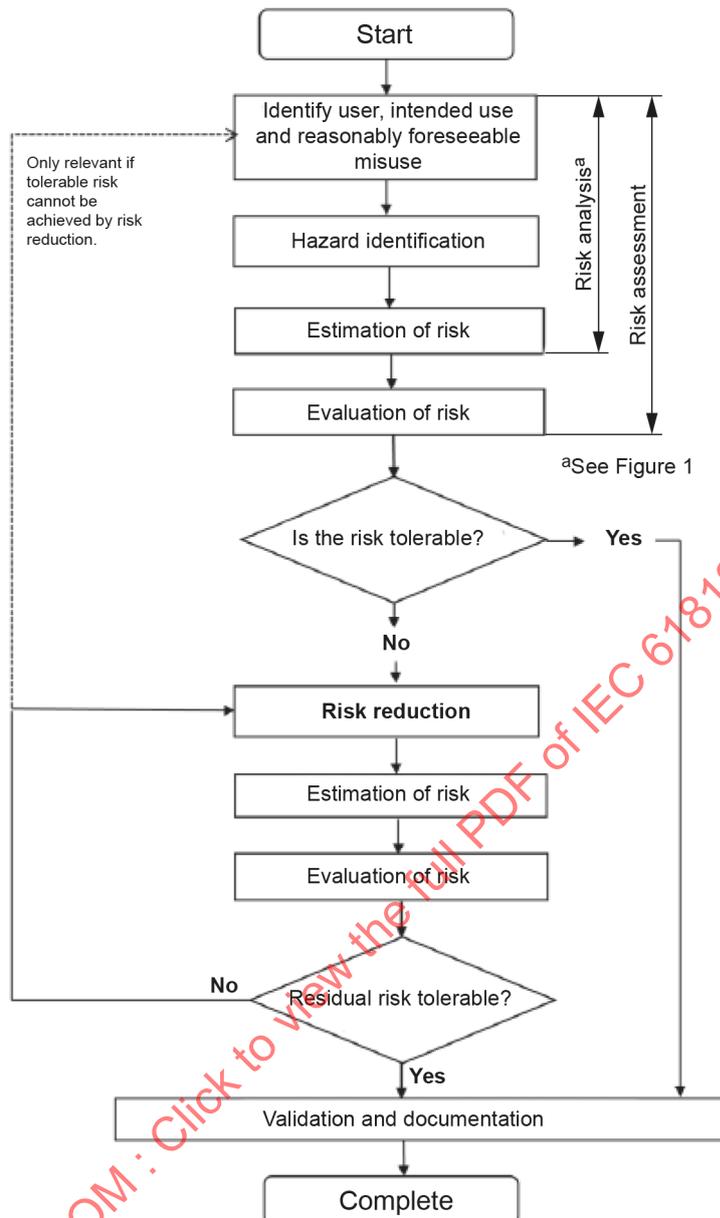
B.1 General

A risk assessment process based on ISO/IEC Guide 51 is given below. Other risk assessment procedures are contained in ISO 14971, SEMI S10, IEC 61508 series, ISO 14121-1, and ANSI TR3. Other established procedures which implement similar steps can also be used.

B.2 Risk assessment procedure

Tolerable risk is achieved by the iterative process of risk assessment (risk analysis and risk evaluation) and risk reduction (see Figure B.1).

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[SOURCE: ISO/IEC GUIDE 51:2014, Figure 2]

^a The footnote refers to ISO/IEC GUIDE 51:2014, Figure 1.

Figure B.1 – Iterative process of risk assessment and risk reduction

B.3 Achieving tolerable risk

The following procedure (see Figure B.1) should be used to reduce risks to a tolerable level:

- a) identify the likely user group(s) for the product, process, or service (including those with special needs and the elderly), and any known contact group (for example use or contact by children);
- c) identify the intended use and assess the reasonably foreseeable misuse of the product, process or service;
- d) identify each hazard (including any hazardous situation and harmful event) arising in all stages and conditions for the use of the product, process or service, including installation, maintenance, repair, and destruction or disposal;

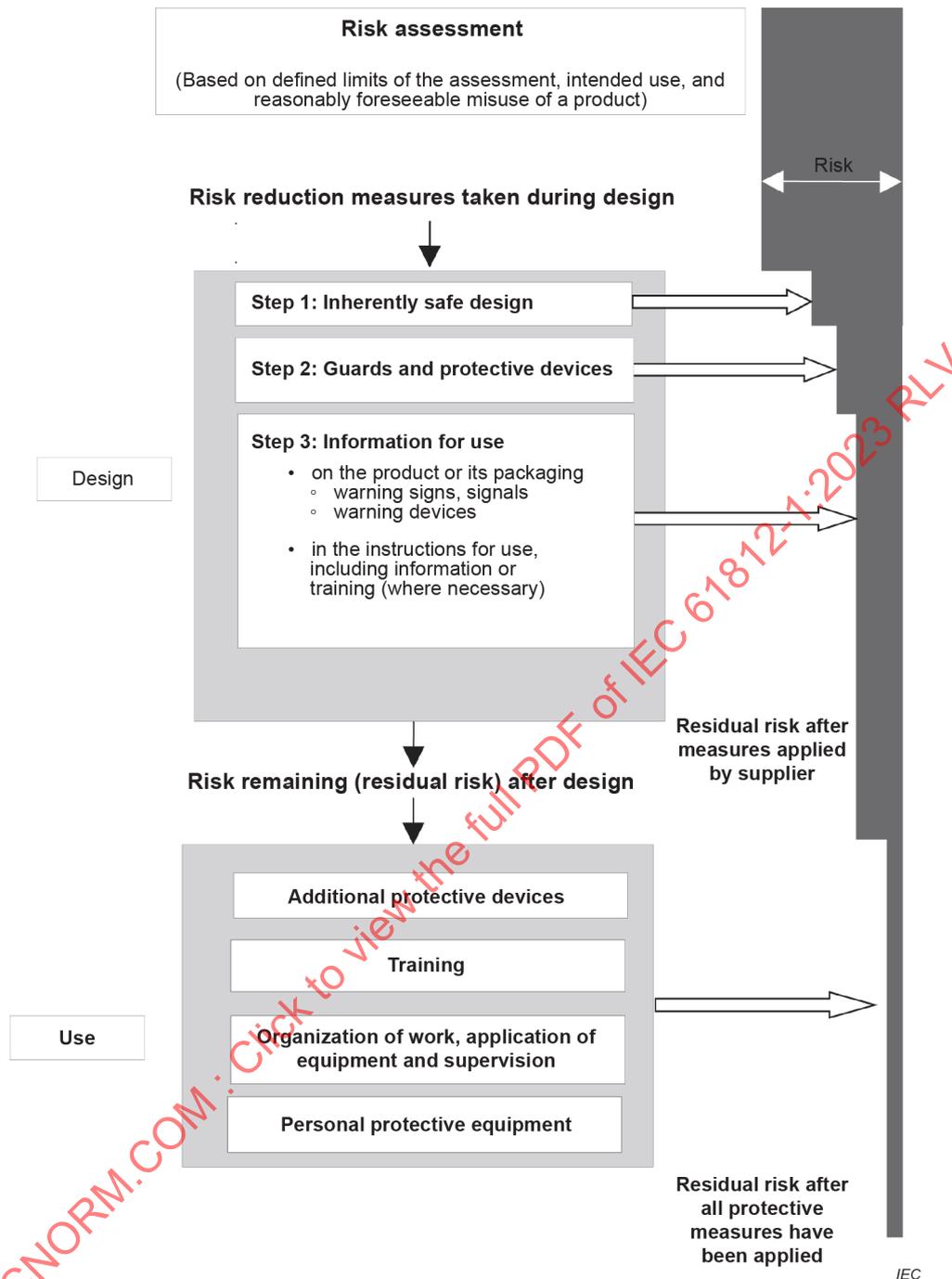
- e) estimate and evaluate the risk (see Figure B.1) to each identified user/contact group arising from each hazard identified;
- f) judge if the risk is tolerable (for example by comparison with similar products, processes or services);
- g) if the risk is not tolerable, reduce the risk until it becomes tolerable.

When reducing risks the order of priority should be as follows:

- 1) eliminate or reduce risks as far as possible (inherently safe design and construction);
- 2) take the necessary protection measures in relation to risks that cannot be eliminated (protection devices);
- 3) inform users of the remaining risk after design due to any shortcomings of the protection measures adopted, indicate whether any particular training is required, and specify any need to provide personal protection equipment (information for safety).

This procedure is based on the assumption that the user has a role to play in the risk reduction procedure by complying with the information provided by the manufacturer (see Figure B.2).

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[SOURCE: IEC 62314:2022, Figure B.2.]

Figure B.2 – Risk reduction

The steps taken in the design procedure are shown in order of priority. The steps to be taken by the user are not in order of priority because this would depend on the application. It is emphasized that the additional protection devices, personal protection equipment and provision of information to users should not be used as substitutes for design improvements.

This step or procedure has to be done for each component as well for all components together (= device). The responsibility is clearly defined that for the component the responsibility has to be taken by the manufacturer. The responsibility for the assembled/complete device is on the side of the user (OEM or manufacturer/developer of the device).

For the relay as component, the considered hazards are given as examples in Table B.1 based on Figure B.3. However, users have to consider which failure modes are risky and take these or all within their risk consideration.

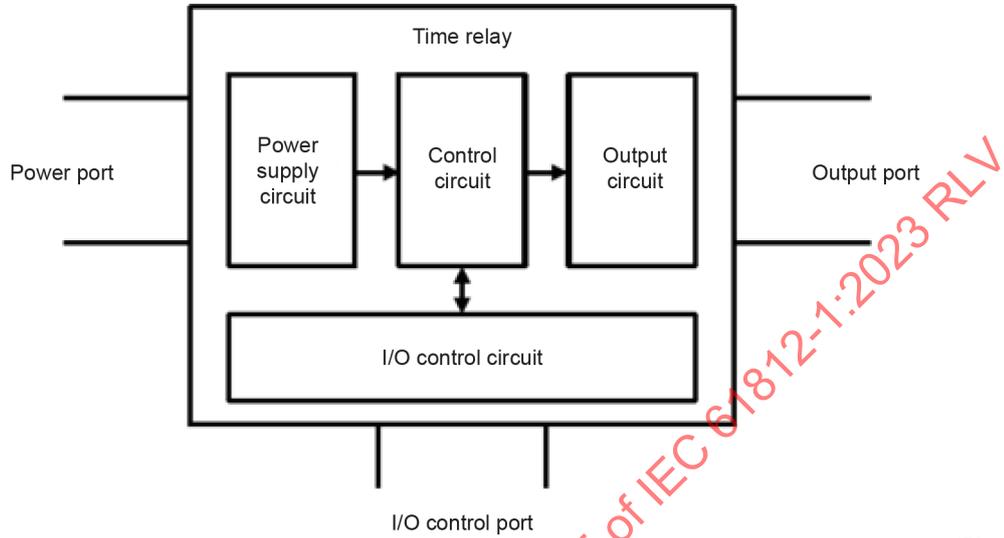


Figure B.3 – Example of the time relay circuit block diagram

Table B.1 – Examples of the relation between failure mode, consequences and hazard

Failure mode	Consequences		Hazard
Failure of power supply circuit	The time relay or coupling relay will not work properly or never work, because a part, a device or a conductor of a printed board in the power supply circuit has been opened or short-circuited.	The power supply for the time relay or coupling relay is not interrupted.	Worst case: uncontrolled heating (overheating), ignition with flame.
		The power supply for the time relay is interrupted.	None (just loss of function).
Failure of I/O control circuit	The time relay or coupling relay will not work properly or never work, because a part, a device or a conductor of a printed board in the I/O control circuit has been opened or short-circuited.	Input signal for the time relay or coupling relay is not interrupted.	Degradation of performance.
		Input signal for the time relay or coupling relay is interrupted.	Loss of function.
Failure of control circuit	The time relay or coupling relay will not work properly or never work, because a part, a device or a conductor of a printed board in the control circuit has been opened or short-circuited.	The power supply for internal circuits is not interrupted.	Worst case: uncontrolled heating (overheating), ignition with flame if the power supply is not interrupted.
		The power supply for internal circuits is interrupted.	Loss of function.
		Relay coil is opened.	None (just loss of function).
Failure of output circuit	The time relay or coupling relay will not work properly or never work, because a part, a device or a conductor of a printed board in the output circuit has been opened or short-circuited.	Relay contact bridging.	Worst case: uncontrolled heating (overheating), ignition with flame if the power supply is not interrupted.

B.4 Application of risk assessment procedures (proposal for the user)

For hazards in the scope of this document, examples of severity of harm are given in Table B.2. Probability of harm is given in Table B.3. The risk category, which is selected based on severity and probability, is given in Table B.4.

Table B.2 – Severity of harm

Severity group	People	Equipment/Facility
Catastrophic	One or more fatalities	Facility loss
Severe	Disabling injuring/illness	Major system loss or facility damage
Moderate	Medical treatment or restricted work activity	Minor subsystem loss or facility damage
Minor	First aid only	Non-serious equipment or facility damage

Table B.3 – Probability of harm

Probability of harm					
Typical occurrence of failure modes (to be assessed by product and application)		Rate of occurrence			
		Frequent	Possible	Rare	Unlikely
Failure modes	Failure to break	X	X	X	X
	Failure to make			X	X
	Failure of supplementary insulation		X	X	X
	Failure of reinforced insulation (basic insulation shall remain)		X	X	X
	Failure of functional insulation		X	X	X
	Input circuit interruption			X	X
	Failure of basic insulation		X	X	X

NOTE Table B.3 is taken from IEC 62314:2022, Table B.3.

Table B.4 – Risk category

Risk assessment/risk category					
Severity of harm		Probability of harm			
		Frequent	Possible	Rare	Unlikely
Severity	Catastrophic	3	3	2	2
	Severe	3	2	2	1
	Moderate	3	1	1	1
	Minor	2	1	1	1
Key	Category	Description			
1	Broadly acceptable	This fulfils the requirement for tolerable risk.			
2	As low as reasonably practicable	This does not automatically fulfil the requirement for tolerable risk. If possible, these risks should be reduced further to Category 1. If not possible, then the instructions should contain a description of the risk so that the responsible body can take appropriate steps to protect the safety of operators.			
3	Intolerable	This contains risks that are not tolerable risk.			

NOTE Table B.4 is taken from IEC 62314:2022, Table B.4.

Annex C (normative)

Tests for EMC

C.1 General

Annex C states the EMC tests for time relays and coupling relays where EMC tests are required.

For products falling within the scope of Annex C, Table C.1 shows two sets of environmental conditions as:

- a) industrial environments;
- b) residential, commercial and light-industrial environments.

Table C.1 – Environmental conditions influencing EMC

	High emission	Low emission
Low immunity	Not allowed	Residential (b)
High immunity	Industrial (a)	All environments

Industrial examples of such equipment are switches in the power distribution network and equipment for industrial use with permanent connection to the power distribution network.

Time relays or coupling relays shall be specified for industrial environments when one or more of the following is expected:

- 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.

C.2 EMC immunity

C.2.1 General

The EMC requirements have been selected to ensure a satisfactory immunity against electromagnetic disturbances of time relays and coupling relays. Tests shall be carried out in accordance with the basic standards given in Annex C and with the specified conditions of Table C.2 for industrial environments and Table C.3 for residential, commercial and light-industrial environments.

The behaviour of the time relay or coupling relay submitted to the immunity tests shall be in accordance with the requirements in Table C.2 for industrial environments and Table C.3 for residential, commercial and light-industrial environments.

C.2.2 Performance criteria

C.2.2.1 General

The performance criteria are defined in detail in C.2.2.

- Performance criterion A: No disturbance of function is allowed in that the adjusted time function (for example 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 according to 3.1.3. The nominal values of the specified time, such as 10 s, are given in Table 4. 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 (for example 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 condition 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.

C.2.2.2 Electrostatic discharges

This test shall be performed according to IEC 61000-4-2:2008, Clause 7 and Clause 8, with the values given in Table C.2 or Table C.3. See IEC 61000-4-2 for applicability of contact or air discharge tests or both.

C.2.2.3 Radiated radio-frequency electromagnetic fields

This test shall be performed according to IEC 61000-4-3:2020, Clause 7 and Clause 8, with the values given in Table C.2 or Table C.3.

C.2.2.4 Electrical fast transients/bursts

This test shall be performed according IEC 61000-4-4:2012, Clause 7 and Clause 8, with the values given in Table C.2 or Table C.3. The test shall be performed at repetition frequencies of 5 kHz. As an alternative, 100 kHz may be selected.

C.2.2.5 Surges

This test shall be performed according to IEC 61000-4-5:2014 and IEC 61000-4-5:2014/AMD1:2017, Clause 7 and Clause 8, with the values given in Table C.2 or Table C.3.

C.2.2.6 Conducted disturbances induced by radio-frequency fields

This test shall be performed according to IEC 61000-4-6:2013, Clause 7 and Clause 8, with the values given in Table C.2 or Table C.3.

C.2.2.7 Immunity to power-frequency magnetic fields

The test method shall be in accordance with IEC 61000-4-8:2009, Clause 7 and Clause 8, with the test levels as defined in Table C.2 or Table C.3.

C.2.2.8 Voltage dips and voltage interruptions

This test shall be performed in accordance with IEC 61000-4-11:2020, Clause 7 and Clause 8, for solid state relays with a rated operational current less than 16 A and in accordance with IEC 61000-4-34 for time relays or coupling relays with a rated operational current higher than 16 A.

C.2.2.9 Summary of Immunity test conditions

Table C.2 and Table C.3 summarize the test conditions and requirements of immunity tests. The configuration and mode of operation during the tests shall be precisely noted in the test report. For each test, the respective test level shall be stated.

Table C.2 – 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 6 GHz	10 V/m enclosure port 3 V/m enclosure port	A
Electrical fast transient/burst ^f IEC 61000-4-4	±2 kV AC, DC power port ±1 kV control port using the capacitive coupling clamp ^a 5 kHz or 100 kHz repetition frequency	B
Surges (1,2/50 µs to 8/20 µs) ^g IEC 61000-4-5	±2 kV required for AC power ports (line to earth) ±1 kV required for control port, DC power ports (line to earth) ±1 kV required for AC power ports (line to line) ±0,5 kV required for DC power ports (line to line)	B
Conducted radio-frequency at 150 kHz to 80 MHz IEC 61000-4-6	10 V control ports, AC/DC power ports	A
Immunity to power-frequency magnetic fields IEC 61000-4-8 ^b	not applicable	A
Voltage dips ^{c, d} IEC 61000-4-11	Class 3 ^e 0 % residual voltage during 1 cycle AC power ports	B
	40 % residual voltage during 10/12 cycles AC power ports	C
	70 % residual voltage during 25/30 cycles AC power ports	C
Voltage interruptions ^{c, d} IEC 61000-4-11 for rated operational current ≤ 16 A IEC 61000-4-34 for rated operational current > 16 A	0 % residual voltage during 250/300 cycles AC power ports	C
^a ±2 kV direct current when control port is connected to the power supply during the test. ^b Equipment susceptible to power frequency magnetic fields as declared, shall be tested with 30 A/m (50 Hz, 60 Hz). ^c The value in front of the slash mark (/) is for 50 Hz and the value behind for 60 Hz tests. ^d If the functional interruption times are more severe values from the required test level, this shall be acceptable and noted in the test report. ^e Class 3 applies to points of common coupling and in-plant points of common coupling in the industrial environment in general. ^f Control ports – applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m. ^g Applicable also to control ports interfacing with cables whose total length according to the manufacturer's functional specifications may exceed 30 m.		

Table C.3 – 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 6 GHz	3 V/m enclosure port 3 V/m enclosure port	A
Electrical fast transient/burst ^e IEC 61000-4-4	±1 kV AC power port ±0,5 kV DC power port ±0,5 kV control port using the capacitive coupling clamp ^a	B
Surges (1,2/50 µs to 8/20 µs) ^f IEC 61000-4-5	±2 kV required for AC power ports (line to earth) ±1 kV required for DC power ports (line to earth) ±1 kV required for AC power ports (line to line) ±0,5 kV required for DC power ports (line to line)	B
Conducted radio-frequency at 150 kHz to 80 MHz IEC 61000-4-6	3 V RMS control ports, AC/DC power ports	A
Immunity to power-frequency magnetic fields IEC 61000-4-8 ^b	not applicable	A
Voltage dips ^{c, d} IEC 61000-4-11	0 % residual voltage during 1 cycle AC power ports	B
	70 % residual voltage during 25/30 cycles AC power ports	C
Voltage interruptions ^{c, d} IEC 61000-4-11 for rated operational current ≤ 16 A IEC 61000-4-34 for rated operational current > 16 A	0 % residual voltage during 250/300 cycles AC power ports	C
^a ±1 kV direct current when control port is connected to the power supply during the test. ^b Equipment susceptible to power frequency magnetic fields as declared, shall be tested with 3 A/m (50 Hz, 60 Hz). ^c If the functional interruption times are more severe values from the required test level, this shall be acceptable and noted in the test report. ^d The value in front of the slash mark (/) is for 50 Hz and the value behind for 60 Hz tests. ^e Control ports – applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m. ^f Applicable also to control ports interfacing with cables whose total length according to the manufacturer's functional specifications may exceed 30 m.		

C.3 EMC radiated and conducted emission

C.3.1 General

The requirements of 18.3 apply.

C.3.2 Conducted radio-frequency emission tests

The description of the test, the test method and the test set-up are given in CISPR 11:2015 and CISPR 11:2015/AMD1:2016, Clause 7. To pass the test, the equipment shall not exceed the levels given in Table C.4.

Table C.4 – Terminal disturbance voltage limits for conducted radio-frequency emission (for power port)

Frequency band MHz	Environment A dB (µV)	Environment B dB (µV)
0,15 to 0,5	79 quasi-peak 66 average	66 to 56 quasi-peak 56 to 46 average (decrease with log of frequency)
0,5 to 5	73 quasi-peak 60 average	56 quasi-peak 46 average
5 to 30	73 quasi-peak 60 average	60 quasi-peak 50 average

NOTE Limits are in accordance with CISPR 11, Group 1 for load input ports and total rated power less than 20 kVA.

C.3.3 Radiated radio-frequency emission tests

The description of the test, the test method and the test set-up are given in CISPR 11:2015 and CISPR 11:2015/AMD1:2016, Clause 7.

The emissions shall not exceed the levels given in Table C.5.

Table C.5 – Radiated emission test limits

Frequency range MHz	Environment A ^a Quasi-peak dB (µV)			Environment B ^a Quasi-peak dB (µV)	
	at 30 m	at 10 m	at 3 m	at 10 m	at 3 m
30 to 230	30	40	50	30	40
230 to 1 000	37	47	57	37	47

^a Tests may be carried out at 3 m distance only to small equipment (equipment, either positioned on a table top or standing on the floor, including its cables, fits in a cylindrical test volume of 1,2 m in diameter and 1,5 m above the ground plane).

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**RELAIS TEMPORISÉS ET RELAIS DE COUPLAGE POUR
APPLICATIONS INDUSTRIELLES ET RÉSIDENTIELLES –****Partie 1: Exigences et essais****AVANT-PROPOS**

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L'IEC 61812-1 a été établie par le comité d'études 94 de l'IEC: Relais électriques de tout-ou-rien. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2011. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) mise à jour des références;
- b) ajout d'exigences relatives à l'appréciation du risque;
- c) ajout d'exigences relatives à l'essai individuel de série;
- d) renumérotation des paragraphes selon un ordre plus logique;

- e) clarification de l'exigence relative aux chocs;
- f) ajout d'exigences de cybersécurité pour les systèmes d'automatisation et de commande industrielles;
- g) ajout d'une exigence d'écoconception;
- h) ajout d'une référence au dictionnaire de données commun;
- i) ajout de termes et définitions relatifs aux types de relais;
- j) ajout des relais de couplage dans le titre;
- k) ajout des relais de couplage dans le domaine d'application.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
94/843/FDIS	94/889/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Le présent document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 61812, publiées sous le titre général *Relais temporisés et relais de couplage pour applications industrielles et résidentielles*, se trouve sur le site web de l'IEC.

Les futurs documents de cette série porteront le nouveau titre général cité ci-dessus. Le titre des documents qui existent déjà dans cette série sera mis à jour lors de leur prochaine édition.

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RELAIS TEMPORISÉS ET RELAIS DE COUPLAGE POUR APPLICATIONS INDUSTRIELLES ET RÉSIDENIELLES –

Partie 1: Exigences et essais

1 Domaine d'application

La présente partie de l'IEC 61812 s'applique aux relais temporisés et aux relais de couplage pour applications industrielles (par exemple, systèmes industriels de commande, d'automatisation et de signalisation) ainsi qu'aux dispositifs de commande électrique automatiques destinés à être utilisés dans, sur ou avec des équipements pour applications résidentielles et analogues.

Le terme "relais", utilisé dans le présent document, comprend tous les types de relais temporisés et de relais de couplage, hormis les relais de mesure.

NOTE 1 Les relais temporisés et les relais de couplage peuvent être utilisés pour une application industrielle (par exemple, systèmes industriels de commande, d'automatisation et de signalisation) ainsi qu'aux dispositifs de commande électrique automatiques destinés à être utilisés dans, sur ou avec des équipements pour applications résidentielles et analogues.

NOTE 2 Les relais de mesure sont traités par le CE 95 de l'IEC.

Le présent document définit l'essai de type et l'essai individuel de série qui visent à confirmer la condition de service. Les définitions des différents types de relais temporisés utilisés dans la série IEC 61812 sont données en 3.2.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-444:2002, *Vocabulaire Électrotechnique International (IEV) – Partie 444: Relais élémentaires*

IEC 60050-445:2010, *Vocabulaire Électrotechnique International (IEV) – Partie 445: Relais temporisés*

IEC 60068-2-2:2007, *Essais d'environnement – Partie 2-2: Essais – Essai B: Chaleur sèche*

IEC 60068-2-6:2007, *Essais d'environnement – Partie 2-6: Essais – Essai Fc: Vibrations (sinusoïdales)*

IEC 60068-2-27:2008, *Essais d'environnement – Partie 2-27: Essais – Essai Ea et guide: Chocs*

IEC 60085:2007, *Isolation électrique – Évaluation et désignation thermiques*

IEC 60112:2020, *Méthode de détermination des indices de résistance et de tenue au cheminement des matériaux isolants solides*

IEC 60529:1989, *Degrés de protection procurés par les enveloppes (Code IP)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60664-1:2020, *Coordination de l'isolement des matériels dans les réseaux d'énergie électrique à basse tension – Partie 1: Principes, exigences et essais*

IEC 60664-3:2016, *Coordination de l'isolement des matériels dans les réseaux d'énergie électrique à basse tension – Partie 3: Utilisation de revêtement, d'empotage ou de moulage pour la protection contre la pollution*

IEC 60664-4:2005, *Coordination de l'isolement des matériels dans les réseaux d'énergie électrique à basse tension – Partie 4: Considérations sur les contraintes de tension à haute fréquence*

IEC 60695-2-11:2021, *Essais relatifs aux risques du feu – Partie 2-11: Essais au fil incandescent/chauffant – Méthode d'essai d'inflammabilité pour produits finis (GWEPT)*

IEC 60695-10-2:2014, *Essais relatifs aux risques du feu – Partie 10-2: Chaleurs anormales – Essai à la bille*

IEC 60947-5-1:2016, *Appareillage à basse tension – Partie 5-1: Appareils et éléments de commutation pour circuits de commande – Appareils électromécaniques pour circuits de commande*

IEC 60947-5-4:2002, *Appareillage à basse tension – Partie 5-4: Appareil et éléments de commutation pour circuits de commande – Méthode d'évaluation des performances des contacts à basse énergie – Essais spéciaux*
IEC 60947-5-4:2002/AMD1:2019

IEC 60999-1:1999, *Dispositifs de connexion – Conducteurs électriques en cuivre – Prescriptions de sécurité pour organes de serrage à vis et sans vis – Partie 1: Prescriptions générales et particulières pour les organes de serrage pour les conducteurs de 0,2 mm² à 35 mm² (inclus)*

IEC 61000-4-2:2008, *Compatibilité électromagnétique (CEM) – Partie 4-2: Techniques d'essai et de mesure – Essai d'immunité aux décharges électrostatiques*

IEC 61000-4-3:2020, *Compatibilité électromagnétique (CEM) – Partie 4-3: Techniques d'essai et de mesure – Essai d'immunité aux champs électromagnétiques rayonnés aux fréquences radioélectriques*

IEC 61000-4-4:2012, *Compatibilité électromagnétique (CEM) – Partie 4-4: Techniques d'essai et de mesure – Essais d'immunité aux transitoires électriques rapides en salves*

IEC 61000-4-5:2014, *Compatibilité électromagnétique (CEM) – Partie 4-5: Techniques d'essai et de mesure – Essai d'immunité aux ondes de choc*
IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2013, *Compatibilité électromagnétique (CEM) – Partie 4-6: Techniques d'essai et de mesure – Immunité aux perturbations conduites, induites par les champs radioélectriques*

IEC 61000-4-8:2009, *Compatibilité électromagnétique (CEM) – Partie 4-8: Techniques d'essai et de mesure – Essai d'immunité au champ magnétique à la fréquence du réseau*

IEC 61000-4-11:2020, *Compatibilité électromagnétique (CEM) – Partie 4-11: Techniques d'essai et de mesure – Essais d'immunité aux creux de tension, coupures brèves et variations de tension pour les appareils à courant d'entrée inférieur ou égal à 16 A par phase*

IEC 61000-4-34:2005, *Compatibilité électromagnétique (CEM) – Partie 4-34: Techniques d'essai et de mesure – Essais d'immunité aux creux de tension, coupures brèves et variations de tension pour matériel ayant un courant appelé de plus de 16 A par phase*
IEC 61000-4-34:2005/AMD1:2009

IEC 61210:2010, *Dispositifs de connexion – Bornes plates à connexion rapide pour conducteurs électriques en cuivre – Exigences de sécurité*

IEC 61810-1:2015, *Relais électromécaniques élémentaires – Partie 1: Exigences générales et de sécurité*
IEC 61810-1:2015/AMD1:2019

IEC 61984:2008, *Connecteurs – Exigences de sécurité et essais*

IEC 62314:2022, *Relais statiques – Exigences de sécurité*

CISPR 11:2015, *Appareils industriels, scientifiques et médicaux – Caractéristiques de perturbations radioélectriques – Limites et méthodes de mesure*
CISPR 11:2015/AMD1:2016
CISPR 11:2015/AMD2:2019

ISO 9223:2012, *Corrosion des métaux et alliages – Corrosivité des atmosphères – Classification, détermination et estimation*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC 60050-444, de l'IEC 60050-445 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <https://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <https://www.iso.org/obp>

3.1 Termes et définitions relatifs aux termes généraux

3.1.1

relais temporisé

relais de tout ou rien (IEV 444-01-02) comportant une ou plusieurs fonctions temporelles

[SOURCE: IEC 60050-445:2010, 445-01-01, modifié – Dans la définition, la référence à l'article de l'IEV a été ajoutée.]

3.1.2

relais de couplage

relais électrique de tout ou rien intégré à un boîtier ou monté sur un socle (rail de montage IEC 60715, par exemple), sans fonction de temporisation ni fonction logique, pour applications industrielles et résidentielles, destiné à être incorporé dans une baie.

Note 1 à l'article: En général, il s'agit d'un relais conforme à la série IEC 61810 ou à l'IEC 62314 intégré à un boîtier ou monté sur un socle (rail de montage IEC 60715, par exemple) pour installation dans une baie industrielle ou résidentielle.

3.1.3

temporisation

caractéristique spécifique d'un relais temporisé pour un type donné de fonction, par exemple temps de fonctionnement, temps de relâchement, temps d'impulsion, temps d'intervalle

[SOURCE: IEC 60050-445:2010, 445-05-01, modifié – La note a été supprimée.]

3.1.4

exactitude de réglage

différence entre la valeur mesurée d'une temporisation et la valeur telle qu'affichée sur l'échelle

Note 1 à l'article: Pour un réglage analogique, il convient que l'exactitude de réglage soit déterminée par rapport à la valeur maximale de réglage.

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

3.1.5

effet d'influence

degré auquel la grandeur d'influence, dans sa plage nominale, affecte la temporisation

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

3.1.6

temps de récupération

durée minimale pendant laquelle l'alimentation est absente ou le signal de commande est appliqué ou retiré pour que la fonction spécifiée puisse être accomplie à nouveau

[SOURCE: IEC 60050-445:2010, 445-05-04, modifié – "doit être absente" et "doit être appliqué" ont été respectivement remplacés par "est absente" et "est appliqué".]

3.1.7

durée minimale d'impulsion de commande

durée la plus courte d'application de l'alimentation nécessaire pour assurer la fonction spécifiée

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

3.1.8

répétabilité

différence entre les limites supérieure et inférieure de l'intervalle de confiance spécifié établi à partir de plusieurs mesures effectuées sur le relais temporisé dans des conditions identiques

Note 1 à l'article: La répétabilité est de préférence indiquée en pourcentage de la valeur moyenne de toutes les valeurs mesurées.

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

3.1.9

alimentation

grandeur électrique (ex.: courant, tension) devant être appliquée ou retirée à l'entrée d'un relais temporisé ou d'un relais de couplage pour lui permettre d'accomplir sa fonction

[SOURCE: IEC 60050-445:2010, 445-03-01, modifié – Dans la définition, "ou d'un relais de couplage" a été ajouté.]

3.1.10

tension d'entrée

grandeur électrique qui peut être appliquée à (ou retirée de) l'alimentation, au signal de commande ou aux deux

3.1.11**signal de commande**

signal d'entrée qui doit être appliqué ou retiré en plus de l'alimentation afin d'assurer le fonctionnement du relais temporisé

Note 1 à l'article: Le signal de commande est fourni par appareil distinct conçu pour fermer ou ouvrir un circuit électrique.

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

3.1.12**courant de court-circuit conditionnel d'un circuit de sortie**

courant électrique présumé qu'un circuit de contact, protégé par un dispositif de protection spécifié contre les courts-circuits, est capable de supporter de manière satisfaisante pendant la durée totale de coupure de ce dispositif de protection dans des conditions spécifiées d'utilisation et de comportement

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

3.1.13**chute de tension d'un circuit de sortie statique**

tension mesurée entre les bornes de la sortie statique à l'état passant d'un relais temporisé ou d'un relais de couplage lorsque cette sortie est traversée par le courant de charge donné

[SOURCE: IEC 60050-445:2010, 445-04-04, modifié – Dans la définition, "ou d'un relais de couplage" a été ajouté.]

3.1.14**courant de fuite d'une sortie statique**

courant passant dans la sortie statique à l'état bloqué d'un relais temporisé ou d'un relais de couplage pour une tension spécifiée

[SOURCE: IEC 60050-445:2010, 445-04-05, modifié – Dans la définition, "ou d'un relais de couplage" a été ajouté.]

3.1.15**port d'alimentation**

port d'un relais temporisé ou d'un relais de couplage auquel l'alimentation (CA ou CC) est raccordée

[SOURCE: IEC 60050-445:2010, 445-07-01, modifié – Dans la définition, "ou d'un relais de couplage" a été ajouté.]

3.1.16**port de commande**

port additionnel d'un relais destiné à la commande de fonctions en présence de l'alimentation, ou pour le branchement d'un potentiomètre, d'un signal de commande, etc.

Note 1 à l'article: Il existe des ports de commande à potentiel flottant et d'autres à potentiel fixé.

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

3.1.17**port de sortie**

port du relais temporisé ou du relais de couplage auquel est raccordée une charge

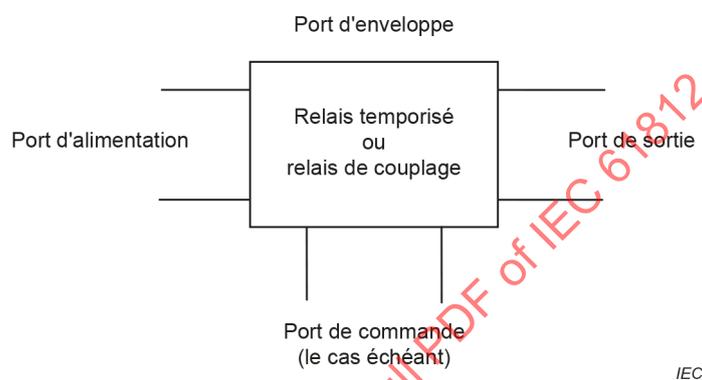
Note 1 à l'article: Le port de sortie peut être constitué de contacts électromécaniques ou de sorties statiques.

[SOURCE: IEC 60050-445:2010, 445-07-03, modifié – Dans la définition, "ou d'un relais de couplage" a été ajouté.]

3.1.18**port d'enveloppe**

frontière physique d'un relais temporisé ou d'un relais de couplage à travers laquelle les champs électromagnétiques peuvent rayonner ou pénétrer

Note 1 à l'article: Voir Figure 1.



IEC

Figure 1 – Définition des ports

[SOURCE: IEC 60050-445:2010, 445-07-04, modifié – Dans la définition, "ou d'un relais de couplage" ainsi que la note et la référence à la Figure 1 ont été ajoutés.]

3.1.19**essai de type**

essai effectué sur un ou plusieurs dispositifs réalisés selon une conception donnée, afin de vérifier que la conception satisfait à des spécifications données

[SOURCE: IEC 61810-1:2015, 3.1.7]

3.1.20**essai individuel de série**

essai auquel est soumis chaque dispositif en cours et/ou en fin de fabrication pour vérifier qu'il satisfait à des critères définis

[SOURCE: IEC 61810-1:2015, 3.1.8]

3.1.21**essai sur prélèvement**

essai effectué sur un certain nombre de dispositifs prélevés au hasard dans un lot

[SOURCE: IEC 61810-1:2015, 3.1.9]

3.1.22**domaine de fonctionnement**

domaine des valeurs de l'alimentation à l'intérieur duquel le relais temporisé ou le relais de couplage est capable d'assurer sa fonction spécifiée

[SOURCE: IEC 61810-1:2015, 3.4.5, modifié – Dans la définition, "la tension aux bornes de la bobine" a été remplacé par "l'alimentation", et "le relais" a été remplacé par "le relais temporisé ou le relais de couplage".]

3.1.23**plage assignée de tensions d'entrée**

plage de tensions d'entrée utilisée à des fins de spécification, définie pour un ensemble spécifié de conditions de fonctionnement

3.1.24**isolation fonctionnelle**

isolation entre parties conductrices, qui est nécessaire uniquement pour le bon fonctionnement du matériel

[SOURCE: IEC 60050-195:2021, 195-02-41, modifié – "nécessaire" a été remplacé par "qui est nécessaire uniquement".]

3.1.25**isolation principale**

isolation des parties actives dangereuses qui assure la protection principale

Note 1 à l'article: Cette notion n'est pas applicable à l'isolation exclusivement utilisée à des fins fonctionnelles.

[SOURCE: IEC 60050-195:2021, 195-06-06, modifié – Dans la définition, "des parties actives dangereuses" a été ajouté.]

3.1.26**isolation supplémentaire**

isolation indépendante prévue, en plus de l'isolation principale, en tant que protection en cas de défaut

[SOURCE: IEC 60050-195:2021, 195-06-07]

3.1.27**double isolation**

isolation comprenant à la fois une isolation principale et une isolation supplémentaire

[SOURCE: IEC 60050-195:2021, 195-06-08]

3.1.28**isolation renforcée**

isolation des parties actives dangereuses assurant un degré de protection contre les chocs électriques équivalent à celui d'une double isolation

Note 1 à l'article: L'isolation renforcée peut comporter plusieurs couches qui ne peuvent pas être soumises aux essais séparément en tant qu'isolation principale ou isolation supplémentaire.

[SOURCE: IEC 60050-195:2021, 195-06-09, modifié – Dans la définition, "des parties actives dangereuses" a été ajouté.]

3.1.29**partie active****partie sous tension**

partie conductrice destinée à être sous tension dans des conditions normales de fonctionnement, y compris le conducteur de neutre et le conducteur de point milieu, à l'exception toutefois du conducteur PEN, du conducteur PEM et du conducteur PEL

Note 1 à l'article: Cette notion n'implique pas nécessairement un risque de choc électrique.

[SOURCE: IEC 60050-195:2021, 195-02-19, modifié – La note a été ajoutée.]

3.1.30**tension de fonctionnement assignée**

tension nominale de l'alimentation destinée à être utilisée

3.1.31**courant de fonctionnement assigné**

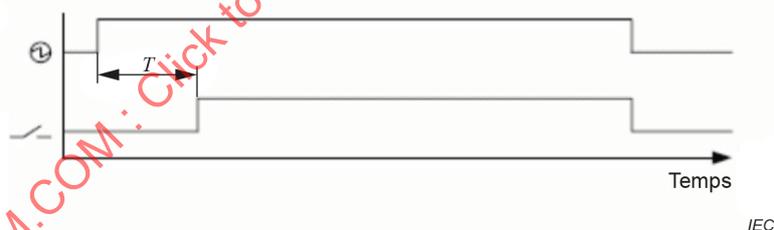
courant nominal de l'alimentation destinée à être utilisée

3.1.32**puissance absorbée**

énergie électrique qu'un relais utilise lors de son fonctionnement ou pour celui-ci, exprimée en VA pour le courant alternatif et en W pour les bobines en courant continu, en incluant les autres circuits électriques

3.2 Termes et définitions relatifs aux types de relais temporisés**3.2.1****relais temporisé à la mise sous tension**

relais temporisé dans lequel la temporisation démarre lorsque l'alimentation est appliquée et la sortie passe à l'état de travail lorsque la temporisation réglée est écoulée (voir Figure 2)

**Légende**

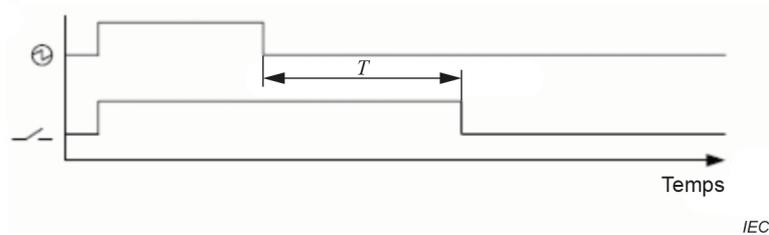
-  alimentation
- T temporisation réglée
-  contact de travail

Figure 2 – Relais temporisé à la mise sous tension

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

3.2.2**relais temporisé à la coupure**

relais temporisé dans lequel la sortie passe immédiatement à l'état de travail lorsque l'alimentation est appliquée; la temporisation démarre lorsque l'alimentation est coupée et la sortie passe à l'état de repos lorsque la temporisation réglée est écoulée (voir Figure 3)

**Légende**

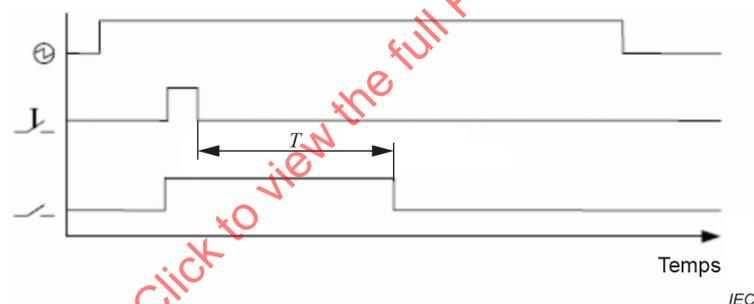
- ⊕ alimentation
- T temporisation réglée
- ↘ contact de travail

Figure 3 – Relais temporisé à la coupure

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

3.2.3**relais temporisé à la coupure avec signal de commande**

relais temporisé dans lequel la sortie passe immédiatement à l'état de travail lorsque l'alimentation et le signal de commande sont appliqués; la temporisation démarre lorsque le signal de commande est coupé, et la sortie passe à l'état de repos lorsque la temporisation réglée est écoulée (voir Figure 4)

**Légende**

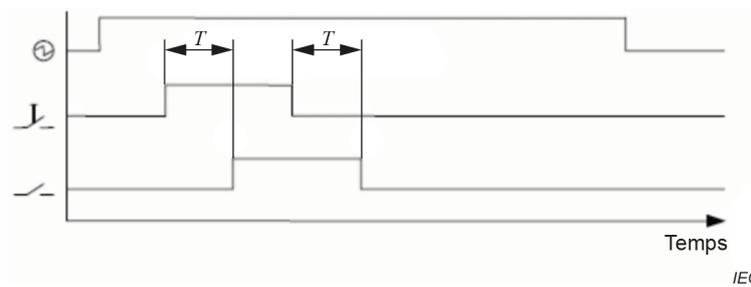
- ⊕ alimentation
- ⌋ signal de commande
- T temporisation réglée
- ↘ contact de travail

Figure 4 – Relais temporisé à la coupure avec signal de commande

[SOURCE: IEC 60050-445:2010, 445-01-04, modifié – La note a été supprimée.]

3.2.4**relais temporisé à la mise sous tension et à la coupure avec signal de commande**

relais temporisé dans lequel la sortie passe à l'état de travail lorsque l'alimentation et le signal de commande sont appliqués et que la temporisation réglée est écoulée; la sortie passe à l'état de repos lorsque le signal de commande est retiré et que la temporisation réglée est écoulée (voir Figure 5)



Légende

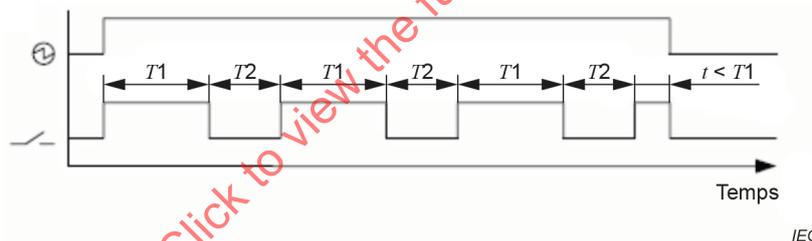
- Ⓢ alimentation
- Ⓜ signal de commande
- T temporisation réglée
- Ⓜ contact de travail

Figure 5 – Relais temporisé à la mise sous tension et à la coupure avec signal de commande

[SOURCE: IEC 60050-445:2010, 445-01-05, modifié – La note a été supprimée.]

3.2.5 relais clignotant

relais temporisé dans lequel la sortie passe périodiquement de l'état de travail à l'état de repos tant que l'alimentation ou le signal de commande est appliqué (voir Figure 6)



Légende

- Ⓢ alimentation
- T_1 temps de travail
- T_2 temps de repos
- Ⓜ contact de travail

Figure 6 – Relais clignotant

Note 1 à l'article: Selon le type de relais, la sortie démarre dans l'état de travail ou dans l'état de repos.

Note 2 à l'article: Le relais clignotant peut aussi être amorcé par un signal de commande.

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

3.2.6 relais clignotant à cycle symétrique

relais clignotant dans lequel la sortie passe périodiquement de l'état de travail à l'état de repos avec des temps de travail et de repos substantiellement identiques

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

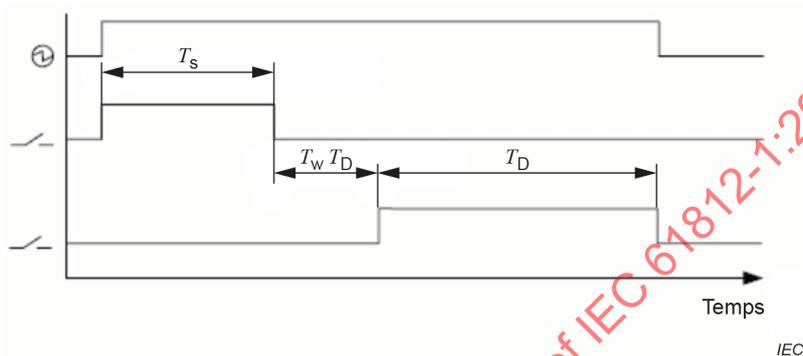
3.2.7 relais clignotant à cycle asymétrique

relais clignotant dans lequel les temps de travail et de repos sont ajustables indépendamment

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

3.2.8 relais temporisé à couplage étoile-triangle

relais temporisé comportant deux sorties temporisées commutant l'une après l'autre conçu pour assurer le démarrage de moteurs dans un couplage en étoile, puis le passage dans un couplage en triangle (voir Figure 7)



Légende

-  alimentation
- T_s temporisation en étoile
- $T_w T_D$ temps de transfert en triangle
-  contact de travail

Figure 7 – Relais temporisé à couplage étoile-triangle

Note 1 à l'article: Les couplages en étoile et en triangle sont définis en IEV 141-02-06 et IEV 141-02-09 respectivement.

Note 2 à l'article: T_s est le temps pendant lequel le moteur démarre et fonctionne avec un couplage en étoile.

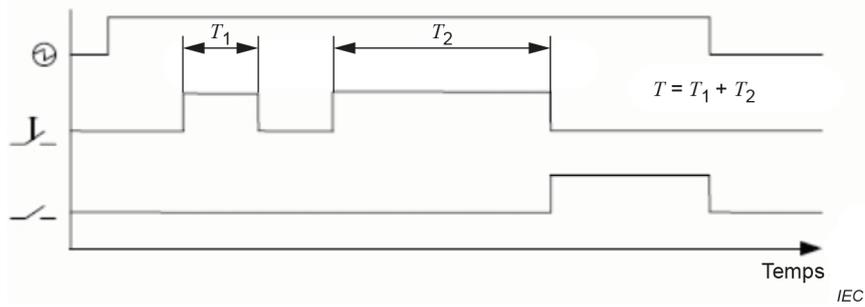
Note 3 à l'article: T_w est le temps de palier après la déconnexion du moteur en étoile et sa reconnexion en triangle.

Note 4 à l'article: T_D est le temps pendant lequel le moteur fonctionne avec un couplage en triangle.

[SOURCE: IEC 60050-445:2010, 445-01-09, modifié – Les Note 2, Note 3 et Note 4 ont été ajoutées.]

3.2.9 relais temporisé à addition de temps

relais temporisé dans lequel la sortie commute lorsque la temporisation réglée est écoulée après addition des durées pendant lesquelles le signal de commande a été appliqué (voir Figure 8)



Légende

- Ⓢ alimentation
- Ⓜ signal de commande
- T temporisation réglée
- Ⓜ contact de travail

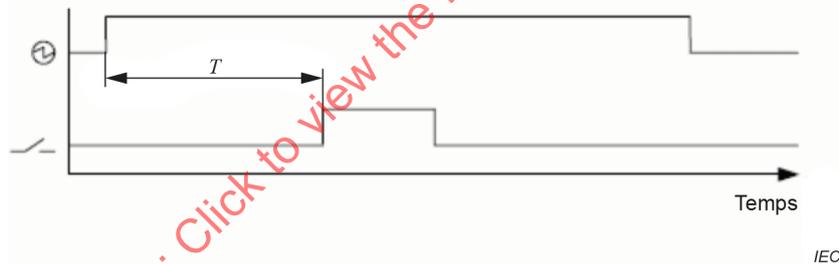
Figure 8 – Relais temporisé à addition de temps

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

3.2.10

relais à impulsion retardée

relais temporisé dont la temporisation démarre dès l'application de l'alimentation et dont la sortie passe momentanément à l'état de travail pour une durée donnée dès que la temporisation réglée est écoulée (voir Figure 9)



Légende

- Ⓢ alimentation
- T temporisation réglée
- Ⓜ contact de travail

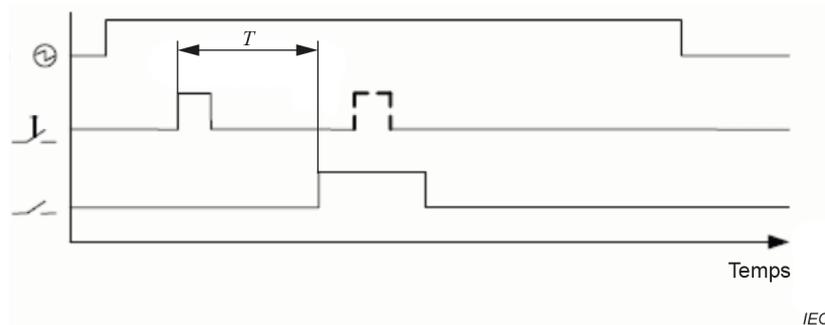
Figure 9 – Relais à impulsion retardée

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

3.2.11

relais à impulsion retardée avec signal de commande

relais temporisé dont la temporisation démarre dès l'application de l'alimentation et du signal de commande et dont la sortie passe momentanément à l'état de travail pour un intervalle donné dès que la temporisation est écoulée (voir Figure 10)

**Légende**

- Ⓢ alimentation
- Ⓜ signal de commande
- T temporisation réglée
- Ⓜ contact de travail

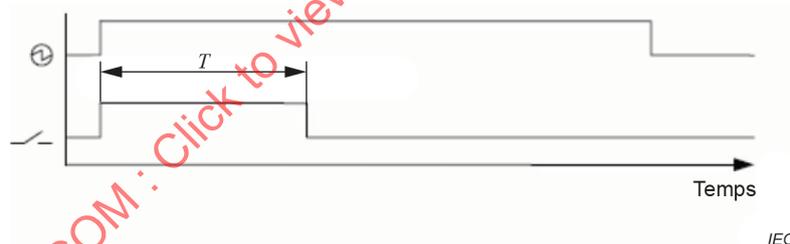
Figure 10 – Relais à impulsion retardée avec signal de commande

Note 1 à l'article: La répétition du signal de commande pendant la temporisation peut ne pas réinitialiser la temporisation.

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

3.2.12 relais d'intervalle

relais temporisé dont la sortie passe à l'état de travail et dont la temporisation démarre dès l'application de l'alimentation et qui retourne à l'état de repos lorsque la temporisation réglée est écoulée (voir Figure 11)

**Légende**

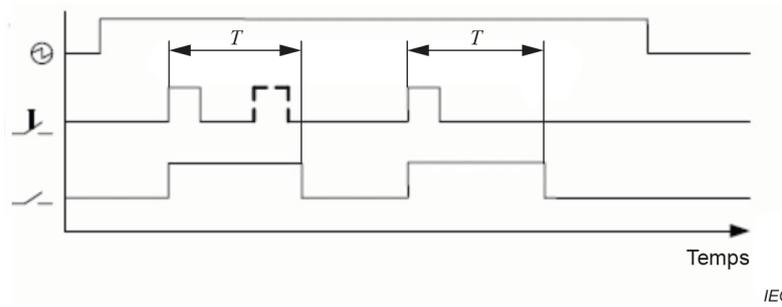
- Ⓢ alimentation
- T temporisation réglée
- Ⓜ contact de travail

Figure 11 – Relais d'intervalle

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

3.2.13 relais d'intervalle avec signal de commande

relais temporisé dont la sortie passe à l'état de travail et dont la temporisation démarre dès l'application de l'alimentation et du signal de commande, et dont la sortie passe à l'état de repos lorsque la temporisation réglée est écoulée (voir Figure 12)



Légende

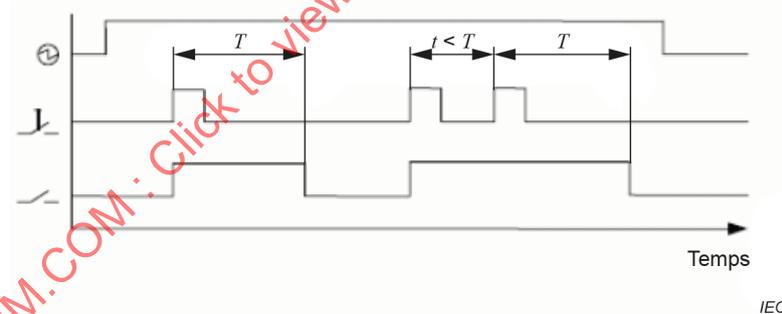
- Ⓢ alimentation
- Ⓜ signal de commande
- T temporisation réglée
- ↔ contact de travail

Figure 12 – Relais d'intervalle avec signal de commande

Note 1 à l'article: La répétition du signal de commande pendant la temporisation peut ne pas réinitialiser celle-ci.
 [SOURCE: IEC 60050-445:2010, 445-01-14]

3.2.14 relais de surveillance

relais temporisé dont la sortie passe à l'état de travail et dont la temporisation démarre dès l'application de l'alimentation et du signal de commande, et dont la sortie passe à l'état de repos lorsque la temporisation réglée est écoulée et si la temporisation n'a pas été réinitialisée par le signal de commande (voir Figure 13)



Légende

- Ⓢ alimentation
- Ⓜ signal de commande
- T temporisation réglée
- ↔ contact de travail

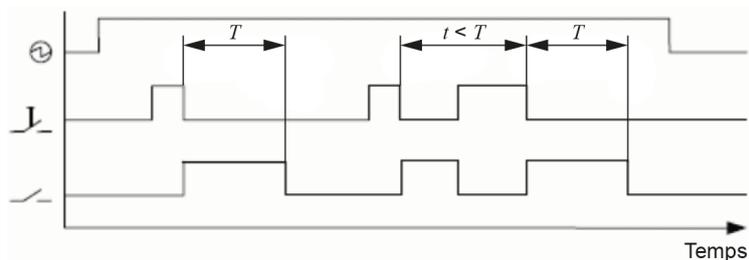
Figure 13 – Relais de surveillance

Note 1 à l'article: La répétition du signal de commande pendant la temporisation réinitialise celle-ci.

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

3.2.15**relais de surveillance à retrait du signal de commande**

relais temporisé dont la sortie passe à l'état de travail et dont la temporisation démarre dès le retrait du signal de commande alors que l'alimentation est appliquée, et dont la sortie passe à l'état de repos lorsque la temporisation réglée, qui peut être réinitialisée par le signal de commande, est écoulée (voir Figure 14)

**Légende**

- Ⓢ alimentation
- Ⓜ signal de commande
- T temporisation réglée
- Ⓜ contact de travail

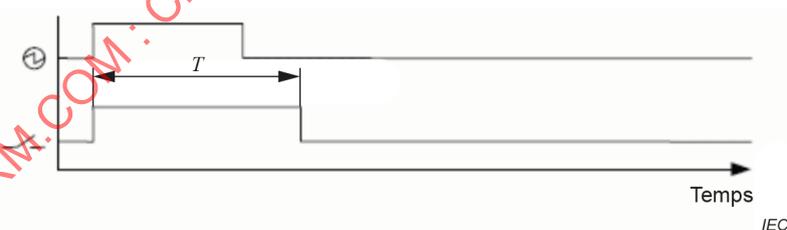
Figure 14 – Relais de surveillance à retrait du signal de commande

Note 1 à l'article: La répétition du signal de commande pendant la temporisation réinitialise celle-ci.

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

3.2.16**relais temporisé maintenu**

relais temporisé qui ne relâche pas prématurément lorsque l'alimentation est retirée alors que la temporisation réglée n'est pas écoulée (voir Figure 15)

**Légende**

- Ⓢ alimentation
- T temporisation réglée
- Ⓜ contact de travail

Figure 15 – Relais temporisé maintenu

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

4 Classification

4.1 Élément de commutation

Les relais temporisés et les relais de couplage peuvent être classés en fonction de l'élément de commutation, par exemple circuit de sortie électromécanique ou circuit de sortie statique.

4.2 Construction mécanique

Les relais temporisés et les relais de couplage peuvent être classés en fonction de la construction mécanique, par exemple relais monobloc (non modulaire) ou relais enfichable (modulaire).

4.3 Montage du dispositif

Les relais temporisés et les relais de couplage peuvent être classés en fonction des capacités de montage, par exemple montage sur rail IEC 60715 ou en panneau.

4.4 Connexion

Les relais temporisés et les relais de couplage peuvent être classés en fonction des dispositifs de connexion, par exemple type à vis ou type à ressort.

4.5 Environnement

Les relais temporisés et les relais de couplage compris dans le domaine d'application du 18.1 doivent être classés en fonction de l'environnement d'application. Ils peuvent être soumis à l'essai de résistance aux ondes de choc selon 11.3.2, à la distance d'isolement selon l'Article 14 ou à la CEM selon l'Article 18 et l'Annexe C, les niveaux d'exigence étant différents pour chaque environnement, industriel ou résidentiel, commercial et de l'industrie légère.

5 Grandeurs d'influence

Les performances spécifiées d'un relais temporisé ou d'un relais de couplage doivent être données en fonction des conditions de référence, par exemple l'ensemble des valeurs de référence de toutes les grandeurs d'influence.

Sauf spécification contraire, les valeurs et les plages de tolérance répertoriées dans le Tableau 1 s'appliquent.

Tableau 1 – Grandeurs d'influence et valeurs de référence

Grandeurs d'influence	Valeurs de référence pour les essais	Tolérances durant les essais
Température ambiante	23 °C	18 °C à 28 °C
Pression atmosphérique	96 kPa	86 kPa à 106 kPa
Humidité relative	50 %	25 % à 75 %
Direction de montage	Comme cela est spécifié	2° dans toute direction
Tension d'entrée	Valeur(s) assignée(s)	±5 % en régime établi ^a
Circuit de sortie (tension/courant)	Valeur(s) assignée(s)	±5 % en régime établi
Fréquence	Comme cela est spécifié	±1 %
Forme d'onde	Sinusoïdale	Taux d'harmoniques maximal 5 % ^b
Composante continue en courant alternatif	Telle qu'indiquée par la tension d'entrée	Au maximum 2 % de la valeur de crête
Composante alternative en courant continu (ondulation)	Telle qu'indiquée par la tension d'entrée	Au maximum 6 % ^c
Chocs et vibrations	Comme cela est spécifié	Au maximum 1 m/s ²
Atmosphères industrielles et autres	Air propre	Air propre (pollution modérée, qui ne dépasse pas la classe C3 de l'ISO 9223)
<p>a Dans la mesure où elles sont considérées comme des grandeurs d'influence dans le cas de la tolérance sur les erreurs de temps de ±1 %.</p> <p>b Taux d'harmoniques: rapport du résidu harmonique, obtenu en soustrayant l'onde fondamentale d'une grandeur harmonique non sinusoïdale, à la valeur efficace de la grandeur non sinusoïdale. Il est généralement exprimé en pourcentage.</p> <p>c La composante alternative (taux d'ondulation) d'une alimentation en courant continu, exprimée en pourcentage, est définie comme suit:</p> $\frac{\text{valeur maximale} - \text{valeur minimale}}{\text{Composante continue}} \times 100$		

6 Valeurs assignées

6.1 Généralités

Les valeurs numériques indiquées dans le présent document sont des valeurs normalisées recommandées ou des valeurs pratiques types relatives aux relais temporisés ou aux relais de couplage électroniques et électromécaniques selon l'état de la technique connu. Il convient de faire confirmer par le fabricant que les caractéristiques spécifiques correspondantes de tout produit spécifique sont conformes au présent document ou de les décrire explicitement si elles s'écartent du présent document.

6.2 Tension d'entrée et fréquence

- La valeur efficace recommandée de la tension d'entrée assignée en courant alternatif doit être spécifiée selon l'une des valeurs suivantes:
12 V; 20 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.
- La tension d'entrée assignée en courant continu recommandée doit être spécifiée selon l'une des valeurs suivantes:
5 V; 6 V; 12 V; 20 V; 24 V; 48 V; 60 V; 100 V; 110 V; 125 V; 220 V; 240 V; 250 V; 360 V.
- Fréquence assignée, valeurs recommandées: 50 Hz, 60 Hz, 400 Hz.
- La plage assignée de tensions d'entrée (par exemple 220 V à 240 V) et les fréquences correspondantes (par exemple 50 Hz/60 Hz) doivent être spécifiées.

e) Le domaine de fonctionnement recommandé doit être spécifié par l'une des valeurs suivantes:

- 80 % à 110 % ou
- 85 % à 110 % ou
- 90 % à 110 % de la tension d'entrée assignée ou de la plage assignée de tensions d'entrée (le cas échéant).

Les valeurs ci-dessus s'appliquent sur toute la plage de températures ambiantes (voir 6.6).

En cas d'écart par rapport au domaine recommandé, la tension d'entrée assignée (ou la plage assignée de tensions d'entrée) et le domaine de fonctionnement correspondant doivent être spécifiés.

6.3 Tension de relâchement

La tension de relâchement ne doit pas être inférieure à 10 % de la tension d'entrée assignée minimale, qui est spécifiée en 6.2.

Les tensions de relâchement s'appliquent sur toute la plage de températures ambiantes (voir 6.6).

6.4 Puissance absorbée

La puissance absorbée maximale d'un relais temporisé ou d'un relais de couplage doit être donnée en VA ou en W à la tension d'entrée assignée ou dans la plage assignée de tensions d'entrée (le cas échéant). Dans le cas de relais temporisés ou de relais de couplage avec plusieurs circuits d'entrée, les puissances absorbées maximales respectives doivent être indiquées.

NOTE 1 Pour les relais temporisés ou les relais de couplage dont l'entrée varie en fonction de la position des parties mobiles ou pour toute autre raison, la valeur la plus élevée est donnée.

NOTE 2 En cas de courant alternatif, le facteur de puissance est facultatif.

NOTE 3 La valeur de la puissance absorbée en W est utile calculer la puissance totale dissipée dans la baie.

NOTE 4 La puissance absorbée maximale est déterminée en utilisant le cas le plus défavorable en régime établi et les grandeurs d'influence du relais temporisé ou du relais de couplage.

6.5 Circuit de sortie

6.5.1 Généralités

Les caractéristiques assignées de charge de sortie doivent être spécifiées.

6.5.2 Circuit de sortie électromécanique

6.5.2.1 Généralités

a) Les charges résistives, les charges inductives et les charges spéciales (par exemple, charges de lampe, tensions de câble) doivent être spécifiées conformément au 5.7, à l'Annexe B et à l'Annexe D de l'IEC 61810-1:2015 ou au Tableau 4 et au Tableau 5 de l'IEC 60947-5-1:2016.

Les éléments suivants doivent être indiqués:

- les valeurs assignées de charge pour les circuits de sortie;
- le nombre de cycles pour l'endurance électrique;
- la fréquence de fonctionnement.

b) Les charges à basse énergie (par exemple, systèmes électroniques et automates programmables) doivent être spécifiées conformément à l'IEC 60947-5-4. Les valeurs assignées de charge et le nombre moyen constant de cycles de manœuvre évalué statistiquement (m_c) doivent être indiqués. Les exemples suivants présentent les formats préférentiels de spécification des valeurs assignées de charge:

- tension et courant minimaux (par exemple 24 V, 1 mA);
- puissance minimale (par exemple, 50 mW, soit 5 V/10 mA ou 10 V/5 mA, ce qui signifie que pour 5 V le courant doit être au moins de 10 mA ou que pour 5 mA la tension doit être au moins de 10 V).

6.5.2.2 Endurance mécanique

La valeur d'endurance mécanique du relais interne doit être utilisée. En variante, l'essai d'endurance mécanique selon l'Article 12 de l'IEC 61810-1:2015 doit être appliqué.

Les éléments suivants doivent être indiqués:

- le nombre de cycles pour l'endurance mécanique;
- la fréquence de fonctionnement.

6.5.3 Circuit de sortie statique

Les catégories de charge doivent être spécifiées selon le 5.2 de l'IEC 62314:2022, le cas échéant.

Les valeurs suivantes doivent être spécifiées:

- la valeur maximale de la chute de tension au courant de charge assigné;
- la valeur maximale du courant de fuite à la température ambiante maximale spécifiée et à la tension de commutation assignée (ou maximale).

6.5.4 Endurance et fréquence de fonctionnement

Les valeurs préférentielles relatives à l'endurance et à la fréquence de fonctionnement sont données dans le Tableau 2 et la charge est donnée dans le Tableau 3.

Tableau 2 – Valeurs préférentielles relatives à l'endurance

Cycles de manœuvre × 10 ⁶
0,03
0,1
0,2
0,3
0,5
1
3
10
20
30

Tableau 3 – Valeurs préférentielles relatives à la fréquence de fonctionnement maximale admissible

Fréquence de fonctionnement dans les conditions de charge maximale spécifiées en 6.5.2 (cycles par heure) ^a
12
30
120
300
600
1 200
1 800
3 600
7 200

^a Cela ne s'applique que dans la mesure où la plus courte durée de fonctionnement réglable le permet.

6.5.5 Courant de court-circuit conditionnel

Le courant de court-circuit conditionnel assigné d'un relais temporisé ou d'un relais de couplage est la valeur du courant présumé (voir 13.3 et 13.4). L'appareil, protégé par un dispositif de protection contre les courts-circuits spécifié par le fabricant, peut résister de manière satisfaisante pendant la durée de fonctionnement de ce dispositif dans les conditions d'essai spécifiées.

NOTE En courant alternatif, le courant de court-circuit conditionnel assigné est exprimé par la valeur efficace de la composante alternative.

6.6 Température ambiante

La plage de températures ambiantes doit être comprise entre 0 °C et +40 °C pour le fonctionnement des relais temporisés ou des relais de couplage. D'autres plages de températures ambiantes peuvent être spécifiées.

6.7 Température de transport et de stockage

Les appareils soumis à des températures extrêmes hors fonctionnement ne doivent subir aucun dommage irréversible et doivent fonctionner normalement dans les conditions spécifiées.

Les valeurs suivantes doivent être spécifiées:

- plage de températures pour le stockage: –25 °C à +55 °C;
- plage de températures pour le transport: –40 °C à +70 °C.

6.8 Humidité

Sauf indication contraire, la plage d'humidités relatives préférentielle est comprise entre 25 % et 75 %.

6.9 Degré de pollution

Sauf indication contraire, un relais temporisé ou un relais de couplage est utilisé dans un degré de pollution 3 pour un environnement industriel et dans un degré de pollution 2 pour un environnement résidentiel, commercial ou de l'industrie légère, conformément à l'IEC 60664-1. Cependant, d'autres degrés de pollution peuvent être appliqués en fonction du micro-environnement. Le degré de pollution du micro-environnement du relais temporisé ou du relais de couplage est influencé par l'installation d'une enveloppe. Par exemple, en montant le relais temporisé ou le relais de couplage dans une enveloppe IP54, le relais temporisé ou le relais de couplage peut au moins satisfaire à une conception de degré de pollution 2.

NOTE 1 Le degré de pollution du micro-environnement du relais temporisé ou du relais de couplage peut être influencé par l'installation d'une enveloppe.

NOTE 2 Le degré de pollution du micro-environnement des circuits à l'intérieur de l'enveloppe propre au relais temporisé ou au relais de couplage peut être différent de celui du micro-environnement du relais.

6.10 Altitude

L'altitude du site d'installation ne doit pas dépasser 2 000 m.

Pour les appareils à utiliser à des altitudes plus élevées, il est nécessaire de tenir compte de la réduction de la rigidité diélectrique et de l'effet de refroidissement de l'air ou des facteurs de correction d'altitude pour les distances d'isolement, conformément à l'IEC 60664-1.

6.11 Fonction de circuit de temporisation

6.11.1 Généralités

Le 6.11 ne s'applique pas aux relais de couplage. La conception de construction du circuit de temporisation détermine la fonction du relais.

La temporisation peut être fixée de façon permanente ou être réglable.

Les valeurs nominales données dans le Tableau 4 sont recommandées comme valeurs finales pour la plage de réglage d'une temporisation.

Tableau 4 – Valeurs finales recommandées de la plage de réglage

Secondes	0,1	0,5	0,6	1	1,2	3	5	6	10	12	18	20	24	30	50	60	72	100	300	500	600
Minutes	0,1	0,5	0,6	1	1,2	3	5	6	10	12	18	20	24	30	50	60	72	100	300	500	600
Heures	0,1	0,5	0,6	1	1,2	3	5	6	10	12	18	20	24	30	50	60	72	100	300	500	600

Pour les relais temporisés numériques, les valeurs de la plage de réglage qui se terminent par le chiffre 9 sont également recommandées (par exemple, 999 min).

6.11.2 Exactitude de réglage

L'exactitude de réglage est exprimée:

- en pourcentage de la valeur à pleine échelle pour les relais temporisés à réglage analogique;
- en pourcentage de la valeur de réglage ou en valeurs absolues pour les relais temporisés à réglage numérique.

6.11.3 Répétabilité

Pour la répétabilité des valeurs temporelles de fonction, les valeurs préférentielles suivantes doivent être respectées:

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

La répétabilité peut être spécifiée comme une valeur en pourcentage ou une valeur absolue, par exemple 0,01 % ou 10 ms.

6.11.4 Temps de récupération et impulsion minimale de commande

À indiquer par le fabricant.

7 Dispositions relatives aux essais

7.1 Généralités

Les dangers étudiés dans le présent document sont les dangers liés à l'échauffement, aux chocs électriques, à l'inflammation, à la CEM et à un mauvais usage prévisible avant la fin du cycle de vie. Les dangers ne doivent pas dépasser un niveau tolérable. Pour le dispositif, la conformité aux essais spécifiés dans le Tableau 5 est considérée comme représentant un niveau tolérable. Pour l'application d'un relais temporisé ou d'un relais de couplage, une appréciation du risque doit être réalisée conformément à l'Annexe B.

L'évaluation du risque suit les mêmes règles d'appréciation pour le dispositif et pour l'application. Pour le dispositif lui-même, l'évaluation du risque peut être donnée par le présent document. Toutefois, pour l'application, elle est réalisée une fois de plus afin de déterminer l'interaction des différents dispositifs et les mauvais usages prévisibles, par exemple lorsque plusieurs relais temporisés peuvent être utilisés en combinaison avec un même socle.

7.2 Essai de type

Les exigences à vérifier ainsi que les essais associés sont spécifiés de l'Article 8 à l'Article 18.

Les essais de type spécifiés sont répertoriés dans le Tableau 5.

Si une éprouvette ne satisfait pas à un essai, cet essai doit être répété une fois avec une éprouvette supplémentaire de même conception. Les éprouvettes supplémentaires doivent satisfaire à l'essai. En cas de modification d'un relais temporisé ou d'un relais de couplage, tous les essais altérés du point de vue technique par cette modification doivent également être répétés.

Sauf indication contraire dans le présent document, les essais et mesurages doivent être réalisés selon les valeurs de référence et les plages de tolérance des grandeurs d'influence données dans le Tableau 1.

Tableau 5 – Essais de type

Essai de type	Article ou paragraphe	Nombre minimal d'éprouvettes	Lot de contrôle	Références supplémentaires
Fonctionnement de base	10	3	1	
Documentation et marquage	8	1	1	
Échauffement	9	1	1	IEC 60085
Distances d'isolement et lignes de fuite	14	1	1	IEC 60664-1
Vibrations	17.1	1	1	
Chocs	17.2	1	1	
Rigidité diélectrique et résistance aux ondes de choc	11	1	2	
Endurance électrique	12	1 ^a	3	
Courant de court-circuit conditionnel	13	1	4	
Résistance mécanique	15	1	5	
Résistance à la chaleur et au feu	16	1	6	IEC 60695-2-11
CEM	18	1	7	
^a Voir 12.1.				

7.3 Essai individuel de série

Les essais individuels de série (voir Tableau 6) ont pour objet de détecter les défauts de matériaux et de qualité d'exécution ainsi que de vérifier le bon fonctionnement de l'appareil. Ils doivent être réalisés sur chaque appareil individuellement.

Les essais individuels de série doivent comprendre:

- a) un essai fonctionnel;
- b) un essai de rigidité diélectrique.

Tableau 6 – Essais individuels de série

Lot de contrôle	Essais	Paragraphe	Références supplémentaires
Tous	Essai fonctionnel – Fonctionnement	10.2	Uniquement pour les relais de couplage
Tous	Essai fonctionnel – Fonction temporelle	10.4.2.2 10.4.2.3	Uniquement pour les relais temporisés ^a
Tous	Essai de rigidité diélectrique	11.3.3	^b
NOTE L'essai peut être effectué à température ambiante sans charge de contact.			
^a Pour l'essai de la fonction temporelle, la tension d'entrée assignée ou la limite supérieure de la plage assignée de tensions d'entrée spécifiée en 6.2 doit être appliquée. La limite inférieure de la plage temporelle doit être vérifiée. En cas de valeurs fixes, la valeur la plus faible doit être soumise à l'essai. Si cette valeur est supérieure à 1 min, l'essai de la fonction temporelle peut être remplacé par un essai sur prélèvement. L'essai peut être réalisé avec les circuits de sortie à vide.			
^b L'essai de rigidité diélectrique est réalisé conformément au 11.3.3, avec les exceptions suivantes: <ul style="list-style-type: none"> • la durée de l'essai de rigidité diélectrique est réduite à 1 s; • l'essai spécifié en 11.3.1.a) peut être omis. 			