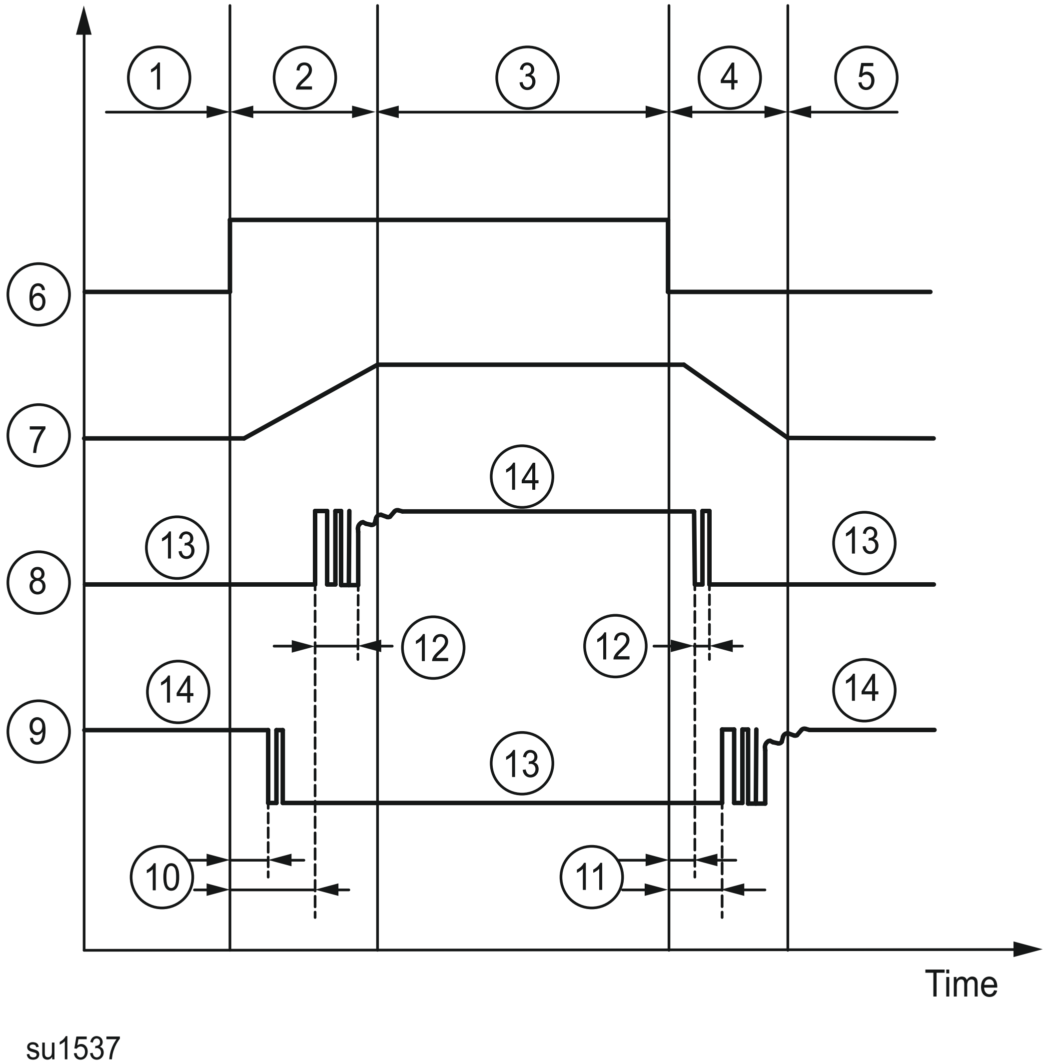
Annex A
(normative)

Explanations regarding relays

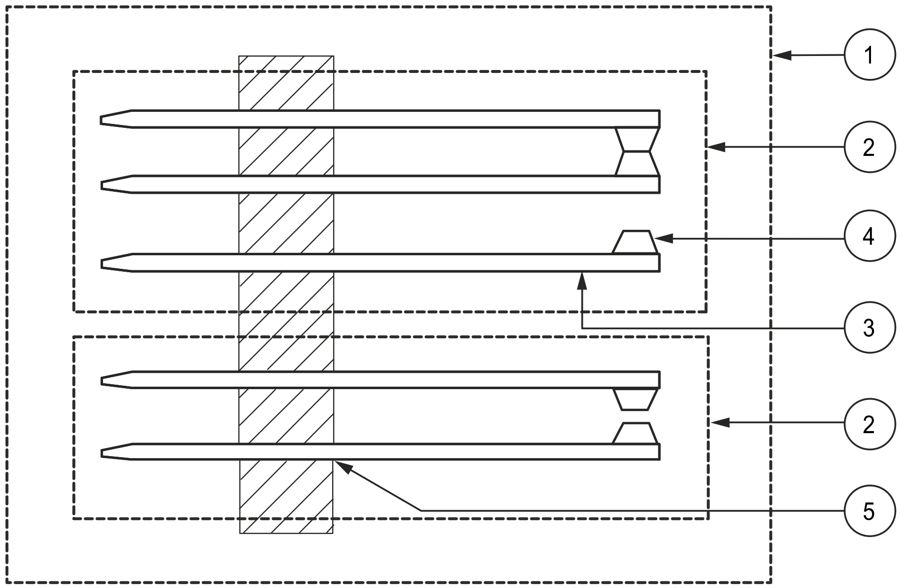


Key

1 Release condition
2 Operate
3 Operate condition
4 Release
5 Release condition
6 Coil voltage
7 Change in position of movable parts
8 Voltage at make contact
9 Voltage at break contact
10 Operate time
11 Release time
12 Bounce time
13 Open
14 Closed

Figure A.1

Diagram explaining terms related to monostable relays



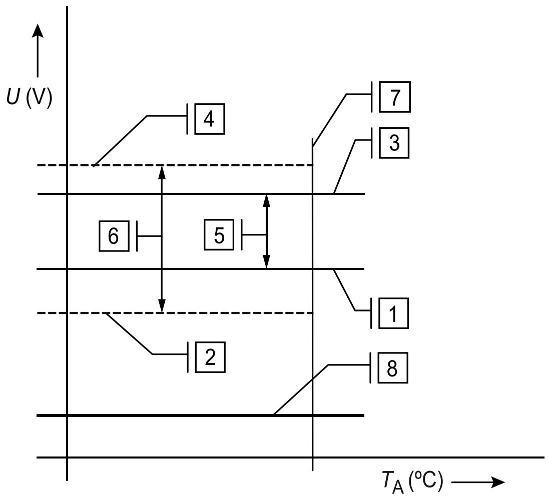
su1541

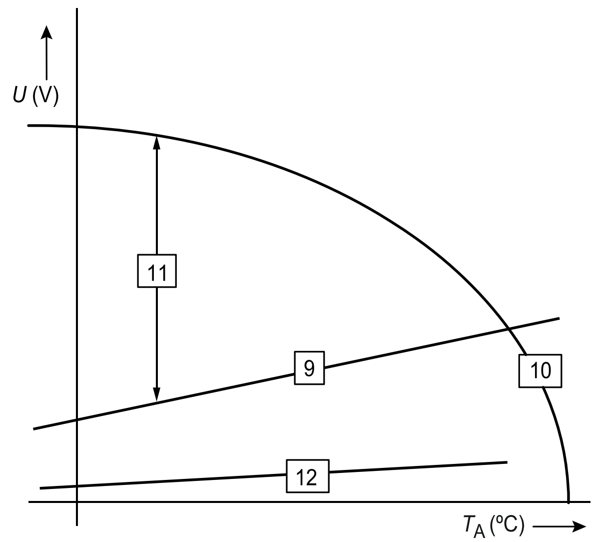
Key

1 Contact set
2 Contact
3 Contact member
4 Contact point
5 Fixing

Figure A.2

Example explaining terms relating to contacts





su1542

Operative range according to 5.3.1

Operative range according to 5.3.2

Key

U Coil voltage

T_A Ambient temperature

1 Rated coil voltage, or lower limit of the rated coil voltage range

2 Lower limit of the operative range of the coil voltage

EXAMPLE 80 % of 1 (for class 1)

3 Rated coil voltage, or upper limit of the rated coil voltage range

4 Upper limit of the operative range of the coil voltage

EXAMPLE 110 % of 3 (for class 1)

5 Rated coil voltage range

6 Operative range of the coil voltage

7 Maximum permissible ambient temperature for the rated coil voltage or the rated coil voltage range

8 Release voltage, ≥ 5 % (DC coil) / 15% (AC coil) of 3

9 Lower limit U_1 of the operative range of the coil voltage

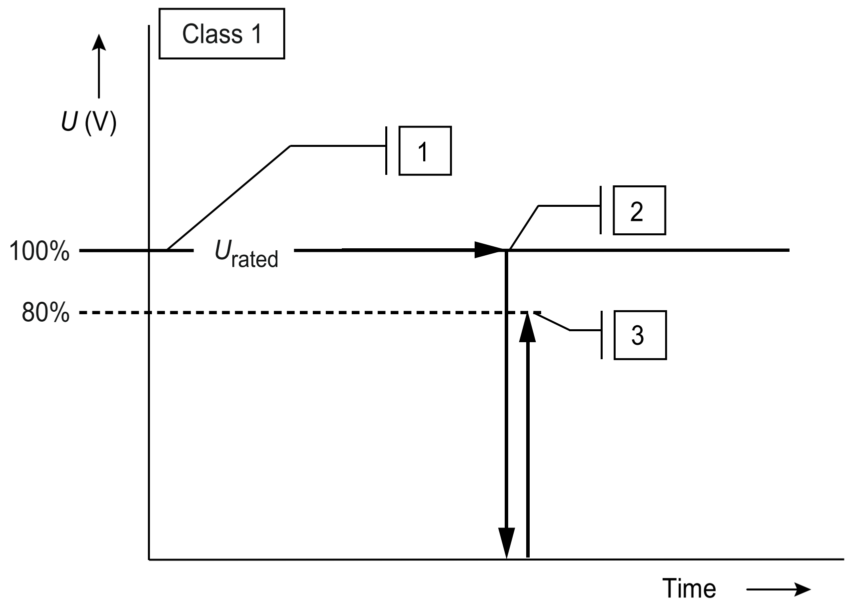
10 Upper limit U_2 of the operative range of the coil voltage (limiting voltage)

11 Operative range of the coil voltage

12 Release voltage, ≥ 10 % (DC coil) / 15% (AC coil) of 9

Figure A.3

Explanations regarding the operative range of the coil voltage



su1543

Key

1 Energization with rated coil voltage (or upper limit of rated coil voltage range) until thermal equilibrium is reached

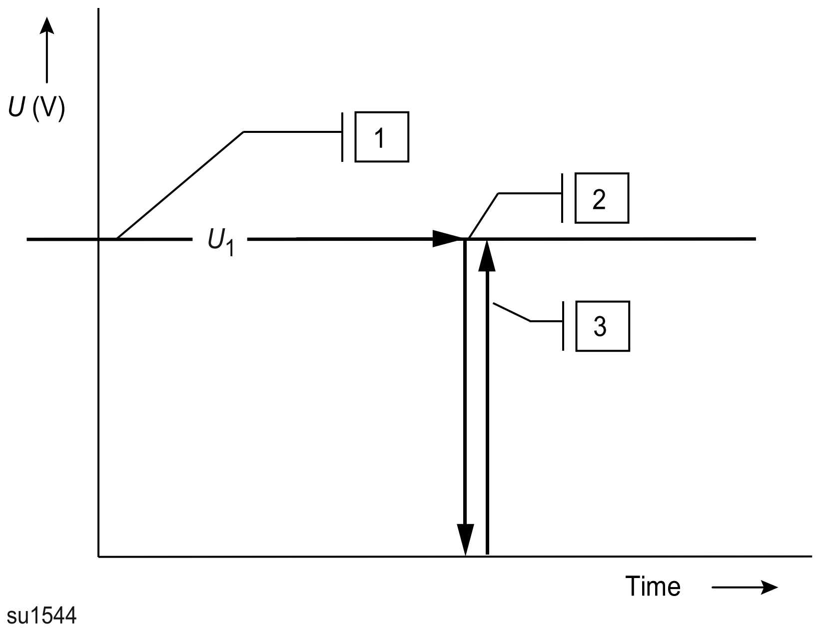
2 Removal of voltage

3 Immediately after the removal of the coil voltage, energization with 80 % of the rated coil voltage (or lower limit of rated coil voltage range)

Requirement: the relay shall operate

Figure A.4

Explanation regarding the preconditioning and testing of the operate voltage according to 5.3.1 (Class 1) and 9.2



Key

1 Energization with the maximum value of the lower limit U_1 of the operative range of the coil voltage until thermal equilibrium is reached

2 Removal of voltage

3 Immediately after the removal of the coil voltage, re-energization with U_1

Requirement: the relay shall operate

Figure A.5

Explanation regarding the preconditioning and testing of the operate voltage according to 5.3.2 and 9.2

Annex B
(informative)

Inductive contact loads

Annex BDV D2 *Modification to Annex B:*

Annex B is normative.

In this annex provisions for the testing of relays with respect to making and breaking capacity and electrical endurance for inductive contact loads are specified. Other loads and tests may be specified by the manufacturer.

Unless otherwise specified the testing is carried out at ambient temperature.

Separate samples may be used for the different tests of Table B.1 to Table B.3.

The sample lot shall be chosen in accordance with Table 5, test procedure B for Table B.1 and Table B.2 and for Table B.3 test procedure A only.

It is up to the discretion of the manufacturer to choose one or more of the tests described in Table B.1, Table B.2 and Table B.3, respectively. However, when the test according to Table B.1 is performed, also the test of Table B.2 applies.

The performed test(s) are to be indicated in the test report.

NOTE In the following tables a classification of loads is given, related to utilization categories (AC 15 and DC 13) defined in IEC 60947-5-1.

For the electrical endurance test the duty factor shall be not more than 50% but not less than 10% and the 10 times making current shall not overheat the test device.

The test circuit shall be in accordance with C.1. In addition a resistor shall be in parallel to the breaking load carrying 3% (for AC and 1% for DC) of the breaking current. The inductance shall be provided by air core reactors or alternatively with iron core reactors (with a maximum distortion factor of 5% for AC). If the contact bouncing is less than 3 ms it is permitted to carry out the electrical endurance only with the breaking load (without the higher inrush load).

NOTE: Provisions for measuring the contact bounce time can be found in IEC 61810-7.

BDV.1 D2 *Modify Annex B by adding the following:*

BDV.1 Test procedure B requires verification of the making and breaking capacity under normal conditions (Table B.2). As a result of this test, there shall be no:

a) Electrical or mechanical breakdown of the device;

b) Undue burning or pitting of the contacts; or

c) Welding of the contacts

BDV.2 The representative load for the overload and making and breaking capacity tests shall be one of the following types:

a) An electromagnetic load in accordance with the applicable load type values per Table B.2; or

b) An electromagnetic load based on the manufacturer's declared values for operational current, Ie and operational voltage, Ue. Unless otherwise known, the ac making current is to be ten times the steady state current.

BDV.3 In lieu of the electromagnetic loads described in BDV.2, an air-core inductive load may be used to produce the making and breaking currents in Table B.2, provided the duration of the making current shall be at least two cycles at 50 or 60 hertz.

BDV.4 An air-core inductive load may be connected in parallel with a resistor if the resistor (R_{SH}) power consumption is approximately 3 percent of the total power consumption calculated in accordance with the following formula:

$$R_{SH} = 33.3\,(1/PF - PF)\cdot E/I$$

In which:

PF is the power factor;

E is the closed-circuit phase voltage; and

I is the phase current.

Table B.1
Verification of the making and breaking capacity (abnormal conditions)

Classification	Making			Breaking			Number of cycles and frequency		
	I/I_e	U/U_e	cos φ	I/I_e	U/U_e	cos φ	Number of cycles	Frequency in cycles per minute	Duration of energization s
AC inductive load (contactor coil, solenoid valve)	10	1,1	0,3	10	1,1	0,3	10	6	0,04
	Total number of cycles						10		
	I/I_e	U/U_e	$T_{0,95}$	I/I_e	U/U_e	$T_{0,95}$	Number of cycles	Frequency in cycles per minute	Duration of energization
DC inductive load (contactor coil, solenoid valve)	1,1	1,1	6 × P[a]	1,1	1,1	6 × P[a]	10	6	$T_{0,95}$
	Total number of cycles						10		
I_e	Rated operating current			I			Switching current		
U_e	Rated operating voltage			U			Switching voltage		
$P = U_e \times I_e$	Steady-state power in W			$T_{0,95}$			Time to reach 95 % of the steady-state current in ms		

[a] The value "6 × P" is derived from an empirical relation appropriate for most of the d.c. inductive loads up to P = 50 W, where 6 × P = 300 ms. Loads with a rated power above 50 W comprise small loads in parallel. Therefore, 300 ms is an upper limit independent of the power value.

Table B.2
Verification of the making and breaking capacity (normal conditions)

Classification	Making			Breaking			Number of cycles and frequency		
	I/I_e	U/U_e	cos φ	I/I_e	U/U_e	cos φ	Number of cycles	Frequency in cycles per minute	Duration of energization s
AC inductive load (contactor coil, solenoid valve)	10	c	0,3	1	c	0,3	50	6	0,05
	10	1	0,3	1	1	0,3	10	> 60[b]	0,05
	10	1	0,3	1	1	0,3	990	60	0,05
	10	1	0,3	1	1	0,3	5 000	6	0,05
	Total number of cycles						6 050		
	I/I_e	U/U_e	$T_{0,95}$	I/I_e	U/U_e	$T_{0,95}$	Number of cycles	Frequency in cycles per minute	Duration of energization
DC inductive load (contactor coil, solenoid valve)	1	c	6 × P[a]	1	c	6 × P[a]	50	6	$T_{0,95}$
	1	1	6 × P[a]	1	1	6 × P[a]	10	> 60 [b]	$T_{0,95}$
	1	1	6 × P[a]	1	1	6 × P[a]	990	60	$T_{0,95}$
	1	1	6 × P[a]	1	1	6 × P[a]	5 000	6	$T_{0,95}$
	Total number of cycles						6 050		

I_e	Rated operating current	I	Switching current
U_e	Rated operating voltage	U	Switching voltage
$P = U_e \times I_e$	Steady-state power in W	$T_{0,95}$	Time to reach 95 % of the steady-state current in ms

[a] The value "6 × P" is derived from an empirical relation appropriate for most of the d.c. inductive loads up to P = 50 W, where 6 × P = 300 ms. Loads with a rated power above 50 W comprise small loads in parallel. Therefore, 300 ms is an upper limit independent of the power value.

[b] With maximum permissible frequency (ensuring reliable making and breaking of the contacts).

[c] The test is carried out at a voltage of U_e × 1,1, with the test current I_e adjusted at U_e.

Table B.3
Electrical endurance test

Current	Classification	Making			Breaking		
AC	inductive load (contactor coil, solenoid valve)	I 10 I_e	U U_e	cos φ 0,7[a]	I I_e	U U_e	cos φ 0,4[a]
DC[b]	inductive load (contactor coil, solenoid valve)	I I_e	U U_e	$T_{0,95}$ 6 × P[c]	I I_e	U U_e	$T_{0,95}$ 6 × P[c]

I_e	Rated operating current	I	Switching current
U_e	Rated operating voltage	U	Switching voltage
$P = U_e \times I_e$	Steady-state power in W	$T_{0,95}$	Time to reach 95 % of the steady-state current in ms

[a] The power factors indicated are conventional values and appear only in test circuits in which electrical characteristics of coils are simulated. Reference is made to the fact that for circuits with a power factor of 0,4 shunt resistors are used to simulate the damping effect due to eddy current losses.

[b] For d.c. inductive loads provided with a switching device to operate an economy resistor, the rated operating current shall be equal to at least the highest making current.

[c] The value "6 × P" is derived from an empirical relation appropriate for most of the d.c. inductive loads up to P = 50 W, where 6 × P = 300 ms. Loads with a rated power above 50 W comprise small loads in parallel. Therefore, 300 ms is an upper limit independent of the power value.

Table B.4
Contact rating designations and equivalency to utilization categories

Designation[a]	**Utilization category**	**Conventional enclosed thermal current I_{the}** A	**Rated operational current I_e (A) at rated operational voltage U_e**						**VA rating**[b] VA	
Alternate current			120 V	240 V	380 V	480 V	500 V	600 V	M	B
A150	AC – 15	10	6	–	–	–	–	–	7 200	720
A300	AC – 15	10	6	3	–	–	–	–	7 200	720
A600	AC – 15	10	6	3	1,9	1,5	1,4	1,2	7 200	720
B150	AC – 15	5	3	–	–	–	–	–	3 600	360
B300	AC – 15	5	3	1,5	–	–	–	–	3 600	360
B600	AC – 15	5	3	1,5	0,95	0,75	0,72	0,6	3 600	360
C150	AC – 15	2,5	1,5	–	–	–	–	–	1 800	180
C300	AC – 15	2,5	1,5	0,75	–	–	–	–	1 800	180
C600	AC – 15	2,5	1,5	0,75	0,47	0,375	0,35	0,3	1 800	180
D150	AC – 14	1,0	0,6	–	–	–	–	–	432	72
D300	AC – 14	1,0	0,6	0,3	–	–	–	–	432	72
E150	AC – 14	0,5	0,3	–	–	–	–	–	216	36
Direct current			125 V	250 V		400 V	500 V	600 V		
N150	DC-13	10	2,2	–		–	–	–	275	275
N300	DC-13	10	2,2	1,1		–	–	–	275	275
N600	DC-13	10	2,2	1,1		0,63	0,55	0,4	275	275
P150	DC-13	5	1,1	–		–	–	–	138	138
P300	DC-13	5	1,1	0,55		–	–	–	138	138
P600	DC-13	5	1,1	0,55		0,31	0,27	0,2	138	138
Q150	DC-13	2,5	0,55	–		–	–	–	69	69
Q300	DC-13	2,5	0,55	0,27		–	–	–	69	69
Q600	DC-13	2,5	0,55	0,27		0,15	0,13	0,1	69	69
R150	DC-13	1,0	0,22	–		–	–	–	28	28
R300	DC-13	1,0	0,22	0,1		–	–	–	28	28
									M = make B = break	

a The letter stands for the conventional enclosed thermal current and identifies (a.c. or d.c.): for example B means 5 A a.c. The rated insulation voltage U_i is at least equal to the number after the letter.

b The rated operational current I_e (A), the rated operational voltage U_e (V) and the break apparent power B (V.A) are correlated by the formula $B = U_e \times I_e$.

Annex C
(normative)

Test set-up

Annex CDV D2 *Modification to Annex C:*

Annex C is normative.

C.1 Test circuit

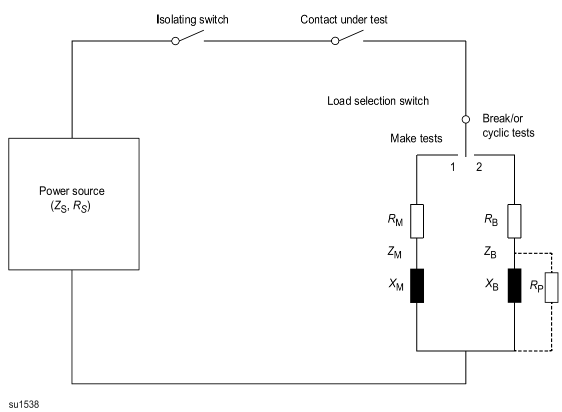
A generalized test circuit is given in Figure C.1 and a functional block diagram in Figure C.2.

NOTE The isolating switch, the load selection switch and the contact under test shall be sequenced appropriate to the test conditions specified.

The characteristics indicated in Table C.1 and Table C.2 apply, unless otherwise specified.

The test conditions given in Clause apply. All relevant details (e. g. number of cycles, frequency of operation, duration of energization) have to be specified by the manufacturer.

The declared value of the current shall be expressed in terms of the steady state (r.m.s. if a.c.) value of current in the contact circuit.



Contact categories 0 and 1	Contact category 2
$Z_s < 0{,}02\ Z_{M,B}$ (a.c.)	$Z_s < 0{,}05\ Z_{M,B}$ (a.c.)
$R_s < 0{,}02\ R_{M,B}$ (d.c.)	$R_s < 0{,}05\ R_{M,B}$ (d.c.)

For standard load values and tolerances for L/R and cos φ: see Table C.2.

Load selection switch, position 1: Make test when different load (inrush current) is used.

Load selection switch, position 2: Make and break (or cyclic) tests with same load.

Isolating switch: Used to connect/disconnect the load circuit, independent of the contact under test.

Formula for R_P: $R_P = 33{,}3\times (1 / \cos \varphi - \cos \varphi)\times U / I_e$

Figure C.1

Standard test circuit