BS EN 62246-1-1:2013

BSI Standards Publication

Reed switches

Part 1-1: Generic specification – Quality assessment

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National foreword

This British Standard is the UK implementation of EN 62246-1-1:2013. It is identical to IEC 62246-1-1:2013. It supersedes DD IEC/PAS 62246-2-1:2008 which is withdrawn.

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

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

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

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

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Reed switches - Part 1-1: Generic specification - Quality assessment

(IEC 62246-1-1:2013)

Contacts à lames souples - Partie 1-1: Spécification générique - Evaluation de qualité (CEI 62246-1-1:2013)

Reedschalter - Teil 1-1: Fachgrundsezifikation – Qualitätsbewertung (IEC 62246-1-1:2013)

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 94/358/FDIS, future edition 1 of IEC 62246-1-1, prepared by IEC TC 94 "All-or-nothing electrical relays" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62246-1-1:2013.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-03-28
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2016-06-28

This standard is intended to be used in conjunction with EN 62246-1:2011.

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

Endorsement notice

The text of the International Standard IEC 62246-1-1:2013 was approved by CENELEC as a European Standard without any modification.

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

IEC 61810-2-1:2011	NOTE	Harmonised as EN 61810-2-1:2011 (not modified).
IEC 60068-2-1:2007	NOTE	Harmonised as EN 60068-2-1:2007 (not modified).
IEC 60068-2-2:2007	NOTE	Harmonised as EN 60068-2-2:2007 (not modified).
IEC 60068-2-7:1983+A1:1986	NOTE	Harmonised as EN 60068-2-7:1993 (not modified).
IEC 60068-2-13:1983	NOTE	Harmonised as EN 60068-2-13:1999 (not modified).
IEC 60068-2-17:1994	NOTE	Harmonised as EN 60068-2-17:1994 (not modified).
IEC 60068-2-27:2008	NOTE	Harmonised as EN 60068-2-27:2009 (not modified).
IEC 60068-2-30:2005	NOTE	Harmonised as EN 60068-2-30:2005 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

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

Publication	Year	Title	EN/HD	Year
IEC 60068-2-6	2007	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	2008
IEC 60068-2-11 + corr. December	1981 1999	Environmental testing - Part 2: Tests - Test Ka: Salt mist	EN 60068-2-11	1999
IEC 60068-2-14	2009	Environmental testing - Part 2-14: Tests - Test N: Change of temperature	EN 60068-2-14	2009
IEC 60068-2-20	2008	Environmental testing - Part 2-20: Tests - Test T: Test methods for solderability and resistance to soldering heat of devices with leads	EN 60068-2-20	2008
IEC 60068-2-21 + corr. January	2006 2012	Environmental testing - Part 2-21: Tests - Test U: Robustness of terminations and integral mounting devices	EN 60068-2-21	2006
IEC 60068-2-78	2001	Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state	EN 60068-2-78 [1)]	2001
IEC 60127-2	2003	Miniature fuses - Part 2: Cartridge fuse-links	EN 60127-2	2003
IEC 61373 + corr. October	2010 2011	Railway applications - Rolling stock equipment - Shock and vibration tests	EN 61373	2010
IEC 62246-1	2011	Reed switches - Part 1: Generic specification	EN 62246-1	2011

[1)] EN 60068-2-78 is superseded by EN 60068-2-78:2013, which is based on IEC 60068-2-78:2012.

CONTENTS

INTRODUCTION

Reed switches which are in mass production and which are widely used in practice could be classified by the following characteristics:

a) Size:
   - Normal or standard reed switches with a tube more than 50 mm in length and more than 5 mm in diameter;
   - Sub-miniature reed switches with a tube more than 20 mm and up to 50 mm in length and up to 5 mm in diameter;
   - Miniature reed switches with a tube more than 10 mm and up to 20 mm in length and more than 2 mm and up to 5 mm in diameter;
   - Micro-miniature reed switches with a tube more than 4 mm and up to 10 mm in length and more than 1,5 mm and up to 5 mm in diameter.

b) Type of switching of electric circuit:
   - Closing or normally open – A type;
   - Opening or normally closed – B type;
   - Changeover – C type.

c) Withstand voltage level:
   - Low-voltage (up to 1 000 V);
   - High-voltage (more than 1 000 V).

d) Switches power:
   - Low-power (up to 60 W);
   - Power (100 to 1 000 W);
   - High-power (more than 1 000 W).

e) Types of electric contacts:
   - The tube is filled with dry air, gas mixture, vacuumized, or high pressurized.

Based on the general provisions of IEC 62246-1, this standard selects and specifies test procedures for reed switches where enhanced requirements for the verification of quality assessment specification apply.

This standard describes sampling and test schedules for qualification approval procedures, quality conformance inspection, formation of inspection lots and intervals between tests.

NOTE All type of reed switches exclude mercury reed switches.

REED SWITCHES –

Part 1-1: Generic specification – Quality assessment

1 Scope

This part of the IEC 62246 which is a quality assessment specification defines requirements and tests to reed switches for use in general and industrial applications.

This standard is intended to be used in conjunction with IEC 62246-1:2011.

This standard selects from IEC 62246-1:2011 and from other sources the appropriate test procedures to be used in detail specifications derived from this specification.

Reed switch types are specified depending on characteristic values and tests.

NOTE Mercury wetted reed switches are not covered by this standard due to their possible environmental impact.

2 Normative references

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

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

IEC 60068-2-11:1981, *Basic environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

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

IEC 60068-2-21:2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60127-2:2003, *Miniature fuses – Part 2: Cartridge fuse-links*

IEC 61373:2010, *Railway applications – Rolling stock equipment – Shock and vibration tests*

IEC 62246-1: 2011, *Reed switches – Part 1: Generic specification*

3 Terms and definitions

The terms and definitions given in IEC 62246-1:2011, as well as the following, apply.

3.1 Reed switch types

3.1.1
type
products having similar design features and nominal dimensions manufactured by the same techniques and falling within a range of ratings specified by the manufacturer

Note 1 to entry: Mounting accessories are ignored, provided they have no significant effect on the test results.

3.1.2
variant
variation within a type having specific characteristics

3.1.3
reed switch
assembly containing contact blades, partly or completely made of magnetic material, hermetically sealed in an envelope and controlled by means of an externally generated magnetic field (e.g. an energizing quantity applied to a coil)

3.1.4
high voltage vacuum reed switch
reed switch, in which ability to switch high voltages is achieved by a high vacuum within the hermetically sealed envelope

3.1.5
heavy-duty reed switch
reed switch, in which greater switching capacity is achieved

Note 1 to entry: Blades having additional contact tips or a contact tip and spring which separate the magnetic path and electric path are typical examples of techniques to increase switching capacity.

3.2 Tests

3.2.1
routine test
conformity test made on each reed switch during or after manufacture

3.2.2
lot-by-lot test
test carried out periodically on a sample of reed switches drawn from running production at least once a month

3.2.3
periodic test
test carried out periodically on a sample of reed switches drawn from running production at least once a year and every two years

Note 1 to entry: The results from periodic tests are used verify that the level of technical performance is maintained.

3.3 Abbreviations

3.3.1
IL
inspection level
inspection level which determines the relationship between the lot or batch size and the sample size

Note 1 to entry: The size of the sample drawn from the lot is dependent on the severity of the inspection level.

3.3.2
AQL
acceptance quality level
maximum percent defective that can be considered satisfactory as a process average

4 Test schedules

4.1 General

Test procedures are referenced in the corresponding subclauses of IEC 62246-1:2011.

4.2 Qualification approval procedures

– Sampling and test schedule are specified in Table 2 and Table 3.
– The tests specified and their order is mandatory.
– Tests stated in Table 2 and 3 are mandatory for the variants except when otherwise specified.

4.3 Quality conformance inspection

An initial conformity test has to be passed and then confirmed by routine tests, lot-by-lot tests and periodic tests.

Quality conformance inspection contains the tests stated in Table 1:

– Group A: routine tests;
– Groups A and B: lot-by-lot tests;
– Group C: periodic tests.

Unless otherwise stated in this specification, all tests of Table 1 are mandatory.

Where a subgroup contains cumulative tests, the order of the tests is mandatory. Specimens that have been subjected to tests denoted as destructive (D) shall not be released for delivery. Specimens that have been subjected to tests denoted as non-destructive (ND) are permitted to be released for delivery.

4.4 Formation of inspection lots

The basis for determination of sample size for the quality conformance inspection is the reed switch quantity produced during one month.

4.5 Intervals between tests

– Subgroup A0: at shipment.
– Subgroups A4 and B1: at least once a month.
– Subgroups C1: at least once a year.
– Subgroup C4: at least once every two years.

4.6 Standard conditions for testing

If not otherwise stated, all tests shall be performed under standard conditions for testing according to 7.3 of IEC 62246-1:2011.

4.7 Mounting of test specimens during the test

The following requirement shall apply for shock and vibration tests:

The reed switch shall be mounted by its normal mounting method to the test fixture, where inherent resonances have been minimized so as not to invalidate the test.

4.8 General conditions for testing

Unless otherwise stated, the test coil number and when applicable its polarity specified in Table 5 shall be used for all tests. Unless otherwise stated in this specification, the polarity shall be as specified by the manufacturer.

Table 1 – Quality conformance inspection *(1 of 8)*

Group A
Subgroup A0

For all tests in this subgroup: 100 % test.

Test no.	Test	Test conditions according to IEC 62246-1:2011	Performance requirements
A0 – 1	Visual inspection and check of dimensions (ND)	Subclause 7.4	According to Table 4 Marking as specified in 7.1
A0 – 2	Functional tests (ND)	Subclause 7.5, Procedure 1 Application points and standard test coil number: must-operate value: saturate value: 150 % of must-operate must-release value: Contact failure-to-make and failure-to-break by monitoring a current, typically 10 mA at 24 V DC max.	 According to Table 5 According to Table 4
A0 – 3	Contact circuit resistance (ND)	Subclause 7.7 Application points: terminals of closed contacts Standard test coil number: Test coil voltage: 150 % of must-operate Test voltage max.: 6 V DC or 6 V AC Test current max.: 1 A	Initial value according to Table 4 According to Table 5
A0 – 4	Dielectric test (ND)	Subclause 7.8 Application points and test voltage: Duration of test: 1 min NOTE A shorter test with a higher voltage can be stated in the detail specification.	 According to Table 4 Maximum leakage current: 0,5 mA
A0 – 5	Operating times (ND)	Subclause 7.10 Application points and standard test coil number: Test coil voltage: 150 % of must-operate 1) operate time 2) release time 3) operate bounce time Contact failure-to-make and failure-to-break by monitoring a current, typically 10 mA at 24 V DC max.	 According to Table 5 According to Table 4
A0 – 6	Sealing (ND)	Subclause 7.21 Application points and standard test coil number: Arc time during test for heavy-duty reed switches: Test coil voltage: 150 % of must-operate Test voltage: 100 V DC – 110 V DC Test current: 0,5 A – 0,55 A Total number of operations required: 3 Leak test for reed switches and high voltage reed switch.	 According to Table 5 According to Table 7

Table 1 *(2 of 8)*

Subgroup A4 (period: inspection lot refers to the production volume in one month)

Test no.	Test	Test conditions according to IEC 62246-1:2011	IL	AQL	Performance requirements
1	Visual inspection and check of dimensions (ND)	Subclause 7.4			According to Table 4 Marking as specified in 7.1
2	Functional tests (ND)	Subclause 7.5, Procedure 1 Application points and standard test coil number: must-operate value saturate value: 150 % of must-operate must-release value Contact failure-to-make and failure-to-break by monitoring a current, typically 10 mA at 24 V DC max.			According to Table 5 According to Table 4
3	Contact-circuit resistance (ND)	Subclause 7.7 Application points: terminals of closed contacts Standard test coil number: Test coil voltage: 150 % of must-operate Test voltage max. 6 V DC or 6 V AC Test current max.:1 A			Initial value according to Table 4 According to Table 5
4	Dielectric test (ND)	Subclause 7.8 Application points and test voltage: Duration of test: 1 min NOTE A shorter test with a higher voltage can be stated in the detail specification.	S4	1,0	According to Table 4 Maximum leakage current: 0,5 mA
5	Operating times (ND)	Subclause 7.10 Application points and standard test coil number: Test coil voltage: 150 % of must-operate 1) operating time 2) release time 3) operate bounce time Contact failure-to-make and failure-to-break by monitoring a current, typically 10 mA at 24 V DC max.			According to Table 5 According to Table 4
6	Sealing (ND)	Subclause 7.21 Application points and standard test coil number: Arc time during test for heavy-duty reed switches: Test coil voltage: 150 % of must-operate Test voltage: 100 V DC – 110 V DC Test current: 0,5 A – 0,55 A Total number of operations required: 3 Leak test for reed switches and high-voltage vacuum reed switch.			According to Table 5 According to Table 7

Table 1 *(3 of 8)*

Subgroup B1 (period: inspection lot refers to the production volume of one month)

Test no.	Test	Test conditions according to IEC 62246-1:2011	IL	AQL	Performance requirements
7	Contact reliability test (D)	Subclause 7.28 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 % Switching load conditions: Monitoring conditions: Final measurements: Test 3 – contact circuit resistance Test 2 – functional tests	S3	2,5	 According to Table 5 According to Table 6 According to Table 6 At each cycle during the test According to Table 4 According to Table 4

Table 1 *(4 of 8)*

Subgroup C1 (period: one year)

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
8	Robustness of terminals (D)	Subclause 7.12 (in accordance with IEC 60068-2-21:2006) Procedure: test Ua1 – tensile Final measurements: Test 1 – visual inspection Test 2 – functional tests Test 6 – sealing	6	0	According to Table 4 No breaking or loosening of terminals No cracks or other deterioration According to Table 4 According to Table 7
9	Soldering (D)	Subclause 7.13 (in accordance with IEC 60068-2-20:2008, test Ta, method 1) Temperature: (250 ± 5) °C Duration: (2 ± 0,5) s Application point: 5 mm from the glass-to-metal seals Subclause 7.13 (in accordance with IEC 60068-2-20:2008, test Ta, method 2) Temperature: (350 ± 5) °C Duration: (3 ± 0,5) s Application point: 5 mm from the glass-to-metal seals Final measurements: Test 1 – visual test Test 2 – functional tests Test 6 – sealing	5	0	The dipped surface shall be 95 % covered with new solder coating, the remaining 5 % may contain only small pinholes No cracks or other deterioration According to Table 4 According to Table 7

Table 1 *(5 of 8)*

Subgroup C1 (period: one year)

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
10	Rapid change of temperature (D)	Subclause 7.16 (in accordance with IEC 60068-2-14:2009) Low temperature: – 50 °C for heavy-duty reed switches – 40 °C for reed switches and high voltage vacuum reed switch Temperature: 100 °C for heavy-duty reed switches 125 °C for reed switches and high voltage vacuum reed switch Exposure time: 20 min for heavy-duty reed switches 30 min for reed switches and high voltage vacuum reed switch Transition time: 1 min for heavy-duty reed switches 15 min for reed switches and high voltage reed switch Number of cycles: 10 for heavy-duty reed switches 5 for reed switches and high voltage vacuum reed switch Final measurements:	6	0	
		Test 4 – dielectric test			According to Table 4
		Test 2 – functional tests			No cracks or other deterioration
		Test 3 – contact circuit resistance			According to Table 7
		Test 1 – visual inspection			According to Table 4
		Test 6 – sealing test			According to Table 7

Table 1 *(6 of 8)*

Subgroup C1 (period: one year)

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
11	Vibration (D) Functional	Subclause 7.18 Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate Axis of mounting: Vibration conditions: Application: three directions Number of sweeps per direction: 3 Sweep rate: 1 octave/min ± 10 % Total duration: approx. 3 × 10 min Test contact voltage and current: 24 V DC max., 10 mA max. Final measurements: Test 1 – visual inspection Test 2 – functional tests Test 6 – sealing	6	0	No opening of closed contact circuit with energization condition or closing of opened contact circuit shall exceed 10 μs The movable contact shall be located in the transverse direction According to Table 7 No cracks or other deterioration According to Table 4 According to Table 7
12	Electrical endurance (D)	Subclause 7.22 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 % Switching load conditions: Monitoring conditions: Final measurements: Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	6	0	According to Table 5 According to Table 6 According to Table 6 At each cycle during the test According to Table 4 According to Table 4 According to Table 4

Table 1 *(7 of 8)*

Subgroup C4 (period: at least once every two years)

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
13	Shock (D) Functional	Subclause 7.19 Test switch type and standard test coil number: According to Table 5 Test coil voltage: 150 % of must-operate Axis of mounting: Shock conditions: Application: three directions Number of shocks: 18 (three positive and three negative in each of the three orthogonal planes) Duration: 11 ms Test contact voltage and current: 24 V DC max., 10 m A max. Final measurements: Test 1 – visual inspection Test 2 – functional tests Test 6 – sealing	6	0	No opening of closed contact circuit with energization condition, or closing of opened contact circuit shall exceed 10 μs The movable contact shall be located in the transverse direction According to Table 7 No cracks or other deterioration According to Table 4 According to Table 7
14	Mechanical endurance (D)	Subclause 7.23 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50% Number of cycles per s: 50 to 60 Periodic measurements: 1×10^6; 3×10^6; 5×10^6; 7×10^6; 1×10^7; 3×10^7; 5×10^7; 7×10^7; and 10^8 Limits for failure to make: Limits for failure to break: Test 3 – contact circuit resistance Test 2 – functional tests	20	1	There shall be no broken parts According to Table 5 ±20 % change of must-operate value for heavy-duty reed switches ±15 % change of must-operate value for reed switches 50 % change of must-release value for heavy-duty reed switches 30 % change of must-release value for reed switches According to Table 4 According to Table 4

Table 1 *(8 of 8)*

Subgroup C4 (period: at least once every two years)

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
15	Making current capacity test (D) Heavy-duty reed switches only	Subclause 7.30 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Making load conditions: Monitoring conditions: monitoring times: t_1 = 400 ms, τ_1 = 50 ms Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	6	0	 According to Table 5 According to Table 6 At each cycle during the test According to Table 4 According to Table 4 According to Table 4
16	Breaking current capacity test (D) Heavy-duty reed switches only	Subclause 7.31 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Breaking load conditions: Monitoring conditions: monitoring times: t_2 = 400 ms, τ_2 = 50 ms Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	6	0	 According to Table 5 According to Table 6 At each cycle during the test According to Table 4 According to Table 4 According to Table 4
17	Surge withstand test (D) Variant B of heavy-duty reed switches only	Subclause 7.25 test voltage: 3 000 V test voltage wave form: 1,2/50 μs number of pulses: 6 pulses (three positive and three negative) Final measurements: Test 1 – visual test Test 2 – functional tests Test 4 – dielectric test	3	0	 According to Table 6 No cracks or other deterioration According to Table 4 According to Table 4

Table 2 – Tests for qualification approval *(1 of 17)*

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
1	Visual inspection and check of dimensions (ND)	Subclause 7.4	170	0	According to Table 4 Marking as specified in 7.1
2	Functional tests (ND)	Subclause 7.5, Procedure 1 Application points and standard test coil number: must-operate value: saturate value: 150 % of must-operate must-release value: Contact failure-to-make and failure-to-break by monitoring a current, typically 10 mA at 24 V DC max.			According to Table 5 According to Table 4
3	Contact circuit resistance (ND)	Subclause 7.7 Application points: terminals of closed contacts Standard test coil number: Test coil voltage: 150 % of must-operate Test voltage max. 6 V DC or 6 V AC Test current max.:1 A			Initial value according to Table 4 According to Table 5
4	Dielectric test (ND)	Subclause 7.8 Application points and test voltage: Duration of test: 1 min NOTE A shorter test with a higher voltage can be stated in the detail specification.			According to Table 4 Maximum leakage current: 0,5 mA
5	Operating times (ND)	Subclause 7.10 Application points and standard test coil number: Test coil voltage: 150 % of must-operate operate time: release time: operate bounce time: Contact failure-to-make and failure-to-break by monitoring a current, typically 10 mA at 24 V DC max.			According to Table 5 According to Table 4
6	Sealing (ND)	Subclause 7.21 Application points and standard test coil number: Arc time during test for heavy-duty reed switches Test coil voltage: 150% of must-operate Test voltage: 100 V DC – 110 V DC Test current: 0,5 A – 0,55 A Total number of operations required: 3 Leak test for reed switches and high voltage vacuum reed switch.			According to Table 5 According to Table 7

Table 2 *(2 of 17)*

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
7	Remanence tests (ND)	Subclause 7.6 Application points and standard test coil number: saturate value: 150 % of must-operate just-operate value 1 saturate value (reverse polarity): 150% of must-operate just-operate value 2	6	0	 According to Table 5 Remanence value: Max. 10%
8	Insulation test (ND)	Subclause 7.9 Application points and test voltage:	6	0	 According to Table 4
9	Contact sticking (ND) Thermal sticking Magnetostrictive sticking	Subclause 7.11.1, Procedure 1 Application points and standard test coil number: upper category temperature: 150 °C for heavy-duty reed switches 125 °C for reed switches saturate value: 150 % of must-operate test period: min 24 h max. permitted value: Subclause 7.11.2 Application points and standard test coil number: pulsing rate: 10 cycles per second limits for the peak-to-peak value of the pulse: 200 % and 100 % of must-operate number of test cycles: 5 min. contact circuit resistance defining failure-to-break:	6	0	According to Table 5 Permitted value: max.10 % According to Table 5 Zero failure-to-break According to Table 4
10	Robustness of terminals (D)	Subclause 7.12 (in accordance with IEC 60068-2-21:2006) Procedure: test Ua1 – tensile Final measurements: Test 1 – visual inspection Test 2 – functional tests Test 6 – sealing	6	0	According to Table 4 No breaking or loosening of terminals No cracks or other deterioration According to Table 4 According to Table 7

Table 2 *(3 of 17)*

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
11	Soldering (D)	Subclause 7.13 (in accordance with IEC 60068-2-20:2008, test Ta, method 1) Temperature: (250 ± 5) °C Duration: (2 ± 0,5) s Application point: 5 mm from the glass-to-metal seals Subclause 7.13 (in accordance with IEC 60068-2-20:2008, test Ta, method 2) Temperature: (350 ± 5) °C Duration: (3 ± 0,5) s Application point: 5 mm from the glass-to-metal seals Final measurements: Test 1 – visual test Test 2 – functional tests Test 6 – sealing	6	0	When inspected with a magnifying lens the dipped surface shall be 95 % covered with new solder coating, the remaining 5 % may contain only small pinholes No cracks or other deterioration According to Table 4 According to Table 7

Table 2 *(4 of 17)*

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
12	Climatic sequence (D)	Subclause 7.14 Dry heat, 7.14.2 of IEC 62246-1:2011 Application points and standard test coil number: Temperature: 200 °C for heavy-duty reed switches 125 °C for reed switches and high voltage vacuum reed switch Duration: 16 h Recovery: 4 h During the last 2 h of dry heat exposure: monitoring of contact-circuit resistance Number of cycles per s: 2 Duty factor: 1:1 Test contact voltage: max. 6 V DC or AC Test contact current: max. 1 A Before the end of dry heat exposure: Test 2 – functional tests Damp heat cyclic, 7.14.2 of IEC 62246-1:2011, one cycle Temperature 55 °C Recovery: 4 h Cold, 7.14.2 of IEC 62246-1:2011 Temperature: – 50 °C for heavy-duty reed switches – 40 °C for reed switches and high voltage vacuum reed switch Duration: 2 h Before the end of cold exposure: Test 2 – functional tests Damp heat cyclic, 7.14.2 of IEC 62246-1:2011, one cycle Temperature: 55 °C Recovery: 4 h Final measurements: Test 4 – dielectric test Test 2 – functional tests Test 3 – contact-circuit resistance Test 1 – visual inspection Test 6 – sealing test	6	0	 According to Table 5 Value according to Table 7 Value according to Table 7 According to Table 4 According to Table 4 According to Table 4 No cracks or other deterioration According to Table 7

Table 2 *(5 of 17)*

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
13	Damp heat, steady state (D)	Subclause 7.15 (in accordance with IEC 60068-2-78:2001) Temperature: 200 °C for heavy-duty reed switches 125 °C for reed switches and high voltage vacuum reed switch Conditioning time: 10 days Final measurements: Test 4 – dielectric test Test 2 – functional tests Test 3 – contact circuit resistance Test 1 – visual inspection Test 6 – sealing test Test 11 – solderability	6	0	 According to Table 4 According to Table 4 According to Table 4 No cracks or other deterioration According to Table 7
14	Rapid change of temperature (D)	Subclause 7.16 (in accordance with IEC 60068-2-14:2009) Low temperature: – 50 °C High temperature: 100 °C Exposure time: 20 min Transition time: 1 min Number of cycles: 10 Final measurements: Test 4 – dielectric test Test 2 – functional tests Test 3 – contact-circuit resistance Test 1 – visual inspection Test 6 – sealing test	6	0	 According to Table 4 According to Table 4 According to Table 4 No cracks or other deterioration According to Table 7

Table 2 *(6 of 17)*

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
15	Salt mist (D)	Subclause 7.17 (in accordance with IEC 60068-2-11:1981) Concentration: (5 ± 1) % by weight PH value: 6,5 to 7,2 Temperature: 35 °C Durations: 168 h for heavy-duty reed switches 24 h for reed switches and high voltage vacuum reed switch Final measurements: Test 4 – dielectric test Test 2 – functional tests Test 3 – contact-circuit resistance Test 1 – visual inspection Test 6 – sealing test	6	0	 According to Table 4 According to Table 4 According to Table 4 No breaking or loosening of terminals According to Table 7

Table 2 *(7 of 17)*

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
16	Vibration (D) Functional	Subclause 7.18 Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate Axis of mounting: Vibration conditions: Application: three directions Number of sweeps per direction: 3 Sweep rate: 1 octave/min ± 10 % Total duration: approx. 3 × 10 min Test contact voltage and current: 24 V DC max., 10 mA max. Final measurements: Test 1 – visual inspection Test 2 – functional tests Test 6 – sealing	6	0	No opening of closed contact circuit with energization condition or closing of opened contact circuit shall exceed 10 μs The movable contact shall be located in the transverse direction According to Table 7 No cracks or other deterioration According to Table 4 According to Table 7
	Vibration (D) Survival	Subclause 7.18 Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate Axis of mounting: Vibration conditions: Application: three directions Frequency: 5 Hz to 150 Hz Number of sweeps per direction: 3 Sweep rate: 1 octave/min ± 10 % Test duration: min. 5 h each Peak to peak values: Vertical direction: 7,90 (m/s^2) Transverse direction: 3,5 (m/s^2) Longitudinal direction: 5,50 (m/s^2) Test contact voltage and current: 24 V DC max., 10 mA max. Final measurements: Test 1 – visual inspection Test 2 – functional tests Test 6 – sealing	6	0	 The movable contact shall be located in the transverse direction No cracks or other deterioration According to Table 4 According to Table 7

Table 2 *(8 of 17)*

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
17	Shock (D) Functional	Subclause 7.19 Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate Axis of mounting: Shock conditions: Application: three directions Number of shocks: 18 (three positive and three negative in each of the three orthogonal planes) Duration: 11 ms Test contact voltage and current: 24 V DC max., 10 mA max. Final measurements: Test 1 – visual inspection Test 2 – functional tests Test 6 – sealing	6	0	No opening of closed contact circuit with energization condition, or closing of opened contact circuit shall exceed 10 μs The movable contact shall be located in the transverse direction According to Table 7 No cracks or other deterioration According to Table 4 According to Table 7
	Shock (D) Survival	Subclause 7.19 Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate Axis of mounting: Shock conditions: Application: three directions Number of shocks: 18 (three positive and three negative in each of the three orthogonal planes) Duration: 11 ms Final measurements: Test 1 – visual inspection Test 2 – functional tests Test 6 – sealing	6	0	No cracks or other deterioration The movable contact shall be located in the transverse direction According to Table 7 According to Table 4 According to Table 4 According to Table 7

Table 2 *(9 of 17)*

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
18	Electrical endurance (D)	Subclause 7.22 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 % Switching load conditions: Monitoring conditions: Final measurements: Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	6	0	 According to Table 5 According to Table 6 According to Table 6 At each cycle during the test According to Table 4 According to Table 4 According to Table 4
19	Mechanical endurance (D)	Subclause 7.23 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50% Number of cycles per s: 50 to 60 Periodic measurements: 1×10^6; 3×10^6; 5×10^6; 7×10^6; 1×10^7; 3×10^7; 5×10^7; 7×10^7 ;and 10^8 Limits for failure to make: Limits for failure to break: Test 3 – contact circuit resistance Test 2 – functional tests	20	1	 There shall be no broken parts According to Table 5 ±20 % change of must-operate value for heavy-duty reed switches ±15 % change of must-operate value for reed switches 50 % change of must-release value for heavy-duty reed switches 30 % changes of must-release value for reed switches According to Table 4 According to Table 4

Table 2 *(10 of 17)*

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
20	Maximum cycling frequency	Subclause 7.24, Procedure 1 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Maximum bounce time: 3 ms Coil suppression: N/A Duty cycle: 50% Maximum cycling frequency per s: 60	6	0	 According to Table 5 According to Table 4
21	Contact reliability test (D)	Subclause 7.28 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 % Switching load conditions: Monitoring conditions: Final measurements: Test 3 – contact-circuit resistance Test 2 – functional tests	20	0	 According to Table 5 According to Table 6 According to Table 6 At each operating cycle According to Table 4 According to Table 4

Table 2 *(11 of 17)*

Specific tests for Variant A of heavy-duty reed switches only

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
A1	Vibration (D) Functional	Clause 8 of IEC 61373:2010 applies Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate Axis of mounting: Vibration conditions: Application: three directions Frequency: 5 Hz to 150 Hz Number of sweeps per direction: 3 Sweep rate: 1 octave/min ± 10 % Total duration: approx. 3 × 10 min Peak to peak values: Vertical direction: 1,00 (m/s^2) Transverse direction: 0,45 (m/s^2) Vertical direction: 0,70 (m/s^2) Test contact voltage and current: max. 24 V DC, max. 10 mA Final measurements: Test 1 – visual inspection Test 2 – functional tests Test 6 – sealing	6	0	No opening of closed contact circuit with energization condition or closing of opened contact circuit shall exceed 10 μs The movable contact shall be located in the transverse direction No cracks or other deterioration According to Table 4 According to Table 7
A2	Shock (D)	Clause 10 of IEC 61373:2010 applies Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate Axis of mounting: Shock conditions: Application: three directions Number of shocks: 18 (three positive and three negative in each of the three orthogonal planes) Duration: 25 ms Peak acceleration values: Vertical direction: 30 (m/s^2) Transverse direction: 30 (m/s^2) Longitudinal direction: 50 (m/s^2) Test contact voltage: max. 24 V DC Test contact current: max. 10 mA Final measurements: Test 1 – visual inspection Test 2 – functional tests Test 6 – sealing	6	0	No opening of closed contact circuit with energization condition or closing of opened contact circuit shall exceed 10 μs The movable contact shall be located in the transverse direction No cracks or other deterioration According to Table 4 According to Table 7

Table 2 *(12 of 17)*

Specific tests for Variant A of heavy-duty reed switches only

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
A3	Electrical endurance (D)	Subclause 7.22.5 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 % Switching load conditions: 110 V DC, 60 mA (L/R = 22 ms) Duty: 50% Switching rate: 5 cycles per second Required switching cycles: Limiting continuous current of 3 A: 5 000 000 min. Limiting continuous current of 5 A: 5 000 000 min. Monitoring conditions: Final measurements: Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	8	0	According to Table 5 With surge absorber Without surge absorber At each cycle during the test under the conditions specified in Table 6 According to Table 4 According to Table 4 According to Table 4
A4	Electrical endurance (D)	Subclause 7.22.5 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 % Switching load conditions: 100 V DC, 125 mA (L/R = 17 ms) Duty: 50% Switching rate: 5 cycles per second Required switching cycles: Limiting continuous current of 5 A: 1 000 000 min. Monitoring conditions: Final measurements: Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	5	0	According to Table 5 At each cycle during the test under the conditions specified in Table 6 According to Table 4 According to Table 4 According to Table 4

Table 2 *(13 of 17)*

Specific tests for Variant A of heavy-duty reed switches only

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
A5	Electrical endurance (D)	Subclause 7.22.5 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 % Switching load conditions: 52 V DC, 100 m A (L/R = 40 ms) Duty: 50% Switching rate: 5 cycles per second Required switching cycles: Limiting continuous current of 5 A: 1 800 000 min. Monitoring conditions: Final measurements: Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	6	0	 According to Table 5 At each cycle during the test under the conditions specified in Table 6 According to Table 4 According to Table 4 According to Table 4
A6	Electrical endurance (D)	Subclause 7.22.5 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 % Switching load conditions: 100 V DC, 0,24 A (L/R = 100 ms) Duty: 50% Switching rate: 5 cycles per second Change of switching polarity not more often than each 2 000 switching cycles Required switching cycles: Limiting continuous current of 5 A: 2 000 000 min. Monitoring conditions: Final measurements: Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	4	0	 According to Table 5 With surge absorber At each cycle during the test under the conditions specified in Table 6 According to Table 4 According to Table 4 According to Table 4

Table 2 *(14 of 17)*

Specific tests for Variant A of heavy-duty reed switches only

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
A7	Electrical endurance (D)	Subclause 7.22.5 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 % Switching load conditions: 24 V DC, 1,2 A (L/R = 2 ms) Duty: 50% Switching frequency: 5 cycles per second Required switching cycles: Limiting continuous current of 5 A: 1 000 000 min. Monitoring conditions: Final measurements: Test 3 – contact circuit resistance Test 2 – functional tests Test 4 – dielectric test	6	0	 According to Table 5 At each cycle during the test under the conditions specified in Table 6 According to Table 4 According to Table 4 According to Table 4
A8	Making and breaking capacities (D)	Subclause 7.26 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Contact ratings: Monitoring conditions: Final measurements: Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	3	0	 According to Table 5 According to Table 6 At each cycle during the test According to Table 4 According to Table 4 According to Table 4

Table 2 *(15 of 17)*

Specific tests for Variant A of heavy-duty reed switches only

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
A9	Conditional short circuit current test(D)	Subclause 7.27 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A type of SCPD: quick acting fuse type FH in accordance with IEC 60127-2:2003, standard sheet 1 ratings of SCPD: 5 A,250 V test voltage: 264 V AC or 115 V DC r.m.s. test current: 20 A AC and DC minimum time interval between tests: 3 min number of tests: 3 Final measurements: Test 1 – visual test Test 2 – functional tests Test 4 – dielectric test	3	0	According to Table 5 According to Table 7 No cracks or other deterioration According to Table 4 According to Table 4
A10	Temperature rise (ND)	Subclause 7.29 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Testing current: Measurement positions: terminals Measurement duration: 1,5 h Final measurements: Test 1 – visual test Test 3 – contact circuit resistance Test 2 – functional test	3	0	According to Table 5 According to Table 4 No damage or other deterioration According to Table 4 According to Table 4

Table 2 *(16 of 17)*

Specific tests for Variant A and B of heavy-duty reed switches only

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
A11	Making current capacity (D)	Subclause 7.30 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Making load conditions: Monitoring conditions: monitoring times: t_1 = 400 ms, τ_1 = 50 ms Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	6	0	 According to Table 5 According to Table 6 At each operating cycle According to Table 4 According to Table 4 According to Table 4
A12	Breaking current capacity (D)	Subclause 7.31 Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Breaking load conditions: Monitoring conditions: monitoring times: t_2 = 400 ms, τ_2 = 50 ms Test 3 – contact circuit resistance If applicable: Test 2 – functional tests Test 4 – dielectric test	6	0	 According to Table 5 According to Table 6 At each operating cycle According to Table 4 According to Table 4 According to Table 4

Table 2 *(17 of 17)*

Specific test for Variant B of heavy-duty reed switches only

Test no.	Test	Test conditions according to IEC 62246-1:2011	Sample size	Acceptable number of failures	Performance requirements
B1	Surge withstand test (D)	Subclause 7.25 test voltage: 3 000 V test voltage wave form: 1,2/50 μs number of pulses: 6 pulses (three positive and three negative) Final measurements: Test 1 – visual test Test 2 – functional tests Test 4 – dielectric test	3	0	 According to Table 6 No cracks or other deterioration According to Table 4 According to Table 4

Table 3 – Qualification approval *(1 of 3)*

At least 170 reed switches shall pass the tests in Group 1. Samples taken from the 170 specimens shall then be subjected to the tests of Groups 2 to 16 as applicable.

Test	Conditions and requirements of tests			Sample size	Accep-table number of failures during test
	Test conditions according to IEC 62246-1:2011				
	Subclause	Particular test conditions	Test no. and description in Table 2		
Group 1					
Visual inspection	7.4		1	170	0
Functional tests	7.5	Procedure 1	2		
Contact circuit resistance	7.7		3		
Dielectric test	7.8		4		
Operating times	7.10		5		
Sealing	7.21		6		
Group 2					
Remanence test	7.6		7	6	0
Insulation resistance	7.9		8	6	0
Contact sticking	7.11	Procedure 1	9	6	0
Group 3					
Robustness of terminals	7.12		10	6	0
Soldering	7.13		11	6	0
Climatic sequence	7.14		12	6	0
Group 4					
Damp heat, steady state	7.15		13	6	0
Rapid change of temperature	7.16		14	6	0
Salt mist	7.17		15	6	0
Group 5					
Vibration	7 18	IEC 60068-2-6:2007	16	12	0
Shock	7.19		17	12	0
Group 6					
Electrical endurance test	7.22	Table 3	18	6	0
Group 7					
Mechanical endurance test	7.23	Method 1	19	20	1

Table 3 *(2 of 3)*

Test	Conditions and requirements of test			Sample size	Accep-table number of failures during test
	Test conditions according to IEC 62246-1:2011				
	Subclause	Particular test conditions	Test no. and description in Table 2		
Group 8					
Maximum cycling frequency	7.24	Procedure 1	20	6	0
Group 9					
Contact reliability test	7.28		21	20	0
Group 10 (Variant A of heavy-duty reed switches only)					
Vibration test	7.18	IEC 61373:2010	A1	6	0
Shock test	7.19	IEC 61373:2010	A2	6	0
Group 11 (Variant A of heavy-duty reed switches only)					
Electrical endurance test	7.22		A3	8	0
Electrical endurance test	7.22		A4	5	0
Electrical endurance test	7.22		A5	6	0
Electrical endurance test	7.22		A6	4	0
Group 12 (Variant A of heavy-duty reed switches only)					
Electrical endurance test	7.22		A7	6	0
Group 13 (Variant A of heavy-duty reed switches only)					
Making and breaking capacities	7.26		A8	3	0

Table 3 *(3 of 3)*

Test	Conditions and requirements of test			Sample size	Accep-table number of failures during test
	Test conditions according to IEC 62246-1:2011				
	Subclause	Particular test conditions	Test no. and description in Table 2		
Group 14 (Variant A of heavy-duty reed switches only)					
Conditional short-circuit current test	7.27		A9	3	0
Temperature rise test	7.29		A10	3	0
Group 15 (Variant A and B of heavy-duty reed switches only)					
Making current capacity test	7.30	Table 5	A11	6	0
Breaking current capacity test	7.31	Table 5	A12	6	0
Group 16 (Variant B of heavy-duty reed switches only)					
Surge withstand test	7.25		B1	3	0

5 Characteristic values of the reed switches

5.1 Characteristics values for general data for reed switches

Table 4 – Characteristic values for general data for reed switches *(1 of 2)*

Reed switch types		Reed switches			High-voltage vacuum	Reed switch	Heavy-duty reed switches	
Limiting continuous current (A)		**0,3**	**1,0**	**2,5**		**0,5**	**3,0**	**5,0**
General data	Glass diameter (mm)	1,8 max.	2,2 max.	2,8 max.		2,54 max.	5,1 max.	6,2 max
	Terminal length (mm)	35,8 ± 0,3	44,3 ± 0,3	55,4 ± 0,3		56,1 ± 0,3	61,0 ± 0,2	71,4 ± 0,2
	Nominal mass (g)	0,05 ± 0,01	0,13 ± 0,05	0,27 ± 0,05		0,2 ± 0,1	1,4 ± 0,5	2,4 ± 0,5
	Contact arrangement	1 NO				1 C/O	1 NO	
	Finish of the terminals	Tinning						
Functional tests	Standard coil number	1 in Annex A of IEC 62246-1:2011	7 in Annex A of IEC 62246-1:2011	13 in Annex A of IEC 62246-1:2011		2 in Annex A of IEC 62246-1:2011	25 in Annex A of IEC 62246-1:2011	
	Must-release value (AT)	5 min.	5 min.	5 min.		4 min.	50 min	60 min
	Must-operate value (AT)	10 – 50	10 – 50	10 – 60		10 – 30	100 – 130	180 – 230
Contact circuit resistance	Max. contact resistance (mΩ)	100					500	500 (100 for Variant B)
Dielectric test	Voltage between the terminals	150 V DC min.		200 V DC min.	1 000 V DC min.	150 V DC min.	500/550 V AC (1 000/1 100 V AC for Variant B)	800/880 V AC (1 000/1 100 V AC for Variant B)
	Duration of the test time	1 min					1 min/1 s	
Rated impulse voltage (Variant B only)	Peak voltage between the terminals	N/A					3 000 V	N/A
	Test voltage wave form	N/A					1,2/50 μs	N/A
	Number of pulses	N/A					Six pulses (three positive and three negative)	N/A
Insulation resistance		1 000 MΩ min. at 100 V DC initial value					1 000 MΩ min. at 500 V DC initial value	

Table 4 *(2 of 2)*

Reed switch types		Reed switches			High-voltage vacuum	Reed switch	Heavy-duty reed switches	
Limiting continuous current (A)		**0,3**	**1,0**	**2,5**		**0,5**	**3,0**	**5,0**
Maximum operating times	Operate time	0,5 ms		0,8 ms		1,5 ms	5 ms	
	Release time	0,1 ms		0,1 ms		0,1 ms	3 ms	
	Operate bounce time	0,5 ms		0,8 ms		2,0 ms	3 ms	

5.2 Standard test coil number for tests

Table 5 – Standard test coil number for tests for reed switches

Reed switch types	Reed switches			High-voltage vacuum	Reed switch	Heavy-duty reed switches	
Limiting continuous current (A)	**0,3**	**1,0**	**2,5**		**0,5**	**3,0**	**5,0**
Functional tests, Remanence tests; Contact circuit resistance; Operating times; Maximum cycling frequency; Contact sticking; Sealing	1 in Annex A of IEC 62246-1:2011	7 in Annex A of IEC 62246-1:2011	13 in Annex A of IEC 62246-1:2011		2 in Annex A of IEC 62246-1:2011	25 in Annex A of IEC 62246-1:2011	
Vibration; Shock; Electrical endurance; Mechanical endurance; Contact reliability test Electrical endurance; Conditional short circuit test; Surge withstand test; Making and breaking capacities; Temperature rise; Making current capacity; Breaking current capacity						28 in Annex A of IEC 62246-1:2011 29 in Annex A of IEC 62246-1:2011 30 in Annex A of IEC 62246-1:2011	

5.3 Contact data

5.3.1 Contact reliability, electrical endurance, making and breaking current capacities and switching frequency

Failure criteria are stated in Table 6 for: limits for failure to make of a closed contact, limits for failure to break of an open contact. In addition a contact fault due to a short circuit between any break and make contact constitutes a defective (see 5.3.2).

Table 6 – Variant A of reed switches *(1 of 3)*

Reed switch types		**Reed switches**			**High-voltage vacuum**	**Reed switch**	**Heavy-duty reed switches**	
Limiting continuous current (A)		**0,3**	**1,0**	**2,5**		**0,5**	**3,0**	**5,0**
Contact reliability	Switching load	5 V DC, 0,1 mA (resistive load)					24 V DC, 1 mA (resistive load)	
	Limits for failure to make	Higher than 0,25 V DC between contacts					Higher than 1,2 V DC between contacts	
	Limits for failure to break	Lower than 4,75 V DC between contacts					Lower than 22,8 V DC between contacts	
	Number of switching cycles[1)]	Min. 10 000 000					Min. 5 000 000	
	Switching cycle frequency	Not more than 100 per second				50 per second	10 per second max.	
	Monitoring times	t_1 = 2 ms, τ_1 = 0,1 ms, t_2 = 2 ms, τ_2 = 0,2 ms				t_1 = 5 ms, τ_1 = 0,1 ms, t_2 = 5 ms, τ_2 = 0,1 ms	t_1 = 30 ms, τ_1 = 20 ms, t_2 = 30 ms, τ_2 = 20 ms	
Electrical endurance	Making and breaking load	5 V DC, 5 mA	12 V DC, 10 mA	100 V DC, 50 mA	350 V DC, 1 mA	5 V DC, 5 mA	24 V DC 37 mA L/R = 7 ms	
	Limits for failure to make	Higher than 0,25 V DC between contacts	Higher than 0,6 V DC between contacts	Higher than 5 V DC between contacts		Higher than 0,25 V DC between contacts	Higher than 1,2V DC between contacts	
	Limits for failure to break	Lower than 0,25 V DC between contacts	Lower than 11,4 V DC between contacts	Lower than 95 V DC between contacts		Lower than 0,25 V DC between contacts	Lower than 22,8 V DC between contacts	
	Switching cycle frequency	Not more than 100 per second		Not more than 50 per second			10 per second max.	
	Monitoring times	t_1 = 2 ms, τ_1 = 0,1 ms, t_2 = 2 ms, τ_2 = 0,2 ms		t_1 = 5 ms, τ_1 = 0,1 ms, t_2 = 2 ms, τ_2 = 0,2 ms			t_1 = 30 ms, τ_1 = 20 ms, t_2 = 30 ms, τ_2 = 20 ms	
	Life expectancy [1) 2)]	10 000 000 switching cycles					10 000 000 switching cycles	20 000 000 switching cycles

Table 6 *(2 of 3)*

Reed switch types		**Reed switches**			**High-voltage vacuum**	**Reed switch**	**Heavy-duty reed switches**	
Limiting continuous current (A)		**0,3**	**1,0**	**2,5**		**0,5**	**3,0**	**5,0**
Electrical endurance (AC inductive load (contactor coil, solenoid valve))	Making and breaking load	N/A					240 V AC, 5 A make (cos φ = 0,7) and 0,5 A break (cos φ = 0,4)	240 V AC, 10 A make (cos φ = 0,7) and 1,0 A break (cos φ = 0,4)
	Limits for failure to make	N/A					Lower than 120 V AC between contacts (Monitoring relay function connected in parallel with switching load)	
	Limits for failure to break	N/A					Higher than 72 V AC between contacts (Monitoring relay function connected in parallel with switching load)	
	Switching cycle frequency	N/A					1 per s max.	
	Monitoring times	N/A					t_1 = 400 ms, τ_1 = 50 ms, t_2 = 400 ms, τ_2 = 50 ms	
	Life expectancy [2)]	N/A					500 000 switching cycles	800 000 switching cycles
Electrical endurance (DC inductive load (contactor coil, solenoid valve))	Making and breaking load	N/A					110 V, 0,2 A (L/R = 40 ms)	110 V, 0,5 A (L/R = 100 ms)
	Limits for failure to make	N/A					Lower than 55 V DC between contacts (Monitoring relay function connected in parallel with switching load)	
	Limits for failure to break	N/A					Higher than 33 V DC between contacts (Monitoring relay function connected in parallel with switching load)	
	Switching cycle frequency	N/A					1 per s max.	
	Monitoring times	N/A					t_1 = 400 ms, τ_1 = 50 ms, t_2 = 400 ms, τ_2 = 50 ms	
	Life expectancy [1) 2)]	N/A					300 000 switching cycles	

Table 6 *(3 of 3)*

Reed switch types		Reed switches			High-voltage vacuum	Reed switch	Heavy-duty reed switches	
Limiting continuous current (A)		**0,3**	**1,0**	**2,5**		**0,5**	**3,0**	**5,0**
Making and breaking capacities	AC inductive load (contactor coil, solenoid valve)	N/A					120 V AC, 1,5 A; 240 V AC, 0,75 A (cos φ = 0,3)	120 V AC, 1,5 A; 240 V AC, 0,75 A; 600 V AC, 0,3 A (cos φ = 0,3)
	DC inductive load (contactor coil, solenoid valve[1])	N/A					120 V DC, 0,55 A L/R = 40 ms	120 V DC, 0,55 A; 240 V DC, 0,27 A L/R = 100 ms
	Total number of cycles	N/A					6 050	
Making current capacity (AC inductive load)	Making load (cos φ = 0,3)	N/A					240 V AC, 15 A max.	240 V AC, 30 A max.
	Number of making cycles	N/A					Min. 10	
	Switching cycle frequency	N/A					6 per min.	
	Number of breaking cycles	N/A					Min. 10	
Breaking current capacity (AC inductive load)	Breaking load (cos φ = 0,3)	N/A					240 V AC, 15 A max.	240 V AC, 30 A max.
	Number of breaking cycles	N/A					Min. 10	
	Switching cycle frequency	N/A					6 per minute	
Breaking current capacity (DC inductive load)	Breaking load	N/A					120 V DC, 0,55 A max. L/R = 40 ms	240 V DC, 0,27 A max.L/R = 100 ms
	Number of breaking cycles[1]	N/A					Min. 10	
	Switching cycle frequency	N/A					6 per minute	

[1] When using a DC circuit, the stationary contact shall be connected to the anode.

[2] Based on the B_{10} values.

Table 7 – Variant B of heavy-duty reed switches

Reed switch types		Heavy-duty reed switches	
Limiting continuous current (A)		**3,0**	**5,0**
Contact reliability	Switching load	24 V DC, 1 mA (resistive load)	1 V DC, 1 mA (resistive load)
	Limits for failure to make	Higher than 1,2 V DC between contacts	Higher than 0,05 V DC between contacts
	Limits for failure to break	Lower than 22,8 V DC between contacts	Lower than 0,95 V DC between contacts
	Number of switching cycles[1)]	Min. 5 000 000	
	Switching frequency	Not more than 10 per second	
	Monitoring times	t_1 = 30 ms, τ_1 = 20 ms, t_2 = 30 ms, τ_2 = 20 ms	
Electrical endurance	Making and breaking load	24 V DC. 37 mA L/R = 7 ms	
	Limits for failure to make	Higher than 1,2 V DC between contacts	
	Limits for failure to break	Lower than 22,8 V DC between contacts	
	Switching frequency	Not more than 10 per second	
	Monitoring times	t_1 = 30 ms, τ_1 = 20 ms, t_2 = 30 ms, τ_2 = 20 ms	
	Life expectancy [1) 2)]	10 000 000 switching cycles	10 000 000 switching cycles
Electrical endurance (DC inductive load (contactor coil, solenoid valve))	Making and breaking load	110 V, 0,3 A (L/R = 40 ms)	110 V, 0,5 A (L/R = 40 ms)
	Limits for failure to make	Lower than 55 V DC between contacts (Monitoring relay function connected in parallel with switching load)	
	Limits for failure to break	Higher than 33 V DC between contacts (Monitoring relay function connected in parallel with switching load)	
	Switching frequency	Not more than 1 per second	
	Monitoring times	t_1 = 400 ms, τ_1 = 50 ms, t_2 = 400 ms, τ_2 = 50 ms	
	Life expectancy [1) 2)]	100 000 switching cycles	1 000 000 switching cycles
Making current capacity (DC inductive load)	Making load (L/R = 5 ms)	110 V DC, 15 A max.	220 V DC, 20 A max.
	Carrying time	0,5 s	
	Number of making cycles	Not less than 10 000	
	Switching frequency	6 per minute	
Breaking current capacity (DC inductive load)	Breaking load (L/R = 40 ms)	110 V DC, 0,5 A	220 V DC, 0,15 A max.
	Number of breaking cycles[1)]	Not less than 100 000	
	Switching frequency	6 per minute	

[1)] When using a DC circuit, the stationary contact shall be connected to the anode.

[2)] Based on the B_{10} values.

5.3.2 Static contact-circuit resistance

500 mΩ max. at 1 A — initial value at rated testing voltage for heavy-duty reed switches,

100 mΩ max. — initial value at rated testing voltage for reed switches,

1 Ω max. at 1 A — after contact reliability, electrical endurance, mechanical endurance and environmental tests at a test coil voltage of 150% of must-operate,

1,2 kΩ max. at 1 mA — during contact reliability, electrical endurance, mechanical endurance and environmental tests at a test coil voltage of 150% of must-operate.

5.3.3 Mechanical endurance

Minimum 10^8 switching cycles (10^7 switching cycles for Variant B of heavy-duty reed switches).

5.4 Environmental data

The reed switches shall withstand at least the environmental stresses specified in Table 8.

Table 8 – Environmental data for reed switches

Reed switch types		**Reed switches**			**High-voltage vacuum**	**Reed switch**	**Heavy-duty reed switches**	
Limiting continuous current (A)		**0,3**	**1,0**	**2,5**		**0,5**	**3,0**	**5,0**
Vibration (sinusoidal)		196,0 m/s^2 (20 g_n); 10 Hz to 2 000 Hz					147,0 m/s^2 (15 g_n); 20 Hz to 1 000 Hz	196,0 m/s^2 (20 g_n); 20 Hz to 1 000 Hz
Shock [1]	Functional	294,0 m/s^2 (30 g_n)					196,0 m/s^2 (20 g_n)	392,0 m/s^2 (40 g_n)
	Survival	980 m/s^2 (100 g_n)						
Operation of short circuit protective device (not applicable to Variant B)		N/A					Min. 20 (A^2 s)	
Robustness of terminals	Force	19,6 N (2 kgf)					98 N (10 kgf)	
Soldering	Solderability	250 °C, 2 s						
	Resistance	350 °C, 3 s						
Sealing	Leak rate	1 Pa × cm^3/s					N/A	N/A
	Arcing time	N/A					Max. 60 ms	Max. 100 ms
	Switching load [2]	N/A					100 V DC, 0,5 A (L/R = 40 ms)	100 V DC, 0,5 A (L/R = 100 ms)
Ambient temperature	Operating temperature	- 40 °C to + 125 °C					- 50 °C to + 150 °C	
	Storage	- 40 °C to + 125 °C					- 60 °C to + 180 °C	

[1] Half-sine acceleration, 11 ms duration.

[2] During the sealing test, the stationary contact shall be connected to the anode.

6 Reliability – Failure rate data

The value stated in Table 9 for contact reliability shall be verified by type tests. During production, contact reliability shall be evaluated by lot-by-lot tests in Table 1.

Table 9 – Reliability data for reed switches

Reed switch types		**Reed switches**			**High-voltage vacuum**	**Reed switch**	**Heavy-duty reed switches**	
Limiting continuous current (A)		**0,3**	**1,0**	**2,5**		**0,5**	**3,0**	**5,0**
Contact reliability	Min. operational power ratings	5 V DC, 0,1 mA					24 V DC, 1 mA	24 V DC, 1 mA (1 V DC, 1 mA for Variant B)
	Failure rate [1)]	Less than 5 failures per 10^9 cycles						
[1)] The value of failure rate is based on a confidence level of 60 %.								

7 Marking and documentation

7.1 Marking of the reed switch

The marking shall be durable and easily legible, and include at least the following items:

a) Coded reed switch type.
b) Coded date of manufacture, for example year/month/week.

7.2 Marking of the packaging

The marking shall be durable and easily legible, and include at least the following items:

a) Manufacturer's name, logo or trademark.
b) Reed switch type and variant code.
c) Manufacturer’s batch identification code.
d) Detail specification reference.
e) Quantity.

Annex A
(normative)

Mounting in a standard coil

The reed switch direction and position that shall be used for testing are given in Figure A.1.

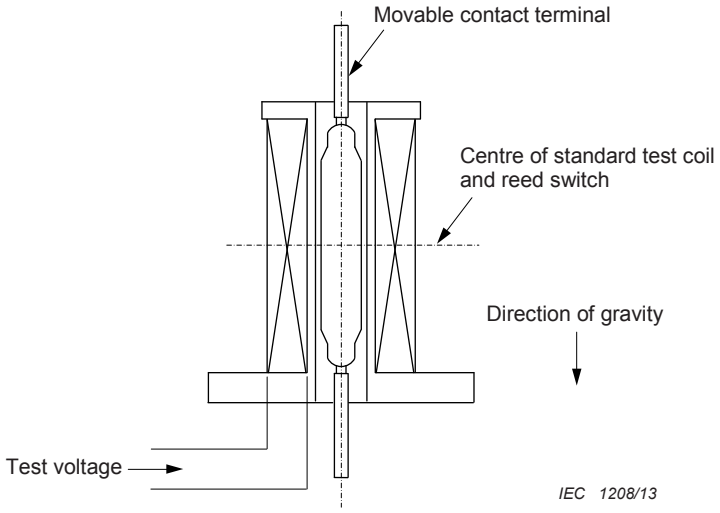

Figure A.1 – Switch direction and position in a standard coil

Annex B
(normative)

Variants

Reed switches covered by this specification are classified into two different variants as follows:

Variant A

This variant is characterized by particular requirements with respect to mechanical endurance.

Variant B

This variant is characterized by particular requirements with respect to dielectric voltage, impulse voltage and electrical endurance.

NOTE Typical applications for these variants are indicated in Annex C for information.

Annex C
(informative)

Typical applications

Variant A

Reed switches of Variant A represent extremely reliable switching elements over a wide range of loads. They are suitable for a wide variety of industrial applications, in particular when subject to harsh environmental conditions (dust, oil, water, vibration, mechanical shock and low and high temperature) and have a high making and breaking capacity.

Typical fields of application are:

a) Elevator control equipment, where reed switches can be used as contact elements of magnetic proximity switches.

   For elevators, escalators and moving walks refer to national standards and where applicable ISO 22201-series, when used in these applications.

b) Railway control, signalling equipment and similar devices, where reed switches can be used as contact elements of control relays, door interlock switches, position switches and push-buttons.

c) Machinery safety equipment, where reed switches can be used for example as contact elements of door interlock switches under harsh environments.

d) Potentially hazardous atmosphere equipment, where reed switches as contact elements of control relays, limit switches, push-buttons and position switches etc. match the needs of explosion-proof equipment.

e) Automobile, where reed switches can be used as liquid level sensors for fuel oil and engine oil, seat position detection, stop lamp switches, etc.

f) Domestic and industrial appliances, where reed switches can be used as open/close detection of refrigerator door, thermal sensor for rice cooker, cylinder sensor, etc.

g) Health and leisure equipment, where reed switches can be used as step counter of pedometer, switching function of exercise machine, etc.

Variant B

Heavy-duty reed switches of Variant B can be used for making, carrying and breaking high currents at high speed with high reliability. They also show an enhanced resistance against dielectric and impulse voltages.

Therefore, the main application is within measuring relays and protection equipment, particularly as part of high-voltage networks.

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