

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

Reed contact units –
Part 2-1: Heavy-duty reed switches – Quality assessment specification

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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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PRE-STANDARD

**Reed contact units –
Part 2-1: Heavy-duty reed switches – Quality assessment specification**

INTERNATIONAL
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PRICE CODE

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CONTENTS

FOREWORD.....	3
1 Scope.....	5
2 Normative references	5
3 Test schedules	5
3.1 General	5
3.2 Qualification approval procedures	6
3.3 Quality conformance inspection.....	6
3.4 Formation of inspection lots.....	6
3.5 Intervals between tests.....	6
3.6 Standard conditions for testing	6
3.7 Mounting of test specimens during the test.....	6
3.8 General conditions for testing.....	6
4 Characteristic values of the heavy-duty reed switches	33
4.1 Standard test coil number for tests	33
4.2 Contact data.....	33
4.2.1 Contact reliability, electrical endurance, rated making and breaking current capacities and switching frequency	33
4.2.2 Static contact-circuit resistance	36
4.2.3 Mechanical endurance.....	36
4.3 Environmental data.....	36
5 Reliability – Failure rate data.....	36
6 Marking and documentation.....	37
6.1 Marking of the heavy-duty reed switch.....	37
6.2 Marking of the packaging	37
Annex A (normative) Mounting in a standard coil	38
Annex B (normative) Variants	39
Annex C (informative) Typical applications.....	40
Figure A.1 – Switch direction and position in a standard coil.....	38
Table 1 – Quality conformance inspection.....	7
Table 2 – Tests for qualification approval.....	15
Table 3 – Qualification approval.....	30
Table 4 – Characteristic values for general data	33
Table 5 – Standard test coil number for tests	33
Table 6 – Data for contact reliability, electrical endurance, making current capacity, breaking current capacity, and rated making and breaking capacities	34
Table 7 – Environmental data	36
Table 8 – Reliability data	36

INTERNATIONAL ELECTROTECHNICAL COMMISSION

REED CONTACT UNITS –

Part 2-1: Heavy-duty reed switches –
Quality assessment specification

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IEC/PAS 62246-2-1 has been processed by IEC Technical Committee 94: All-or-nothing electrical relays.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
94/264/NP	94/271/RVN

Following the publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned will transform it into an International Standard. It is intended to incorporate its contents into the next edition of IEC 62246-2 during the upcoming maintenance cycle for that standard.

This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single 3-year period, following which it shall be revised to become another type of normative document, or shall be withdrawn.

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REED CONTACT UNITS –

Part 2-1: Heavy-duty reed switches – Quality assessment specification

1 Scope

This PAS defines requirements and tests for heavy-duty reed switches intended to be incorporated into devices that can be used in various industrial applications.

This PAS is to be used in conjunction with IEC 62246-2.

This PAS selects from IEC 62246-2 and from other sources the appropriate test procedures to be used in detail specifications derived from this PAS.

Two different product variants (variant A and variant B) are specified depending on characteristic values and tests (see Annex B).

2 Normative references

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

IEC 60068-2-11 (1981): *Environmental testing – Part 2: Tests. Test Ka: Salt mist*

IEC 60068-2-14 (1984): *Environmental testing – Part 2: Tests. Test N: Change of temperature*

IEC 60068-2-20 (1979): *Environmental testing. Part 2: Tests. Test T: Soldering*
Amendment 2 (1987)

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

IEC 60068-2-29 (1987): *Environmental testing. Part 2: Tests. Test Eb and guidance: Bump*

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 (1999): *Railway applications – Rolling stock equipment – Shock and vibration tests*

IEC 62246-1 (2002): *Reed contact units – Part 1: Generic specification*

IEC 62246-2 (2007): *Reed contact units – Part 2: Heavy-duty reed switches*

3 Test schedules

3.1 General

Test procedures are referenced in the corresponding subclauses of IEC 62246-2.

3.2 Qualification approval procedures

Qualification approval procedures are indicated in Table 2 and Table 3:

- 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 are mandatory for the variants except when otherwise specified;
- tests stated in Table 3 are mandatory only for the variants indicated.

3.3 Quality conformance inspection

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 PAS, 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.

3.4 Formation of inspection lots

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

3.5 Intervals between tests

The following are the intervals necessary between tests:

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

3.6 Standard conditions for testing

If not otherwise stated, all tests shall be performed under standard conditions for testing according to 3.3 of IEC 62246-1.

3.7 Mounting of test specimens during the test

The following requirement shall apply for shock and vibration tests:

The heavy-duty 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.

3.8 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 PAS, the polarity shall be as specified by the manufacturer.

Table 1 – Quality conformance inspection**Group A
Subgroup A0**

For all tests in this subgroup: 100 % test.

Test No.	Test	Test conditions according to IEC 62246-2	Performance requirements
A0 – 1	Visual inspection and check of dimensions (ND)	Subclause 3.4	According to Table 4 Marking as specified in 6.1
A0 – 2	Functional tests (ND)	Subclause 3.5, 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 d.c.	According to Table 5 According to Table 4
A0 – 3	Contact-circuit resistance (ND)	Subclause 3.7 Application points: terminals of closed contacts Standard test coil number: Test coil voltage: 150 % of must-operate Test voltage max.: 6 V d.c. Test current max.: 1 A	Initial value according to Table 4 According to Table 5
A0 – 4	Dielectric test (ND)	Subclause 3.8 Application points and test voltage. Duration of test: 1 min. A shorter test with a higher voltage may be stated in the detail specification	According to Table 4 Maximum leakage current: 0,5 mA
A0 – 5	Operate, release, transfer or bridging and bounce times (ND)	Subclause 3.10 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 d.c.	According to Table 5 According to Table 4
A0 – 6	Sealing (ND)	Subclause 3.22 Application points and standard test coil number: Arc time during test: Test coil voltage: 150 % of must-operate Test voltage: 100 V – 110 V d.c. Test current: 0,5 A – 0,55 A Total number of operations required: 3	According to Table 5 According to Table 7

Table 1 – Quality conformance inspection (continued)

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

Test No.	Test	Test conditions according to IEC 62246-2	IL	AQL	Performance requirements
1	Visual inspection and check of dimensions (ND)	Subclause 3.4			According to Table 4 Marking as specified in 6.1
2	Functional tests (ND)	Subclause 3.5, 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 d.c.			According to Table 5 According to Table 4
3	Contact-circuit resistance (ND)	Subclause 3.7 Application points: terminals of closed contacts Standard test coil number: Test coil voltage: 150 % of must-operate Test voltage max.: 6 V d.c. Test current max.: 1 A			Initial value according to Table 4 According to Table 5
4	Dielectric test (ND)	Subclause 3.8 Application points and test voltage: Duration of test: 1 min A shorter test with a higher voltage may be stated in the detail specification	S4	1,0	According to Table 4 Maximum leakage current: 0,5 mA
5	Operate, release, transfer or bridging and bounce times (ND)	Subclause 3.10 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 d.c.			According to Table 5 According to Table 4
6	Sealing (ND)	Subclause 3.22 Application points and standard test coil number: Arc time during test: Test coil voltage: 150 % of must-operate Test voltage: 100 V – 110 V d.c. Test current: 0,5 A – 0,55 A Total number of operations required: 3			According to Table 5 According to Table 7

Table 1 – Quality conformance inspection (*continued*)**Subgroup B1** (period: inspection lot refers to the production volume of one month)

Test No.	Test	Test conditions according to IEC 62246-2	IL	AQL	Performance requirements
7	Contact reliability test (D)	Subclause 3.32 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 – Quality conformance inspection (continued)

Subgroup C1 (period: one year)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
8	Robustness of terminals (D)	<p>Subclause 3.12 (in accordance with IEC 60068-2-21)</p> <p>Procedure: test Ua1 – tensile</p> <p>Final measurements:</p> <p>Test 1 – visual inspection</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	6	0	<p>According to Table 4</p> <p>No breaking or loosening of terminals</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 7</p>
9	Soldering (D)	<p>Subclause 3.13 (in accordance with IEC 60068-2-20, test Ta, method 1)</p> <p>Temperature: (235 ± 5) °C</p> <p>Duration: (2 ± 0,5) s</p> <p>Application point: 5 mm from the glass-to-metal seals</p> <p>Subclause 3.13 (in accordance with IEC 60068-2-20, test Ta, method 2)</p> <p>Temperature: (350 ± 5) °C</p> <p>Duration: (3 ± 0,5) s</p> <p>Application point: 5 mm from the glass-to-metal seals</p> <p>Final measurements:</p> <p>Test 1 – visual test</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	5	0	<p>The dipped surface shall be 95 % covered with new solder coating, the remaining 5 % may contain only small pinholes</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 7</p>

Table 1 – Quality conformance inspection (continued)**Subgroup C1 (period: one year)**

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
10	Rapid change of temperature (D)	<p>Subclause 3.16 (in accordance with IEC 60068-2-14)</p> <p>Low temperature: – 50 °C High temperature: 100 °C Exposure time: 20 min Transition time: 1 min Number of cycles: 10</p> <p>Final measurements:</p> <p>Test 4 – dielectric test</p> <p>Test 2 – functional tests</p> <p>Test 3 – contact-circuit resistance</p> <p>Test 1 – visual inspection</p> <p>Test 6 – sealing test</p>	6	0	<p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>No cracks or other deterioration</p> <p>According to Table 7</p>
11	Vibration (D) Functional	<p>Subclause 3.19</p> <p>Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate</p> <p>Axis of mounting:</p> <p>Vibration conditions: Application: three directions Number of sweeps per direction: 3 Sweep rate: 1 octave/min ± 10 % Total duration: approx. 3 × 10 min</p> <p>Test contact voltage and current: 24 V d.c. max., 10 mA max.</p> <p>Final measurements:</p> <p>Test 1 – visual inspection</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	6	0	<p>No opening of closed contact circuit with energization condition or closing of opened contact circuit shall exceed 10 µs</p> <p>The movable contact shall be located in the transverse direction</p> <p>According to Table 7</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 7</p>

Table 1 – Quality conformance inspection (continued)

Subgroup C1 (period: one year)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
12	Electrical endurance (D)	Subclause 3.23 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

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Table 1 – Quality conformance inspection (continued)**Subgroup C4** (period: at least once every two years)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
13	Shock (D) Functional	<p>Subclause 3.20</p> <p>Test switch type and standard test coil number: According to Table 5 Test coil voltage: 150 % of must-operate</p> <p>Axis of mounting:</p> <p>Shock conditions: Application: three directions Number of shocks: 18 (three positive and three negative in each of the three orthogonal planes) Duration: 30 ms</p> <p>Test contact voltage and current: 24 V d.c. max., 10 mA max.</p> <p>Final measurements:</p> <p>Test 1 – visual inspection</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	6	0	<p>No opening of closed contact circuit with energization condition, or closing of opened contact circuit shall exceed 10 µs</p> <p>The movable contact shall be located in the transverse direction</p> <p>According to Table 7</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 7</p>
14	Mechanical endurance (D)	<p>Subclause 3.24</p> <p>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 second: 50 to 60</p> <p>Periodic measurements: 1 × 10⁶; 3 × 10⁶; 5 × 10⁶; 7 × 10⁶; 1 × 10⁷; 3 × 10⁷; 5 × 10⁷; 7 × 10⁷; and 10⁸</p> <p>Limits for failure to make:</p> <p>Limits for failure to break:</p> <p>Test 3 – contact-circuit resistance</p> <p>Test 2 – functional tests</p>	20	1	<p>There shall be no broken parts</p> <p>According to Table 5</p> <p>±20 % change of must-operate value</p> <p>50 % change of must-release value</p> <p>According to Table 4</p> <p>According to Table 4</p>

Table 1 – Quality conformance inspection (continued)

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

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
15	Making current capacity (D)	<p>Subclause 3.34</p> <p>Test switch type and standard test coil number:</p> <p>Test coil voltage: 150 % of must-operate Coil suppression: N/A</p> <p>Making load conditions:</p> <p>Monitoring conditions: monitoring times: $t_1 = 400$ ms, $\tau_1 = 50$ ms</p> <p>Test 3 – contact-circuit resistance</p> <p>If applicable: Test 2 – functional tests</p> <p>Test 4 – dielectric test</p>	6	0	<p>According to Table 5</p> <p>According to Table 6</p> <p>At each cycle during the test</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>
16	Breaking current capacity (D)	<p>Subclause 3.35</p> <p>Test switch type and standard test coil number:</p> <p>Test coil voltage: 150 % of must-operate Coil suppression: N/A</p> <p>Breaking load conditions.</p> <p>Monitoring conditions: monitoring times: $t_2 = 100$ ms, $\tau_2 = 50$ ms</p> <p>Test 3 – contact-circuit resistance</p> <p>If applicable: Test 2 – functional tests</p> <p>Test 4 – dielectric test</p>	6	0	<p>According to Table 5</p> <p>According to Table 6</p> <p>At each cycle during the test</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>
17	Rated impulse voltage (D) Variant B only	<p>Subclause 3.29</p> <p>Test voltage: 3 000 V d.c. Test voltage wave form: 1,2 / 50 μs Number of pulses: 6 pulses (three positive and three negative)</p> <p>Final measurements:</p> <p>Test 1 – visual test</p> <p>Test 2 – functional tests</p> <p>Test 4 – dielectric test</p>	3	0	<p>According to Table 6</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 4</p>

Table 2 – Tests for qualification approval

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
1	Visual inspection and check of dimensions (ND)	Subclause 3.4			According to Table 4 Marking as specified in 6.1
2	Functional tests (ND)	Subclause 3.5, 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 d.c.			According to Table 5 According to Table 4
3	Contact circuit resistance (ND)	Subclause 3.7 Application points: terminals of closed contacts Standard test coil number: Test coil voltage: 150 % of must-operate Test voltage max.: 6 V d.c. Test current max.: 1 A			Initial value according to Table 4 According to Table 5
4	Dielectric test (ND)	Subclause 3.8 Application points and test voltage: Duration of test: 1 min A shorter test with a higher voltage may be stated in the detail specification	170	0	According to Table 4 Maximum leakage current: 0,5 mA
5	Operate, release, transfer or bridging, and bounce times (ND)	Subclause 3.10 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 d.c.			According to Table 5 According to Table 4
6	Sealing (ND)	Subclause 3.22 Application points and standard test coil number: Arc time during test Test coil voltage: 150 % of must-operate Test voltage: 100 V – 110 V d.c. Test current: 0,5 A – 0,55 A Total number of operations required: 3			According to Table 5 According to Table 7

Table 2 – Tests for qualification approval (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
7	Remanence test (ND)	Subclause 3.6 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: Maximum 10 %
8	Insulation test (ND)	Subclause 3.9 Application points and test voltage:	6	0	According to Table 4
9	Contact sticking (ND) Thermal sticking Magnetostrictive sticking	Subclause 3.11, Procedure 1 Application points and standard test coil number: Upper category temperature: 150 °C Saturate value: 150 % of must-operate Test period: minimum 24 h Maximum permitted value: Subclause 3.11.2 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 Minimum 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 3.12 (in accordance with IEC 60068-2-21) 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 – Tests for qualification approval (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
11	Soldering (D)	<p>Subclause 3.13 (in accordance with IEC 60068-2-20, test Ta, method 1)</p> <p>Temperature: (235 ± 5) °C Duration: (2 ± 0,5) s Application point: 5 mm from the glass-to-metal seals</p> <p>Subclause 3.13 (in accordance with IEC 60068-2-20), test Ta, method 2)</p> <p>Temperature: (350 ± 5) °C Duration: (3 ± 0,5) s Application point: 5 mm from the glass-to-metal seals</p> <p>Final measurements:</p> <p>Test 1 – visual test</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	6	0	<p>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</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 7</p>
12	Climatic sequence (D)	<p>Subclause 3.14</p> <p>Dry heat, 3.14.1 of IEC 62246-1</p> <p>Application points and standard test coil number:</p> <p>Temperature: 200 °C Duration: 16 h Recovery: 4 h During the last 2 h of dry heat exposure: monitoring of contact-circuit resistance</p> <p>Number of cycles per second: 2 Duty factor: 1:1 Test contact voltage: max. 6 V d.c. or a.c. Test contact current: max. 1 A</p> <p>Before the end of dry heat exposure: Test 2 – functional tests</p> <p>Damp heat cyclic, 3.14.1, one cycle Temperature 55 °C Recovery: 4 h</p> <p>Cold, 3.14.1 Temperature: – 50 °C Duration: 2 h</p> <p>Before the end of cold exposure: Test 2 – functional tests</p> <p>Damp heat cyclic, 3.14.1, one cycle Temperature: 55 °C Recovery: 4 h</p>	6	0	<p>According to Table 5</p> <p>Value according to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>

Table 2 – Tests for qualification approval (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
12	Climatic sequence (continued)	Final measurements: Test 4 – dielectric test Test 2 – functional tests Test 3 – contact-circuit resistance Test 1 – visual inspection Test 6 – sealing test			According to Table 4 According to Table 4 According to Table 4 No cracks or other deterioration According to Table 7
13	Damp heat, steady state (D)	Subclause 3.15 (in accordance with IEC 60068-2-78) Temperature: 200 °C 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 3.16 (in accordance with IEC 60068-2-14) 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 – Tests for qualification approval (continued)

Test no.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
15	Salt mist (D)	<p>Subclause 3.17 (in accordance with IEC 60068-2-11)</p> <p>Concentration: 5 ± 1 % by weight PH value: 6,5 to 7,2 Temperature: 35 °C Durations: 168 h</p> <p>Final measurements:</p> <p>Test 4 – dielectric test</p> <p>Test 2 – functional tests</p> <p>Test 3 – contact-circuit resistance</p> <p>Test 1 – visual inspection</p> <p>Test 6 – sealing test</p>	6	0	<p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>No breaking or loosening of terminals</p> <p>According to Table 7</p>
16	Bump (D)	<p>Subclause 3.18 (in accordance with IEC 60068-2-29, test Eb)</p> <p>Standard test coil according to Table 5 Test coil voltage: 150 % of must-operate</p> <p>Peak acceleration: 150 m/s² Duration: 6 ms Number of bumps: 100 + 5</p> <p>Final measurements:</p> <p>Test 2 – functional tests</p> <p>Test 1 – visual inspection</p> <p>Test 6 – sealing test</p>	6	0	<p>No opening of closed contact circuit with energization condition or closing of opened contact circuit shall exceed 10 µs</p> <p>According to Table 4</p> <p>No breaking or loosening of terminals</p> <p>According to Table 7</p>

Table 2 – Tests for qualification approval (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
17	Vibration (D) Functional	<p>Subclause 3.19</p> <p>Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate</p> <p>Axis of mounting:</p> <p>Vibration conditions: Application: three directions Number of sweeps per direction: 3 Sweep rate: 1 octave/min ± 10 % Total duration: approx. 3 × 10 min</p> <p>Test contact voltage and current: 24 V d.c. max., 10 mA max.</p> <p>Final measurements:</p> <p>Test 1 – visual inspection</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	6	0	<p>No opening of closed contact circuit with energization condition or closing of opened contact circuit shall exceed 10 µs</p> <p>The movable contact shall be located in the transverse direction</p> <p>According to Table 7</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 7</p>
	Vibration (D) Survival	<p>Clause 9 of IEC 61373 applies</p> <p>Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate</p> <p>Axis of mounting:</p> <p>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</p> <p>Peak to peak values: Vertical direction: 7,90 m/s² Transverse direction: 3,5 m/s² Longitudinal direction: 5,50 m/s²</p> <p>Test contact voltage and current: 24 V d.c. max., 10 mA max.</p> <p>Final measurements:</p> <p>Test 1 – visual inspection</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	6	0	<p>The movable contact shall be located in the transverse direction</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 7</p>

Table 2 – Tests for qualification approval (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
18	Shock (D) Functional	<p>Subclause 3.20</p> <p>Test switch type and standard test coil number: According to Table 5</p> <p>Test coil voltage: 150 % of must-operate</p> <p>Axis of mounting:</p> <p>Shock conditions: Application: three directions Number of shocks: 18 (three positive and three negative in each of the three orthogonal planes) Duration: 30 ms</p> <p>Test contact voltage and current: 24 V d.c. max., 10 mA max.</p> <p>Final measurements:</p> <p>Test 1 – visual inspection</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	6	0	<p>No opening of closed contact circuit with energization condition, or closing of opened contact circuit shall exceed 10 μs</p> <p>The movable contact shall be located in the transverse direction</p> <p>According to Table 7</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 7</p>
	Shock (D) Survival	<p>Subclause 3.20</p> <p>Test switch type and standard test coil number: according to Table 5</p> <p>Test coil voltage: 150 % of must-operate</p> <p>Axis of mounting:</p> <p>Shock conditions: Application: three directions Number of shocks: 18 (three positive and three negative in each of the three orthogonal planes) Duration: 30 ms</p> <p>Final measurements:</p> <p>Test 1 – visual inspection</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	6	0	<p>No cracks or other deterioration</p> <p>The movable contact shall be located in the transverse direction</p> <p>According to Table 7</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 7</p>

Table 2 – Tests for qualification approval (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
19	Electrical endurance (D)	<p>Subclause 3.23</p> <p>Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 %</p> <p>Switching load conditions:</p> <p>Monitoring conditions:</p> <p>Final measurements:</p> <p>Test 3 – contact-circuit resistance</p> <p>If applicable: Test 2 – functional tests</p> <p>Test 4 – dielectric test</p>	6	0	<p>According to Table 5</p> <p>According to Table 6</p> <p>According to Table 6 At each cycle during the test</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>
20	Mechanical endurance (D)	<p>Subclause 3.24</p> <p>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 second: 50 to 60</p> <p>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</p> <p>Limits for failure to make:</p> <p>Limits for failure to break:</p> <p>Test 3 – contact-circuit resistance</p> <p>Test 2 – functional tests</p>	20	1	<p>There shall be no broken parts</p> <p>According to Table 5</p> <p>± 20 % change of must-operate value</p> <p>50 % change of must-release value</p> <p>According to Table 4</p> <p>According to Table 4</p>

Table 2 – Tests for qualification approval (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
21	Maximum cycling frequency	Subclause 3.25, 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 second: 60	6	0	According to Table 5 According to Table 4
22	Rated conditional short-circuit current (D) Not required for Variant B	Subclause 3.31 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, standard sheet 1. Ratings of SCPD: 5 A 250 V Test voltage: 264 V a.c. or 115 V d.c. r.m.s. test current: 20 A a.c. and d.c. 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
23	Contact reliability test (D)	Subclause 3.32 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 – Tests for qualification approval (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of defectives	Performance requirements
24	Temperature rise (ND)	<p>Subclause 3.33</p> <p>Test switch type and standard test coil number:</p> <p>Test coil voltage: 150 % of must-operate Coil suppression: N/A</p> <p>Testing current: Measurement positions: terminals Measurement duration: 1,5 h</p> <p>Final measurements: Test 1 – visual test</p> <p>Test 3 – contact-circuit resistance</p> <p>Test 2 – functional test</p>	3	0	<p>According to Table 5</p> <p>According to Table 4</p> <p>No damage or other deterioration</p> <p>According to Table 4</p> <p>According to Table 4</p>
25	Making current capacity (D)	<p>Subclause 3.34</p> <p>Test switch type and standard test coil number:</p> <p>Test coil voltage: 150 % of must-operate Coil suppression: N/A</p> <p>Making load conditions:</p> <p>Monitoring conditions: monitoring times: $t_1 = 400$ ms, $\tau_1 = 50$ ms</p> <p>Test 3 – contact-circuit resistance</p> <p>If applicable: Test 2 – functional tests</p> <p>Test 4 – dielectric test</p>	6	0	<p>According to Table 5</p> <p>According to Table 6</p> <p>At each operating cycle</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>
26	Breaking current capacity (D)	<p>Subclause 3.35</p> <p>Test switch type and standard test coil number:</p> <p>Test coil voltage: 150 % of must-operate Coil suppression: N/A</p> <p>Breaking load conditions:</p> <p>Monitoring conditions: monitoring times: $t_2 = 100$ ms, $\tau_2 = 50$ ms</p> <p>Test 3 – contact-circuit resistance</p> <p>If applicable: Test 2 – functional tests</p> <p>Test 4 – dielectric test</p>	6	0	<p>According to Table 5</p> <p>According to Table 6</p> <p>At each operating cycle</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>

Table 2 – Tests for qualification approval (continued)

Specific tests for Variant A only

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
A1	Vibration (D) Functional	<p>Clause 8 of IEC 61373 applies</p> <p>Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate</p> <p>Axis of mounting:</p> <p>Vibration conditions: Application: three directions Frequency: 5 Hz to 150 Hz Number of sweeps per direction: 3 Sweep rate: 1 octave/min \pm 10 % Total duration: approx. 3 \times 10 min</p> <p>Peak to peak values: Vertical direction: 1,00 m/s² Transverse direction: 0,45 m/s² Vertical direction: 0,70 m/s²</p> <p>Test contact voltage and current: max. 24 V d.c., max. 10 mA</p> <p>Final measurements:</p> <p>Test 1 – visual inspection</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	6	0	<p>No opening of closed contact circuit with energization condition or closing of opened contact circuit shall exceed 10 μs</p> <p>The movable contact shall be located in the transverse direction</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 7</p>
A2	Shock (D)	<p>Clause 10 of IEC 61373 applies</p> <p>Test switch type and standard test coil number: according to Table 5 Test coil voltage: 150 % of must-operate</p> <p>Axis of mounting:</p> <p>Shock conditions: Application: three directions Number of shocks: 18 (three positive and three negative in each of the three orthogonal planes) Duration: 30 ms</p> <p>Peak acceleration values: Vertical direction: 30 m/s² Transverse direction: 30 m/s² Longitudinal direction: 50 m/s²</p> <p>Test contact voltage: max. 24 V d.c. Test contact current: max. 10 mA</p> <p>Final measurements:</p> <p>Test 1 – visual inspection</p> <p>Test 2 – functional tests</p> <p>Test 6 – sealing</p>	6	0	<p>No opening of closed contact circuit with energization condition or closing of opened contact circuit shall exceed 10 μs</p> <p>The movable contact shall be located in the transverse direction</p> <p>No cracks or other deterioration</p> <p>According to Table 4</p> <p>According to Table 7</p>

Table 2 – Tests for qualification approval (continued)

Specific tests for Variant A only (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of defectives	Performance requirements
A3	Electrical endurance (D)	<p>Subclause 3.23.4</p> <p>Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 %</p> <p>Switching load conditions: 110 V d.c., 60 mA (L/R = 22 ms) Duty: 50 % Switching rate: 5 cycles per second</p> <p>Required switching cycles: Limiting continuous current of 3 A: 5 000 000 min. Limiting continuous current of 5 A: 5 000 000 min.</p> <p>Monitoring conditions:</p> <p>Final measurements:</p> <p>Test 3 – contact-circuit resistance</p> <p>If applicable: Test 2 – functional tests</p> <p>Test 4 – dielectric test</p>	8	0	<p>According to Table 5</p> <p>With surge absorber</p> <p>Without surge absorber</p> <p>At each cycle during the test under the conditions specified in Table 6</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>
A4	Electrical endurance (D)	<p>Subclause 3.23.4</p> <p>Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 %</p> <p>Switching load conditions: 100 V d.c., 125 mA (L/R = 17 ms) Duty: 50 % Switching rate: 5 cycles per second</p> <p>Required switching cycles: Limiting continuous current of 5 A: 1 000 000 min.</p> <p>Monitoring conditions:</p> <p>Final measurements:</p> <p>Test 3 – contact-circuit resistance</p> <p>If applicable: Test 2 – functional tests</p> <p>Test 4 – dielectric test</p>	5	0	<p>According to Table 5</p> <p>At each cycle during the test under the conditions specified in Table 6</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>

Table 2 – Tests for qualification approval (continued)

Specific tests for Variant A only (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
A5	Electrical endurance (D)	<p>Subclause 3.23.4</p> <p>Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 %</p> <p>Switching load conditions: 52 V d.c., 100 mA (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.</p> <p>Monitoring conditions:</p> <p>Final measurements: Test 3 – contact-circuit resistance</p> <p>If applicable: Test 2 – functional tests Test 4 – dielectric test</p>	6	0	<p>According to Table 5</p> <p>At each cycle during the test under the conditions specified in Table 6</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>
A6	Electrical endurance (D)	<p>Subclause 3.23.4</p> <p>Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 %</p> <p>Switching load conditions: 100 V d.c., 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.</p> <p>Monitoring conditions:</p> <p>Final measurements: Test 3 – contact-circuit resistance</p> <p>If applicable: Test 2 – functional tests Test 4 – dielectric test</p>	4	0	<p>According to Table 5</p> <p>With surge absorber</p> <p>At each cycle during the test under the conditions specified in Table 6</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>

Table 2 – Tests for qualification approval (continued)

Specific tests for Variant A only (continued)

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
A7	Rated making and breaking capacity (D)	<p>Subclause 3.30</p> <p>Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A</p> <p>Contact ratings:</p> <p>Monitoring conditions:</p> <p>Final measurements:</p> <p>Test 3 – contact-circuit resistance</p> <p>If applicable: Test 2 – functional tests</p> <p>Test 4 – dielectric test</p>	3	0	<p>According to Table 5</p> <p>According to Table 6</p> <p>At each cycle during the test</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>
A8	Electrical endurance (D)	<p>Subclause 3.23.4</p> <p>Test switch type and standard test coil number: Test coil voltage: 150 % of must-operate Coil suppression: N/A Duty cycle: 50 %</p> <p>Switching load conditions: 24 V d.c., 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.</p> <p>Monitoring conditions:</p> <p>Final measurements:</p> <p>Test 3 – contact-circuit resistance</p> <p>Test 2 – functional tests</p> <p>Test 4 – dielectric test</p>	6	0	<p>According to Table 5</p> <p>At each cycle during the test under the conditions specified in Table 6</p> <p>According to Table 4</p> <p>According to Table 4</p> <p>According to Table 4</p>

Table 2 – Tests for qualification approval (continued)

Specific test for Variant B only

Test No.	Test	Test conditions according to IEC 62246-2	Sample size	Acceptable number of failures	Performance requirements
B1	Rated impulse voltage (D)	Subclause 3.29 Test voltage: 3 000 V d.c. Test voltage wave form: 1,2 / 50 μ s 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

At least 170 heavy-duty 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	Acceptable number of failures during test
	Test conditions according to IEC 62246-2		Test No. and description in Table 2		
	Subclause	Particular test conditions			

Group 1

Visual inspection	3.4		1	170	0
Functional tests	3.5	Procedure 1	2		
Contact circuit resistance	3.7		3		
Dielectric test	3.8		4		
Operate, release, transfer or bridging, and bounce times	3.10		5		
Sealing	3.22		6		

Group 2

Remanence test	3.6		7	6	0
Insulation resistance	3.9		8	6	0
Contact sticking	3.11	Procedure 1	9	6	0
Temperature rise	3.33		24	3	0

Group 3

Robustness of terminals	3.12		10	6	0
Soldering	3.13		11	6	0
Climatic sequence	3.14		12	6	0

Table 3 (continued)

Test	Conditions and requirements of test			Sample size	Acceptable number of failures during test
	Test conditions according to IEC 62246-2		Test No. and description in Table 2		
	Subclause	Particular test conditions			

Group 4

Damp heat, steady state	3.15		13	6	0
Rapid change of temperature	3.16		14	6	0
Salt mist	3.17		15	6	0

Group 5

Bump	3.18		16	6	0
Vibration	3.19	IEC 61373	17	12	0
Shock	3.20		18	12	0

Group 6

Electrical endurance test	3.23	Table 3	19	6	0
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Group 7

Mechanical endurance test	3.24	Method 1	20	20	1
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Group 8

Maximum cycling frequency	3.25	Procedure 1	21	6	0
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Group 9 (not required for Variant B)

Rated conditional short-circuit current	3.31		22	3	0
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Group 10

Contact reliability test	3.32		23	20	0
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Group 11

Making current capacity	3.34	Table 5	25	6	0
Breaking current capacity	3.35	Table 5	26	6	0

Table 3 (continued)

Test	Conditions and requirements of test			Sample size	Acceptable number of failures during test
	Test conditions according to IEC 62246-2				
	Subclause	Particular test conditions	Test No. and description in Table 2		

Group 12 (Variant A only)

Vibration test	3.19	IEC 61373	A1	6	0
Shock test	3.20	IEC 61373	A2	6	0

Group 13 (Variant A only)

Electrical endurance test	3.23.4		A3	8	0
Electrical endurance test	3.23.4		A4	5	0
Electrical endurance test	3.23.4		A5	6	0
Electrical endurance test	3.23.4		A6	4	0

Group 14 (Variant B only)

Rated impulse voltage	3.29		B1	3	0
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Group 15 (Variant A only)

Rated making and breaking capacities	3.30	Table 4 Table C.1	A7	3	0
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Group 16 (Variant A only)

Electrical endurance test	3.23		A8	6	0
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4 Characteristic values of the heavy-duty reed switches

Table 4 – Characteristic values for general data

Limiting continuous current		3,0 A	5,0 A
General data	Glass diameter (mm)	4,95 ± 0,1	6,0 ± 0,15
	Terminal length (mm)	61,0 ± 0,2	71,4 ± 0,2
	Nominal mass	1,4 ± 0,5	2,4 ± 0,5
	Contact arrangement	1 NO	
	Finish of the terminals	Tinning	
Functional tests	Standard coil number	3 in Annex E of IEC 62246-2	
	Must-release value (AT)	50 ± 3	60 ± 3
	Must-operate value (AT)	130 ± 3	230 ± 3
Contact circuit resistance	Max. contact resistance (mΩ)	500	500 (100 for Variant B)
Dielectric test	Voltage between the terminals	500/550 V a.c. (1000/1100 V a.c. for Variant B)	800/880 V a.c. (1000/1100 V a.c. for Variant B)
	Duration of the test voltage	1 min/1 s	
Rated impulse voltage (Variant B only)	Peak voltage between the terminals	3 000 V	N/A
	Test voltage wave form	1,2 / 50 μs	N/A
	Number of pulses	Six pulses (three positive and three negative)	N/A
Insulation resistance		100 MΩ min. at 500 V d.c. initial value	
Maximum operate, release and bounce time	Operate time	5 ms	
	Release time	3 ms	
	Operate bounce time	3 ms	

4.1 Standard test coil number for tests

Table 5 – Standard test coil number for tests

Limiting continuous current	3,0 A	5,0 A
Functional tests; remanence tests; contact circuit resistance; operate, release, transfer or bridging and bounce times; maximum cycling frequency; contact sticking	3 in Annex E of IEC 62246-2	
Bump; vibration; shock; electrical endurance; mechanical endurance; contact reliability test	6 in Annex E of IEC 62246-2	7 in Annex E of IEC 62246-2
Rated conditional short-circuit current; rated impulse voltage; rated making and breaking capacities; temperature rise; making current capacity; breaking current capacity; sealing	8 in Annex E of IEC 62246-2	

4.2 Contact data

4.2.1 Contact reliability, electrical endurance, rated 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 3.32).