

## TEST REPORT

On Behalf of

**SMART-GROUP (Dongguan Shima Electronics Co., Ltd.)**

**Relay Controllers**

**Model: SB-RLY8c16A-DN, SB-RLY4c20A-DN, SB-RLY6c20A-DN, SB-RLY4c16A-DN, SB-RLY6c16A-DN, SB-RLY12c10A-DN, SB-PS9A-WL**

**Prepared For : SMART-GROUP  
(Dongguan Shima Electronics Co., Ltd.)**  
No.135, Huancheng Road, Mawu Village, Qiaoli Management  
Community, Changping Town, Dongguan City, Guangdong  
Province, China

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**Date of Test: Jan. 19, 2017 to Feb. 07, 2017**  
**Date of Report: Feb. 07, 2017**  
**Report Number: R0117011391S**

**TEST REPORT**

**EN 60947-1**

**Low-voltage switchgear and controlgear**

**- Part 1:General rules**

**Report**

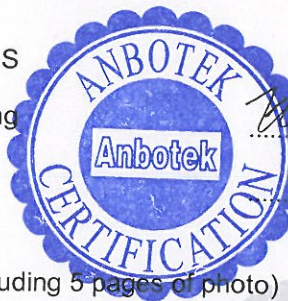
Report reference No.....: R0117011391S

Tested by.....: Elaiven Zhuang

Approved by.....: Jeff Zhu

Date of issue .....: Aug. 18, 2011

Contents.....: 38 pages (including 5 pages of photo)



**Testing laboratory**

Name .....: Shenzhen Anbotek Compliance Laboratory Limited

Address .....: 1/F., Building 1, SEC Industrial Park, No.0409 Qianhai Road,  
Nanshan District, Shenzhen, Guangdong, China

Testing location .....: As above

**Client**

Name .....: SMART-GROUP  
(Dongguan Shima Electronics Co., Ltd.)

Address.....: No.135, Huancheng Road, Mawu Village, Qiaoli Management  
Community, Changping Town, Dongguan City, Guangdong  
Province, China

**Manufacturer**

Name .....: Same as applicant

Address.....: Same as applicant

**Test specification**

Standard.....: EN 60947-1: 2007+A2: 2014

Procedure deviation .....: N.A.

Non-standard test method .....: N.A.

**Test item**

Description .....: Relay Controllers

Trademark .....: SMART-BUS

SMART-BUS/ PREUSSEN/ S-MESH

Model and/or type reference .....: SB-RLY8c16A-DN, SB-RLY4c20A-DN, SB-RLY6c20A-DN, SB-  
RLY4c16A-DN, SB-RLY6c16A-DN, SB-RLY12c10A-DN, SB-PS9A-  
WL

Rating(s) .....: 11-24VDC, 110-260VAC 15mA, 0.4W for DC24V at static, 40mA,  
1W for DC24V at dynamic

**Test case verdicts**

Test case does not apply to the test object .....: N(.A.)

Test item does meet the requirement .....: P(ass)

Test item does not meet the requirement .....: F(ail)

**Testing**

Date of receipt of test item .....: Aug. 11, 2011

Date(s) of performance of test .....: Aug. 11, 2011 to Aug. 18, 2011

**General remarks**

This report shall not be reproduced except in full without the written approval of the testing laboratory.

The test results presented in this report relate only to the item tested.

"(see remark #)" refers to a remark appended to the report.

"(see Annex #)" refers to an annex appended to the report.

Throughout this report a comma is used as the decimal separator.

Factory: SMART-GROUP (Dongguan Shima Electronics Co., Ltd.)

Address: No.135, Huancheng Road, Mawu Village, Qiaoli Management

Community, Changping Town, Dongguan City, Guangdong Province, China

1. This series contains 7 models. If no otherwise specification, all the test were performed on model SB-RLY8c16A-DN.
2. The altitude of the site of installation does not exceed 2 000 m.
3. This report is prepared by depending on type test on the submitted samples.

Copy of marking plate. Formed as following:

**Relay Controllers**  
**Model No.: SB-RLY8c16A-DN**  
**Rating: 11-24VDC, 110-260VAC**  
**15mA, 0.4W for DC24V at static,**  
**40mA, 1W for DC24V at dynamic**  
**SMART-GROUP**  
**(Dongguan Shima Electronics Co., Ltd.)**



**Summary of testing**

Rubbing for 15 s with a piece of cloth soaked with water. And a further 15 s with a piece of cloth soaked with petroleum.

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| Clause   | Requirement - Test  | Result                        | Verdict |
|----------|---|-------------------------------|---------|
| <b>4</b> | <b>Characteristics</b>  |                               | ---     |
| 4.1      | The characteristics of an equipment shall be stated in the relevant product standard in respect of the following, where applicable: |                               | P       |
| 4.2      | Type of equipment   |                               | ---     |
|          | - kind of equipment: e.g. contactor, circuit-breaker, etc.;   | Circuit-breaker               | P       |
|          | - number of poles;  | 3                             | P       |
|          | - kind of current;  | AC                            | P       |
|          | - interrupting medium;  | Electronic                    | P       |
|          | - operating conditions (method of operation, method of control, etc.).  | Manual, and automatic control | P       |
| 4.3      | Rated and limiting values for the main circuit  |                               | ---     |
| 4.3.1    | Rated voltages  | 110-260V                      | P       |
| 4.3.1.1  | Rated operational voltage (Ue)  |                               | N       |
| 4.3.1.2  | Rated insulation voltage (Ui)   |                               | P       |
| 4.3.1.3  | Rated impulse withstand voltage (Uimp)  |                               | P       |
| 4.3.2    | Currents  |                               | P       |
| 4.3.2.1  | Conventional free air thermal current (Ith)   |                               | N       |
| 4.3.2.2  | Conventional enclosed thermal current (Ithe)  |                               | N       |
| 4.3.2.3  | Rated operational current (Ie) or rated operational power   |                               | N       |
| 4.3.2.4  | rated uninterrupted current (iu)  |                               | N       |
| 4.3.3    | Rated frequency   | 50/60Hz                       | P       |
| 4.3.4    | Rated duties  |                               | --      |
| 4.3.4.1  | Eight-hour duty   |                               | N       |
| 4.3.4.2  | Uninterrupted duty  |                               | N       |
| 4.3.4.3  | Intermittent periodic duty or intermittent duty   |                               | P       |
| 4.3.4.4  | Temporary duty  |                               | N       |
| 4.3.4.5  | Periodic duty   |                               | N       |
| 4.3.5    | Normal load and overload characteristics  |                               | P       |
| 4.3.5.1  | Ability to withstand motor switching overload currents  |                               | N       |
| 4.3.5.2  | Rated making capacity   |                               | P       |
| 4.3.5.3  | Rated breaking capacity   |                               | N       |
| 4.3.6    | Short-circuit characteristics   |                               | N       |
| 4.3.6.1  | Rated short-time withstand current (Icw)  |                               | N       |

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|------------|--|---|---------|
| Clause     | Requirement - Test   | Result  | Verdict |
| 4.3.6.2    | Rated short-circuit making capacity (Icm)  |   | N       |
| 4.3.6.3    | Rated short-circuit breaking capacity (Icn)  |   | N       |
| 4.3.6.4    | Rated conditional short-circuit current  |   | N       |
| 4.4        | Utilization category   |   | P       |
| 4.5        | Control circuits   |   | ---     |
| 4.5.1      | Electrical control circuits  |   | P       |
|            | – kind of current;   | AC  | P       |
|            | – rated frequency if a.c.;   | 50/60Hz   | P       |
|            | – rated control circuit voltage Uc (nature, and frequency if a.c.);  |   | N       |
|            | – rated control supply voltage Us (nature, and frequency if a.c.), where applicable.                                   | 110-260V  | P       |
| 4.5.2      | Air-supply control circuits (pneumatic or electro-pneumatic)   |   | N       |
| 4.6        | Auxiliary circuits   |   | N       |
| 4.7        | Relays and releases  |   | N       |
| 4.8        | Co-ordination with short-circuit protective devices (SCPD)   |   | N       |
| 4.9        | Switching overvoltages   |   | N       |
| <b>5</b>   | <b>Product information</b>   |   | ---     |
| 5.1        | Nature of information  |   | ---     |
|            | Identification:  |   | ---     |
|            | – manufacturer's name or trademark;  | SMART-GROUP<br>(Dongguan Shima Electronics Co., Ltd.) | P       |
|            | – type designation or serial number;   | See page 1  | P       |
|            | – number of the relevant product standard, if the manufacturer claims compliance.                                      | EN 60947-1  | P       |
|            | Characteristics:   |   | ---     |
|            | – rated operational voltages (see 4.3.1.1 and note to 5.2);  | 110-260V  | P       |
|            | – utilization category and rated operational currents  |   | P       |
|            | – the value of the rated frequency/frequencies, e.g.: 50 Hz, 50 Hz/60 Hz, and/or the indication "d.c." or the symbol ; | 50/60Hz   | P       |
|            | – rated duty, with the indication of the class of intermittent duty, if any (see 4.3.4);                               |   | P       |

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| Clause | Requirement - Test   | Result | Verdict |
|--------|--|--------|---------|
|        | – rated making and/or breaking capacities. These indications may be replaced, where applicable, by the indication of the utilization category; |        | N       |
|        | – rated insulation voltage (see 4.3.1.2);  | 1500V  | P       |
|        | – rated impulse withstand voltage (see 4.3.1.3);   | 2500V  | P       |
|        | – switching overvoltage (see 4.9);   |        | N       |
|        | – rated short-time withstand current together with its duration, where applicable (see 4.3.6.1);   |        | N       |
|        | – rated short-circuit making and/or breaking capacities, where applicable (see 4.3.6.2 and 4.3.6.3);   |        | N       |
|        | – rated conditional short-circuit current, where applicable (see 4.3.6.4);   |        | N       |
|        | – IP code, in case of enclosed equipment (see Annex C);  |        | N       |
|        | – pollution degree (see 6.1.3.2);  | II     | N       |
|        | – type and maximum ratings of short-circuit protective device, where applicable;   |        | N       |
|        | – class of protection against electric shock (see IEC 61140), where applicable;  |        | N       |
|        | – rated control circuit voltage, kind of current and frequency;  |        | N       |
|        | – rated control supply voltage, kind of current and frequency, if different from those of the control coil;                                    |        | N       |
|        | – rated supply pressure of the air-pressure and limits of pressure variations (for air-pressure controlled equipment);                         |        | N       |
| 5.2    | Marking  |        | ---     |
|        | All relevant information, as detailed in 5.1, which is to be marked on the equipment, shall be specified in the relevant product standard.     |        | N       |
|        | The following information shall also be marked and visible after mounting:   |        | P       |
|        | – direction of movement of the actuator (see 7.1.5.2), if applicable;  |        | P       |
|        | – indication of the position of the actuator (see also 7.1.6.1 and 7.1.6.2);   |        | P       |
|        | – approval or certification mark, if applicable;   |        | P       |

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| Clause   | Requirement - Test  | Result                                 | Verdict |
|----------|---|--|---------|
|          | – for miniaturized equipment, symbol, colour code or letter code;   |  | P       |
|          | – terminal identification and marking (see 7.1.8.4);  |  | P       |
|          | – IP code and class of protection against electric shock,   | Class I                                | P       |
|          | – suitability for isolation   |  | N       |
| 5.3      | Instructions for installation, operation and maintenance  |  | P       |
|          | The manufacturer shall specify in his documents or catalogues the conditions for installation, operation and maintenance, if any, of the equipment during operation and after a fault.  |  | P       |
| <b>6</b> | <b>Normal service, mounting and transport conditions</b>  |  | ---     |
| 6.1      | Normal service conditions   |  | P       |
|          | Equipment complying with this standard shall be capable of operating under the following standard conditions:   |  | P       |
| 6.1.1    | Ambient air temperature   | 0-45°C                                 | N       |
| 6.1.2    | The altitude of the site of installation does not exceed 2 000 m.   |  | P       |
| 6.1.3    | The relative humidity of the air does not exceed 50 % at a maximum temperature of +40 °C. Higher relative humidities may be permitted at lower temperatures, e.g. 90 % at +20 °C. Special measures may be necessary in cases of occasional condensation due to variations in temperature. |  | P       |
| 6.1.3.2  | The pollution degree (see 2.5.58) refers to the environmental conditions for which the equipment is intended.   |  | P       |
|          | For equipment intended for use within an enclosure or provided with an integral enclosure, the pollution degree of the environment in the enclosure is applicable.  | Use in an enclosure                    | P       |
|          | Unless otherwise stated by the relevant product standard, equipment for household and similar applications is generally for use in pollution degree 2 environment.  | use in pollution degree 2 environment. | P       |
| 6.1.4    | Standard conditions of shock and vibration to which the equipment can be submitted are under consideration.   |  | ---     |

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| Clause  | Requirement - Test   | Result | Verdict |
|---------|--|--------|---------|
| 6.2     | A special agreement shall be made between user and manufacturer if the conditions during transport and storage, e.g. temperature and humidity, differ from those defined in 6.1, except that, unless otherwise specified, the following temperature range applies during transport and storage: between -25 °C and +55 °C and, for short periods not exceeding 24 h, up to +70 °C. |        | P       |
|         | Equipment subjected to these extreme temperatures without being operated shall not undergo any irreversible damage and shall then operate normally under the specified conditions.   |        | P       |
| 6.3     | The equipment shall be mounted in accordance with the manufacturer's instructions.   |        | P       |
| 7       | Constructional and performance requirements  |        | --      |
| 7.1     | The equipment with its enclosure, if any, whether integral or not, shall be designed and constructed to withstand the stresses occurring during installation and normal use and, in addition, shall provide a specified degree of resistance to abnormal heat and fire.  |        | P       |
| 7.1.1   | The suitability of materials used is verified by making tests  |        | P       |
|         | The suitability shall be determined with respect to resistance to abnormal heat and fire.  |        | P       |
| 7.1.1.1 | Parts of insulating materials which might be exposed to thermal stresses due to electrical effects, and the deterioration of which might impair the safety of the equipment, shall not be adversely affected by abnormal heat and by fire.   |        | P       |
|         | Parts of insulating materials necessary to retain current-carrying parts in position shall conform to the glow-wire tests of 8.2.1.1.1 at a test temperature of 850 °C or 960 °C according to the expected fire hazard. Product standards shall specify the value appropriate to the product, taking into account the Annex A to IEC 60695-2-11                                    |        | N       |
|         | Parts of insulating materials other than those specified in the previous paragraph shall conform to the requirements of the glow-wire test of 8.2.1.1.1 at a temperature of 650 °C.  |        | N       |

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| Clause  | Requirement - Test   | Result            | Verdict |
|---------|--|-------------------|---------|
| 7.1.2   | Current-carrying parts shall have the necessary mechanical strength and current-carrying capacity for their intended use.  |                   | P       |
|         | For electrical connections, no contact pressure shall be transmitted through insulating material other than ceramic or other material with characteristics not less suitable, unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or yielding of the insulation material.   | No other material | P       |
| 7.1.3   |  |                   |         |
| 7.1.4.1 | The actuator of the equipment shall be insulated from the live parts for the rated insulation voltage and, if applicable, the rated impulse withstand voltage  |                   | P       |
| 7.1.4.2 | The direction of operation for actuators of devices shall normally conform to IEC 60447. Where devices cannot conform to these requirements, e.g. due to special applications or alternative mounting positions, they shall be clearly marked such that there is no doubt as to the "I" and "O" positions and the direction of operation.  |                   | P       |
| 7.1.5.1 | When an equipment is provided with means for indicating the closed and open positions, these positions shall be unambiguous and clearly indicated. This is done by means of a position indicating device   |                   | P       |
|         | For equipment operated by means of two push-buttons, only the push-button designated for the opening operation shall be red or marked with the symbol "O".   |                   | N       |
|         | Red colour shall not be used for any other push-button.  |                   | N       |
| 7.1.5.2 | When the actuator is used to indicate the position of the contacts, it shall automatically take up or stay, when released, in the position corresponding to that of the moving contacts; in this case, the actuator shall have two distinct rest positions corresponding to those of the moving contacts, but for automatic opening a third distinct position of the actuator may be provided. |                   | N       |

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| Clause  | Requirement - Test   | Result              | Verdict |
|---------|--|---------------------|---------|
| 7.1.6.1 | Equipment suitable for isolation shall provide in the open position (see 2.4.21) an isolation distance in accordance with the requirements necessary to satisfy the isolating function (see 7.2.3.1 and 7.2.7). Indication of the position of the main contacts shall be provided by one or more of the following means: |                     | ---     |
|         | – the position of the actuator   |                     |         |
|         | – a separate mechanical indicator  |                     |         |
|         | – visibility of the moving contacts  |                     |         |
|         | The effectiveness of each of the means of indication provided on the equipment and its mechanical strength shall be verified in accordance with 8.2.5  |                     | P       |
|         | When means are provided or specified by the manufacturer to lock the equipment in the open position, locking in that position shall only be possible when the main contacts are in the open position. This shall be verified in accordance with 8.2.5.   |                     | P       |
|         | Equipment shall be designed so that the actuator, front plate or cover are fitted to the equipment in a manner which ensures correct contact position indication and locking, if provided.   |                     | P       |
|         | The indicated open position is the only position in which the specified isolation distance between the contacts is ensured.  |                     | P       |
|         | For equipment provided with positions such as “tripped position” or “standby position”, which are not the indicated open position, those positions shall be clearly identified. The marking of such positions shall not include the symbols “I” or “O”.  |                     | N       |
|         | An actuator having only one position of rest shall not be considered as appropriate to indicate the position of the main contact.  |                     | N       |
| 7.1.6.2 | If equipment suitable for isolation is provided with an auxiliary switch for the purpose of electrical interlocking with contactor(s) or circuit-breaker(s) and intended to be used in motor circuits, the following requirements shall apply unless the equipment is rated for AC-23 utilization category.              |                     | N       |
|         | An auxiliary switch shall be rated according to IEC 60947-5-1 as stated by the manufacturer.   | No auxiliary switch | N       |

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| Clause  | Requirement - Test  | Result | Verdict |
|---------|---|--------|---------|
|         | The time interval between the opening of the contacts of the auxiliary switch and the contacts of the main poles shall be sufficient to ensure that the associated contactor or circuit-breaker interrupts the current before the main poles of the equipment open.   |        | N       |
|         | Unless otherwise stated in the manufacturer's technical literature, the time interval shall be not less than 20 ms when the equipment is operated according to the manufacturer's instructions  |        | N       |
|         | During the closing operation the contacts of the auxiliary switch shall close after or simultaneously with the contacts of the main poles.  |        | N       |
|         | A suitable opening time interval may also be provided by an intermediate position (between the ON an OFF positions) at which the interlocking contact(s) is (are) open and the main poles remain closed.  |        | N       |
| 7.1.6.3 | The locking means shall be designed in such a way that it cannot be removed with the appropriate padlock(s) installed. When the equipment is locked by even of a single padlock, it shall not be possible by operating the actuator, to reduce the clearance between open contacts to the extent that it no longer complies with the requirements of 7.2.3.1b). |        | N       |
|         | Alternatively, the design may provide padlockable means to prevent access to the actuator.  |        | N       |
| 7.1.7.1 | All parts of terminals which maintain contact and carry current shall be of metal having adequate mechanical strength.  |        | P       |
|         | Terminal connections shall be such that the conductors may be connected by means of screws, springs or other equivalent means so as to ensure that the necessary contact pressure is maintained.  |        | P       |
|         | Terminals shall be so constructed that the conductors can be clamped between suitable surfaces without any significant damage either to conductors or terminals   |        | P       |
|         | Terminals shall not allow the conductors to be displaced or be displaced themselves in a manner detrimental to the operation of equipment and the insulation voltage shall not be reduced below the rated values.   |        | P       |

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| Clause  | Requirement - Test  | Result | Verdict |
|---------|---|--------|---------|
|         | If required by the application, terminals and conductors may be connected by means of cable lugs for copper conductors only.  |        | P       |
| 7.1.7.2 | The manufacturer shall state the type (rigid – solid or stranded – or flexible), the minimum and the maximum cross-sections of conductors for which the terminal is suitable and, if applicable, the number of conductors simultaneously connectable to the terminal. However, the maximum cross-section shall not be smaller than that stated in 8.3.3.3 for the temperature-rise test and the terminal shall be suitable for conductors of the same type (rigid – solid or stranded – or flexible) at least two sizes smaller, as given in the appropriate column of Table 1. |        |         |
| 7.1.7.3 | Terminals for connection to external conductors shall be readily accessible during installation.  |        | N       |
|         | Clamping screws and nuts shall not serve to fix any other component although they may hold the terminals in place or prevent them from turning.   |        | N       |
| 7.1.7.4 | Terminals shall be clearly and permanently identified in accordance with IEC 60445 and Annex L, unless superseded by the requirements of the relevant product standard.   |        | P       |
|         | Terminals intended exclusively for the neutral conductor shall be identified by the letter "N", in accordance with IEC 60445.   |        | N       |
|         | The protective earth terminal shall be identified in accordance with 7.1.9.3.   |        | N       |
| 7.1.8   | When an equipment is provided with a pole intended only for connecting the neutral, this pole shall be clearly identified to that effect by the letter N (see 7.1.7.4).   |        | N       |
|         | A switched neutral pole shall break not before and shall make not after the other poles.  |        | N       |
|         | If a pole having an appropriate short-circuit breaking and making capacity (see 2.5.14 and 2.5.15) is used as a neutral pole, then all poles, including the neutral pole, may operate substantially together.   |        | N       |
|         | For equipment having a value of conventional thermal current (free air or enclosed, see 4.3.2.1 and 4.3.2.2) not exceeding 63 A, this value shall be identical for all poles.   |        | N       |

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| Clause  | Requirement - Test  | Result | Verdict |
|---------|---|--------|---------|
|         | For higher conventional thermal current values, the neutral pole may have a value of conventional thermal current different from that of the other poles, but not less than half that value or 63 A, whichever is the higher  |        | N       |
| 7.1.9.1 | The exposed conductive parts (e.g. chassis, framework and fixed parts of metal enclosures) other than those which cannot constitute a danger shall be electrically interconnected and connected to a protective earth terminal for connection to an earth electrode or to an external protective conductor. |        | N       |
|         | Exposed conductive parts are considered not to constitute a danger if they cannot be touched on large areas or grasped with the hand or if they are of small size (approximately 50 mm × 50 mm) or are so located as to exclude any contact with live parts.  |        | N       |
| 7.1.9.2 | The protective earth terminal shall be readily accessible and so placed that the connection of the equipment to the earth electrode or to the protective conductor is maintained when the cover or any other removable part is removed.   |        | N       |
|         | The protective earth terminal shall be suitably protected against corrosion   |        | N       |
|         | In the case of equipment with conductive structures, enclosures, etc., means shall be provided, if necessary, to ensure electrical continuity between the exposed conductive parts of the equipment and the metal sheathing of connecting conductors.   |        | N       |
|         | The protective earth terminal shall have no other function, except when it is intended to be connected to a PEN conductor (see 2.1.1.5 – Note). In this case, it shall also have the function of a neutral terminal in addition to meeting the requirements applicable to the protective earth terminal.    |        | N       |
| 7.1.9.3 | The protective earth terminal shall be clearly and permanently identified by its marking  |        | N       |
|         | The identification shall be achieved by colour (green-yellow mark) or by the notation PE, or PEN, as applicable, in accordance with IEC 60445, subclause 5.3, or by a graphical symbol for use on equipment.  |        | N       |

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| Clause   | Requirement - Test   | Result | Verdict |
|----------|--|--------|---------|
| 7.1.10   | The following requirements are only applicable to enclosures supplied or intended to be used with the equipment.   |        | P       |
| 7.1.10.1 | The enclosure shall be so designed that, when it is opened and other protective means, if any, are removed, all parts requiring access for installation and maintenance, as prescribed by the manufacturer, are readily accessible.  |        | P       |
|          | Sufficient space shall be provided inside the enclosure for the accommodation of external conductors from their point of entry into the enclosure to the terminals to ensure adequate connection.  |        | P       |
|          | The fixed parts of a metal enclosure shall be electrically connected to the other exposed conductive parts of the equipment and connected to a terminal which enables them to be earthed or connected to a protective conductor.   |        | P       |
|          | Under no circumstances shall a removable metal part of the enclosure be insulated from the part carrying the earth terminal when the removable part is in place.   |        | P       |
| 7.1.10.2 | If, in order to prevent accidental contact between a metallic enclosure and live parts, the enclosure is partly or completely lined with insulating material, then this lining shall be securely fixed to the enclosure.   |        | P       |
| 7.1.11   | Degrees of protection of enclosed equipment and relevant tests are given in Annex C.   |        | P       |
| 7.1.12   | Polymeric enclosures of equipment, whether integral or not, provided with threaded conduit entries, intended for the connection of extra heavy duty, rigid threaded metal conduits complying with IEC 60981, shall withstand the stresses occurring during its installation such as pull-out, torque, bending. |        | P       |
| 7.2      | The following requirements apply to clean new equipment unless otherwise stated in the relevant product standard.  |        | P       |
| 7.2.1.1  | The equipment shall be operated in accordance with the manufacturer's instructions or the relevant product standard, especially for equipment with dependent manual operation where the making and breaking capacities may depend on the skill of the operator.  |        | P       |

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| Clause  | Requirement - Test  | Result | Verdict |
|---------|---|--------|---------|
| 7.2.1.2 | Limits of operation of power operated equipment   |        | ---     |
|         | Unless otherwise stated in the relevant product standard, electromagnetic and electropneumatic equipment shall close with any control supply voltage between 85 % and 110 % of its rated value $U_s$ and an ambient air temperature between $-5^{\circ}\text{C}$ and $+40^{\circ}\text{C}$ . These limits apply to d.c. or a.c. as appropriate. |        | N       |
|         | For pneumatic and electro-pneumatic equipment, unless otherwise stated, the limits of the air supply pressure are 85 % and 110 % of the rated pressure.   |        | N       |
| 7.2.1.3 | Limits of operation of under-voltage relays and releases  |        | ---     |
|         | An under-voltage relay or release, when associated with a switching device, shall operate to open the equipment even on a slowly falling voltage within the range between 70 % and 35 % of its rated voltage.   |        | P       |
|         | For a time-delay under-voltage relay or release, the time-lag shall be measured from the instant when the voltage reaches the operating value until the instant when the relay or release actuates the tripping device of the equipment.  |        | N       |
| 7.2.1.4 | A shunt release for opening shall cause tripping under all operating conditions of an equipment when the supply voltage of the shunt release measured during the tripping operation remains between 70 % and 110 % of the rated control supply voltage and, if a.c., at the rated frequency.  |        | N       |
| 7.2.1.5 | Limits of operation of current operated relays and releases shall be stated in the relevant product standard.   |        | N       |
| 7.2.2   | The temperature-rises of the parts of an equipment, measured during a test carried out under the conditions specified in 8.3.3.3, shall not exceed the values stated in this subclause.   |        | P       |
| 7.2.2.1 | The temperature-rises of terminals shall not exceed the values stated in Table 2.   |        | P       |
| 7.2.2.2 | The temperature-rises of accessible parts shall not exceed the values stated in Table 3.  |        | P       |

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|---------|--|--------|---------|
| 7.2.2.3 | The temperature-rise limits given in Tables 2 and 3 are applicable only if the ambient air temperature remains within the limits given in 6.1.1.   | 0-45°C | P       |
| 7.2.2.4 | The main circuit of an equipment shall be capable of carrying the conventional thermal current of the equipment without the temperature-rises exceeding the limits specified in Tables 2 and 3 when tested in accordance with 8.3.3.3.4.   |        | P       |
| 7.2.2.5 | The control circuits of an equipment, including control circuit devices to be used for the closing and operating operations of an equipment, shall permit the rated duty according to 4.3.4 and also the temperature-rises tests specified in 8.3.3.3.5 to be made without the temperature-rises exceeding the limits specified in Tables 2 and 3.                       |        | P       |
| 7.2.2.6 | With current flowing through the main circuit the windings of coils and electromagnets shall withstand their rated voltage without the temperature-rises exceeding the limits specified in 7.2.2.8 when tested in accordance with 8.3.3.3.6.   |        | P       |
| 7.2.2.7 | Auxiliary circuits of an equipment including auxiliary switches shall be capable of carrying their conventional thermal current without the temperature-rise exceeding the limits specified in Tables 2 and 3, when tested in accordance with 8.3.3.3.7.   |        | P       |
| 7.2.2.8 | The temperature-rises obtained during the test shall not cause damage to current-carrying parts or adjacent parts of the equipment. In particular, for insulating materials, the manufacturer shall demonstrate compliance either by reference to the insulation temperature index (determined for example by the methods of IEC 60216) or by compliance with IEC 60085. |        | P       |
| 7.2.3   | Dielectric properties  |        | P       |
|         | The dielectric properties are based on basic safety publications IEC 60664-1 and IEC 61140.  |        | N       |
| 7.2.3.1 | Impulse withstand voltage  |        | P       |
|         | 1) Main circuit  |        | P       |
|         | 2) Auxiliary and control circuits  |        | P       |
| 7.2.3.2 | Power-frequency withstand voltage of the main, auxiliary and control circuits  |        | P       |

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| Clause  | Requirement - Test  | Result | Verdict |
|---------|---|--------|---------|
| 7.2.3.3 | Clearances  |        | ---     |
|         | Clearances shall be sufficient to enable the equipment to withstand the rated impulse withstand voltage, according to 7.2.3.1.  |        | P       |
|         | The method of measuring clearances is given in Annex G.   |        | P       |
| 7.2.3.4 | Creepage distances  |        | ---     |
|         | a) Dimensioning   |        | ---     |
|         | For pollution degrees 1 and 2, creepage distances shall be not less than the associated clearances selected according to 7.2.3.3.   |        | P       |
|         | For pollution degrees 3 and 4, the creepage distances shall be not less than the case A clearances (Table 13) to reduce the risk of disruptive discharge due to overvoltages, even if the clearances are smaller than the values of case A as permitted in 7.2.3.3.   |        | N       |
|         | The method of measuring creepage distances is given in Annex G.   |        | P       |
|         | b) Use of ribs  |        | ---     |
|         | A creepage distance can be reduced to 0,8 of the relevant value of Table 15 by using ribs of 2 mm minimum height, irrespective of the number of ribs. The minimum base of the rib is determined by mechanical requirements (see G.2).   |        | P       |
|         | c) Special applications   |        | ---     |
|         | Equipment intended for certain applications where severe consequences of an insulation fault have to be taken into account shall have one or more of the influencing factors of Table 15 (distances, insulating materials, pollution in the micro-environment) utilized in such a way as to achieve a higher insulation voltage than the rated insulation voltage given to the equipment according to Table 15. |        | N       |
| 7.2.3.5 | Solid insulation  |        | ---     |
|         | Solid insulation shall be verified by either power-frequency tests, in accordance with item 3) of 8.3.3.4.1, or d.c. tests in the case of d.c. equipment.   |        | P       |
|         | Dimensioning rules for solid insulation and d.c. test voltages are under consideration.   |        | P       |
| 7.2.3.6 | Spacing between separate circuits   |        | ---     |

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| Clause    | Requirement - Test   | Result | Verdict |
|-----------|--|--------|---------|
|           | For dimensioning clearances, creepage distances and solid insulation between separate circuits, the highest voltage ratings shall be used (rated impulse withstand voltage for clearances and associated solid insulation and rated insulation voltage or working voltage for creepage distances).   |        | P       |
| 7.2.3.7   | Requirements for equipment with protective separation  |        | P       |
|           | Requirements for equipment with protective separation are given in Annex N.  |        | P       |
| 7.2.4     | Ability to make, carry and break currents under no-load, normal load and overload conditions   |        | ---     |
| 7.2.4.1   | The equipment shall be capable of making and breaking load and overload currents without failure under the conditions stated in the relevant product standard for the required utilization categories and the number of operations stated in the relevant product standard (see also general test conditions of 8.3.3.5).  |        | P       |
| 7.2.4.2   | Tests concerning the operational performance of equipment are intended to verify that the equipment is capable of making, carrying and breaking without failure the currents flowing in its main circuit under conditions corresponding to the specified utilization category, where relevant.   |        | P       |
|           | Specific requirements and test conditions shall be stated in the relevant product standard and may concern   |        | N       |
| 7.2.4.3   | Durability   |        | ---     |
| 7.2.4.3.1 | Mechanical durability  |        | ---     |
|           | With respect to its resistance to mechanical wear, an equipment is characterized by the number, stated in the relevant product standard, of no-load operating cycles (i.e., without current at the main contacts) which can be effected before it becomes necessary to service or replace any mechanical parts; however, normal maintenance according to the manufacturer's instructions may be permitted for equipment designed to be maintained. |        | P       |
| 7.2.4.3.2 | Electrical durability  |        | ---     |

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| Clause    | Requirement - Test  | Result | Verdict |
|-----------|---|--------|---------|
|           | With respect to its resistance to electrical wear, an equipment is characterized by the number of on-load operating cycles, corresponding to the service conditions given in the relevant product standard, which can be made without repair or replacement.  |        | P       |
| 7.2.5     | Ability to make, carry and break short-circuit currents   |        | ---     |
|           | The equipment shall be so constructed as to be capable of withstanding, under conditions specified in the relevant product standard, the thermal, dynamic and electrical stresses resulting from short-circuit currents. In particular the equipment shall behave in such a manner that it complies with the requirements of 8.3.4.1.8. |        | P       |
| 7.2.6     | Switching overvoltages  |        | ---     |
|           | Product standards may specify switching overvoltage tests if applicable.  |        | P       |
|           | In this case the test procedure and the requirements shall be defined in the product standard.  |        | N       |
| 7.2.7     | Leakage currents of equipment suitable for isolation  |        | ---     |
|           | For equipment suitable for isolation and having a rated operational voltage $U_e$ greater than 50 V, the leakage current shall be measured through each pole with the contacts in the open position.  |        | P       |
|           | The value of leakage current, with a test voltage equal to 1,1 times the rated operational voltage shall not exceed   |        | P       |
| 7.3       | Electromagnetic compatibility (EMC)   |        | ---     |
| 7.3.1     | General   |        | P       |
| 7.3.2     | Immunity  |        | P       |
| 7.3.2.1   | Equipment not incorporating electronic circuits   |        | N       |
| 7.3.2.2   | Equipment incorporating electronic circuits   |        | P       |
| 7.3.3     | Emission  |        | P       |
| 7.3.3.1   | Equipment not incorporating electronic circuits   |        | N       |
| 7.3.3.2   | Equipment incorporating electronic circuits   |        | P       |
| 7.3.3.2.1 | Limits for high-frequency emissions   |        | P       |
| 7.3.3.2.2 | Limits for low-frequency emissions  |        | P       |
| <b>8</b>  | <b>Tests</b>  |        | ---     |

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| Clause | Requirement - Test   | Result | Verdict |
|--------|--|--------|---------|
| 8.1    | Kinds of test  |        | ---     |
| 8.1.1  | General  |        | ---     |
| 8.1.2  | Type tests   |        | ---     |
|        | Type tests are intended to verify compliance of the design of a given equipment with this standard, where applicable, and the relevant product standard.   |        | P       |
|        | They may comprise, as appropriate, the verification of   |        | P       |
|        | – constructional requirements;   |        | P       |
|        | – temperature-rise;  |        | P       |
|        | – dielectric properties (see 8.3.3.4.1, where applicable);   |        | P       |
|        | – making and breaking capacities;  |        | P       |
|        | – short-circuit making and breaking capacities;  |        | P       |
|        | – operating limits;  |        | P       |
|        | – operational performance;   |        | P       |
|        | – degree of protection of enclosed equipment;  |        | P       |
|        | – tests for EMC.   |        | P       |
|        | The type tests to which the equipment shall be submitted, the results to be obtained, and, if relevant, the test sequences and the number of samples, shall be specified in the relevant product standard. |        | P       |
| 8.1.3  | Routine tests  |        | ---     |
|        | Routine tests are intended to detect faults in materials and workmanship and to ascertain proper functioning of the equipment. They shall be made on each individual piece of equipment.                   |        | N       |
|        | Routine tests may comprise   |        | N       |
|        | a) functional tests;   |        | N       |
|        | b) dielectric tests.   |        | N       |
|        | Details of the routine tests and the conditions under which they shall be made shall be stated in the relevant product standard.   |        | N       |
|        | 8.1.4 Sampling tests   |        | ---     |
|        | If engineering and statistical analysis show that routine tests (on each product) are not required, sampling tests may be made instead, if so stated in the relevant product standard.                     |        | N       |

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| Clause    | Requirement - Test  | Result | Verdict |
|-----------|---|--------|---------|
|           | The tests may comprise  |        | N       |
|           | a) functional tests;  |        | N       |
|           | b) dielectric tests.  |        | N       |
|           | Sampling tests may also be made to verify specific properties or characteristics of an equipment, either on the manufacturer's own initiative, or by agreement between manufacturer and user. |        | N       |
| 8.2       | Compliance with constructional requirements   |        | ---     |
|           | The verification of compliance with the constructional requirements stated in 7.1 concerns, for example   |        | P       |
|           | – the materials;  |        | P       |
|           | – the equipment;  |        | P       |
|           | – the degrees of protection of enclosed equipment;  |        | P       |
|           | – the mechanical properties of terminals;   |        | P       |
|           | – the actuator;   |        | P       |
|           | – the position indicating device (see 2.3.18).  |        | P       |
| 8.2.1     | Materials   |        | ---     |
| 8.2.1.1   | Test of resistance to abnormal heat and fire  |        | ---     |
| 8.2.1.1.1 | Glow-wire test (on equipment)   |        | ---     |
|           | The glow-wire test shall be made according to clauses 4 to 10 of IEC 60695-2-10 and IEC 60695-2-11 under the conditions specified in 7.1.1.1.   |        | P       |
|           | For the purpose of this test, a protective conductor is not considered as a current-carrying part.  |        | P       |
| 8.2.1.1.2 | Flammability, hot wire ignition and arc ignition tests (on materials)   |        | P       |
|           | Suitable specimens of the material shall be subjected to the following tests:   |        | P       |
|           | a) flammability test, in accordance with IEC 60695-11-10;   |        | P       |
|           | b) hot wire ignition (HWI) test, as described in Annex M;   |        | P       |
|           | c) arc ignition (AI) test, as described in Annex M.   |        | P       |

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| Clause    | Requirement - Test  | Result | Verdict |
|-----------|---|--------|---------|
|           | The test c) is required only if the material is located within the 13 mm of arcing parts or live parts which are subject to loosening of connections. Materials located within 13 mm of arcing parts are exempt from this test if the equipment is subjected to make/break testing. |        | P       |
| 8.2.2     | Equipment   |        | ---     |
|           | Covered by the various subclauses of 8.2.   |        | P       |
| 8.2.3     | Enclosures for equipment<br>For the degrees of protection of enclosed equipment, see Annex C.   |        | P       |
| 8.2.4     | Mechanical properties of terminals  |        | N       |
| 8.2.5     | Verification of the effectiveness of indication of the main contact position of equipment suitable for isolation  |        | ---     |
|           | To verify the effectiveness of the indication of the main contact position as required by 7.1.6, all means of indication of contact position shall continue to function correctly after the operational performance type tests, and special durability tests if performed.          |        | P       |
| 8.2.5.1   | Condition of equipment for the tests  |        | ---     |
|           | The condition of the equipment for the tests shall be stated in the relevant product standard.  |        | P       |
| 8.2.5.2   | Method of test  |        | ---     |
| 8.2.5.2.1 | Dependent and independent manual operation  |        | ---     |
|           | The normal operation force F required at the extremity of the actuator to operate the equipment into the open position shall first be determined.   |        | P       |
|           | With the equipment in the closed position, the fixed and moving contacts of the pole for which the test is deemed to be the most severe shall be fixed together, for example, by welding.   |        | P       |
|           | The actuator shall be submitted to a test force of 3F but which, however, shall not be less than the minimum nor more than the maximum values given in Table 17, corresponding to the type of actuator.   |        | P       |
|           | The test force shall be applied without shock to the extremity of the actuator, for a period of 10 s, in the direction to open the contacts.  |        | P       |

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| Clause    | Requirement - Test  | Result | Verdict |
|-----------|---|--------|---------|
|           | The direction of the test force with respect to the actuator, as shown in Figure 16, shall be maintained throughout the test.   |        | P       |
| 8.2.5.2.2 | Dependent power operation   |        | ---     |
|           | With the equipment in the closed position, the fixed and moving contacts of the pole for which the test is deemed to be the most severe shall be fixed together, e.g. by welding.   |        | P       |
|           | The supply voltage to the power operator shall be applied at 110 % of its normal rated value to attempt to open the contact system of the equipment.  |        | P       |
|           | Three attempts to operate the equipment at 5 min intervals by the power operator shall be made, each for a period of 5 s, unless an associated protective device of the power operator limits the time to a shorter period.                       |        | P       |
|           | Verification shall be made to 8.2.5.3.2.  |        | P       |
| 8.2.5.2.3 | Independent power operation   |        | ---     |
|           | With the equipment in the closed position, the fixed and moving contacts of the pole for which the test is deemed to be the most severe shall be fixed together, e.g. by welding.   |        | N       |
|           | The stored energy of the power operator shall be released to attempt to open the contact system of the equipment.   |        | N       |
|           | Three attempts to operate the equipment by releasing the stored energy shall be made.   |        | N       |
|           | Verification shall be made to 8.2.5.3.2.  |        | N       |
| 8.2.5.3   | Condition of equipment during and after test  |        | ---     |
| 8.2.5.3.1 | Dependent and independent manual operation  |        | ---     |
|           | After the test, when the test force is no longer applied, the actuator being left free, the open position shall not be indicated by any of the means provided and the equipment shall not show any damage such as to impair its normal operation. |        | P       |
|           | When the equipment is provided with a means of locking in the open position, it shall not be possible to lock the equipment while the test force is applied.  |        | P       |
| 8.2.5.3.2 | Dependent and independent power operation   |        | P       |

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| Clause    | Requirement - Test   | Result | Verdict |
|-----------|--|--------|---------|
|           | During and after the test, the open position shall not be indicated by any of the means provided and the equipment shall not show any damage such as to impair its normal operation.   |        | P       |
|           | When the equipment is provided with means for locking in the open position, it shall not be possible to lock the equipment during the test.  |        | P       |
| 8.2.7     | Conduit pull-out test, torque test and bending test with metallic conduits   |        | N       |
| 8.3       | Performance  |        | ---     |
| 8.3.1     | Test sequences   |        | ---     |
|           | Where applicable, the relevant product standard shall specify the test sequences to which the equipment is to be submitted.  |        | P       |
| 8.3.2     | General test conditions  |        | ---     |
| 8.3.2.1   | General requirements   |        | ---     |
| 8.3.2.2   | Test quantities  |        | P       |
| 8.3.2.2.1 | Values of test quantities  |        | P       |
| 8.3.2.2.3 | Recovery voltage   |        | P       |
| 8.3.2.3   | Evaluation of test results   |        | P       |
| 8.3.2.4   | Test reports   |        | P       |
| 8.3.3     | Performance under no-load, normal load and overload conditions   |        | P       |
| 8.3.3.1   | Operation  |        | ---     |
|           | Tests shall be made to verify that the equipment operates correctly according to the requirements of 7.2.1.1.  |        | P       |
| 8.3.3.2   | Operating limits   |        | P       |
| 8.3.3.2.1 | Power operated equipment   |        | P       |
|           | It shall be verified that the equipment opens and closes correctly within the limiting values of the control quantities, such as voltage, current, air pressure and temperatures, specified in the relevant product standard. Tests are made with no current flowing through the main circuit, unless otherwise specified. |        | P       |
| 8.3.3.2.2 | Relays and releases  |        | ---     |

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| Clause    | Requirement - Test   | Result | Verdict |
|-----------|--|--------|---------|
|           | The operating limits of relays and releases shall comply with the requirements of 7.2.1.3, 7.2.1.4 and 7.2.1.5 and shall be verified according to the test procedure defined in the relevant product standard. |        | P       |
|           | For undervoltage relays and releases, see 7.2.1.3.   |        | P       |
|           | For shunt releases, see 7.2.1.4.   |        | N       |
|           | For current operated relays and releases, see 7.2.1.5.   |        | N       |
| 8.3.3.3   | Temperature-rise   |        | P       |
| 8.3.3.3.1 | Ambient air temperature  |        | P       |
| 8.3.3.3.2 | Measurement of the temperature of parts  |        | P       |
| 8.3.3.3.3 | Temperature-rise of a part   |        | P       |
| 8.3.3.3.4 | Temperature-rise of the main circuit   |        | P       |
|           | The equipment shall be mounted as specified in 8.3.2.1 and shall be protected against abnormal external heating or cooling.  |        | P       |
| 8.3.3.3.5 | Temperature-rise of control circuits   |        | P       |
|           | The temperature-rise tests of control circuits shall be made with the specified current and, in the case of a.c., at the rated frequency. Control circuits shall be tested at their rated voltage.             |        | P       |
| 8.3.3.3.6 | Temperature-rise of coils of electromagnets  |        | P       |
| 8.3.3.3.7 | Temperature-rise of auxiliary circuits   |        | P       |
| 8.3.3.4   | Dielectric properties  |        | ---     |
| 8.3.3.4.1 | Type tests   |        | ---     |
|           | 1) General conditions for withstand voltage tests  |        | P       |
|           | 2) Verification of impulse withstand voltage   |        | P       |
|           | 3) Power-frequency withstand verification of solid insulation  |        | P       |
|           | 4) Power-frequency withstand verification after switching and short-circuit tests  |        | P       |
|           | 7) Verification of creepage distances  |        | P       |
|           | 8) Verification of leakage current of equipment suitable for isolation   |        | P       |
| 8.3.3.4.2 | Routine tests  |        | ---     |
|           | 1) Impulse withstand voltage   |        | N       |

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| Clause    | Requirement - Test   | Result | Verdict |
|-----------|--|--------|---------|
|           | 2) Power-frequency withstand voltage   |        | N       |
|           | 3) Combined impulse voltage and power-frequency withstand voltage                      |        | N       |
|           | 4) In no case the application of the metal foil according to 8.3.3.4.1 1) is required. |        | N       |
|           | 8.3.3.4.3 Sampling tests for verification of clearances                                |        | N       |
|           | 1) General   |        | N       |
|           | 2) Test voltage  |        | N       |
|           | 3) Application of test voltage   |        | N       |
|           | 4) Acceptance criteria   |        | N       |
| 8.3.3.4.4 | Tests for equipment with protective separation   |        | N       |
| 8.3.3.5   | Making and breaking capacities   |        | P       |
| 8.3.3.5.1 | General test conditions  |        | P       |
| 8.3.3.5.2 | Test circuit   |        | P       |
| 8.3.3.5.3 | Characteristics of transient recovery voltage  |        | P       |
| 8.3.3.5.5 | Test procedure for making and breaking capacities                                      |        | P       |
| 8.3.3.5.6 | Behaviour of the equipment during and after making and breaking capacity tests         |        | P       |
| 8.3.3.6   | Operational performance capability   |        | P       |
| 8.3.3.7   | Durability   |        | P       |
| 8.3.3.7.1 | Mechanical durability  |        | P       |
| 8.3.3.7.2 | Electrical durability  |        | P       |
| 8.3.4     | Performance under short-circuit conditions   |        | P       |
| 8.3.4.1   | General conditions for short-circuit tests   |        | P       |
| 8.3.4.1.1 | General requirements   |        | P       |
| 8.3.4.1.2 | Test circuit   |        | P       |
| 8.3.4.1.3 | Power-factor of the test circuit   |        | P       |
| 8.3.4.1.4 | Time-constant of the test circuit  |        | P       |
| 8.3.4.1.5 | Calibration of the test circuit  |        | P       |
| 8.3.4.1.6 | Test procedure   |        | P       |
| 8.3.4.1.7 | Behaviour of the equipment during short-circuit making and breaking tests              |        | P       |
| 8.3.4.1.8 | Interpretation of records  |        | P       |
| 8.3.4.1.9 | Condition of the equipment after the tests   |        | P       |
| 8.3.4.2   | Short-circuit making and breaking capacities   |        | P       |

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|----------|--|--------|---------|
| 8.3.4.3  | Verification of the ability to carry the rated short-time withstand current  |        | P       |
| 8.3.4.4  | Co-ordination with short-circuit protective devices and rated conditional short-circuit current  |        | P       |
| 8.4      | Tests for EMC  |        | P       |
| 8.4.1    | Immunity   |        | P       |
| 8.4.1.1  | Equipment not incorporating electronic circuits  |        | N       |
| 8.4.1.2  | Equipment incorporating electronic circuits  |        | P       |
| 8.4.2    | Emission   |        | P       |
| 8.4.2.1  | Equipment not incorporating electronic circuits  |        | N       |
| 8.4.2.2  | Equipment incorporating electronic circuits  |        | P       |
| <b>A</b> | <b>Annex A (informative)</b><br><b>Examples of utilization categories for low-voltage switchgear and controlgear</b>                               |        | ---     |
| <b>B</b> | <b>Annex B (informative)</b><br><b>Suitability of the equipment when conditions for operation in service differ from the normal conditions</b>     |        | ---     |
| B.1      | Examples of conditions differing from normal   |        | N       |
| B.1.1    | Ambient air temperature  |        | N       |
| B.1.2    | Altitude   |        | N       |
| B.1.3    | Atmospheric conditions   |        | N       |
| B.1.4    | Conditions of installation   |        | N       |
| B.2      | Connections with other apparatus   |        | N       |
| B.3      | Auxiliary contacts   |        | N       |
| B.4      | Special applications   |        | N       |
| <b>C</b> | <b>Annex C (normative)</b><br><b>Degrees of protection of enclosed equipment</b>   |        | ---     |
|          | Introduction   |        | ---     |
| C.1      | Scope  |        | P       |
| C.2      | Object   |        | P       |
| C.3      | Definitions  |        | P       |
| C.4      | Designation  |        | P       |
| C.5      | Degrees of protection against access to hazardous parts and against ingress of solid foreign objects indicated by the first characteristic numeral |        | P       |

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|----------|---|--------|---------|
| C.6      | Degrees of protection against ingress of water indicated by the second characteristic numeral               |        | P       |
| C.7      | Degrees of protection against access to hazardous parts indicated by the additional letter                  |        | P       |
| C.8      | Supplementary letters   |        | P       |
| C.9      | Examples of designations with IP Code   |        | P       |
| C.10     | Marking   |        | P       |
| C.11     | General requirements for tests  |        | P       |
| C.11.1   | Clause 11.1 of IEC 60529 applies.   |        | P       |
| C.11.2   | Clause 11.2 of IEC 60529 applies with the following additions:  |        | P       |
| C.11.3   | Subclause 11.3 of IEC 60529 applies with the following addition:  |        | P       |
| C.11.4   | Clause 11.4 of IEC 60529 applies.   |        | P       |
| C.11.5   | Where an empty enclosure is used as a component of an enclosed equipment, clause 11.5 of IEC 60529 applies. |        | P       |
| C.12     | Tests for protection against access to hazardous parts indicated by the first characteristic numeral        |        | P       |
| C.13     | Tests for protection against ingress of solid foreign objects indicated by the first characteristic numeral |        | P       |
| C.13.4   | Dust test for first characteristic numerals 5 and 6   |        | N       |
| C.13.5.2 | Acceptance conditions for first characteristic numeral 5  |        | N       |
| C.14     | Tests for protection against water indicated by second characteristic numeral                               |        | P       |
| C.14.1   | Subclause 14.1 of IEC 60529 applies.  |        | P       |
| C.14.2   | Subclause 14.2 of IEC 60529 applies.  |        | P       |
| C.14.3   | Subclause 14.3 of IEC 60529 applies with the following addition:  |        | P       |
| C.15     | Tests for protection against access to hazardous parts indicated by additional letter                       |        | P       |
| C.16     | Summary of responsibilities of relevant technical committees  |        | P       |
| <b>D</b> | <b>Annex D (informative)</b><br><b>Examples of terminals</b>  |        | ---     |

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| Clause   | Requirement - Test  | Result | Verdict |
|----------|---|--------|---------|
| <b>E</b> | <b>Annex E (informative)</b><br><b>Description of a method for adjusting the load circuit</b>   |        | --      |
|          | To adjust the load circuit to obtain the characteristics prescribed above, several methods may be applicable in practice. One of them is described below.   |        | N       |
| <b>F</b> | <b>Annex F (informative)</b><br><b>Determination of short-circuit power-factor or time-constant</b>   |        | ---     |
|          | There is no method by which the short-circuit power-factor or time-constant can be determined with precision, but for the purpose of this standard, the determination of the power-factor or the time-constant of the test circuit may be made by one of the following methods. |        | P       |
| F.1      | Determination of short-circuit power-factor   |        | P       |
| F.2      | Determination of short-circuit time-constant (oscillographic method)  |        | P       |
| <b>G</b> | <b>Annex G (informative)</b><br><b>Measurement of creepage distances and clearances</b>   |        | ---     |
| G.1      | Basic principles<br>The widths X of grooves specified in examples 1 to 11 basically apply to all examples as a function of pollution as follows:  |        | P       |
| G.2      | Use of ribs   |        | P       |
|          | Because of their influence on contamination and their better drying-out effect, ribs decrease considerably the formation of leakage current.  |        | P       |
|          | Creepage distances can therefore be reduced to 0,8 of the required value provided the minimum height of the ribs is 2 mm.   |        | P       |
| <b>H</b> | <b>Annex H (informative)</b><br><b>Correlation between the nominal voltage of the supply system and the rated impulse withstand voltage of equipment</b>  |        | ---     |
|          | INTRODUCTION<br>This annex is intended to give the necessary information concerning the choice of equipment for use in a circuit within an electrical system or part thereof.   |        | P       |
| <b>J</b> | <b>Annex J (informative)</b><br><b>Items subject to agreement between manufacturer and user</b>   |        | ---     |
| <b>L</b> | <b>Annex L (normative)</b><br><b>Terminal marking and distinctive number</b>  |        | ---     |

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| Clause   | Requirement - Test   | Result | Verdict |
|----------|--|--------|---------|
| L.1      | General  |        | N       |
| L.2      | Terminal marking of impedances (alphanumeric)  |        | N       |
| L.2.1    | Coils  |        | N       |
| L.2.2    | Electromagnetic releases   |        | N       |
| L.2.3    | Interlocking electromagnets  |        | N       |
| L.2.4    | Indicating light devices   |        | N       |
| L.3      | Terminal marking of contact elements for switching devices with two positions (numerical)  |        | N       |
| L.3.1    | Contact elements for main circuits (main contact elements) L.3.2 Contact elements for auxiliary circuit (auxiliary contact elements) |        | N       |
| L.4      | Terminal marking of overload protection devices  |        | N       |
| L.5      | Distinctive number   |        | N       |
| <b>M</b> | <b>Annex M (normative)<br/>Flammability test</b>   |        | ---     |
| M.1      | Hot wire ignition test   |        | P       |
| M.2      | Arc ignition test  |        | P       |
| <b>N</b> | <b>Annex N (normative)<br/>Requirements and tests for equipment with protective separation</b>                                       |        | ---     |
| N.1      | General  |        | N       |
| N.2      | Definitions  |        | N       |
| N.3      | Requirements   |        | N       |
| N.3.1    | Dielectric requirements  |        | N       |
| N.3.1.1  | Creepages  |        | N       |
| N.3.1.2  | Clearances   |        | N       |
| N.3.2    | Construction requirements  |        | N       |
| N.4      | Tests  |        | N       |
| N.4.1    | General  |        | N       |
| N.4.2    | Dielectric tests   |        | N       |
| N.4.2.1  | Creepages verification   |        | N       |
| N.4.2.2  | Clearances verification  |        | N       |
| N.4.3    | Examples of constructional measures  |        | N       |
| <b>O</b> | <b>Annex O (informative)<br/>Environmental aspects</b>   |        | ---     |

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| Clause   | Requirement - Test   | Result | Verdict |
|----------|--|--------|---------|
|          | Introduction   |        | P       |
| O.1      | Scope  |        | P       |
| O.2      | Definitions  |        | P       |
| O.3      | General considerations   |        | P       |
| O.4      | Inputs and outputs to be considered  |        | P       |
| O.4.1    | General  |        | P       |
| O.4.2    | Inputs and outputs   |        | P       |
| O.4.3    | Inputs: materials and energy   |        | P       |
| O.4.4    | Outputs  |        | P       |
| O.5      | Techniques for identifying and assessing environmental impacts   |        | P       |
| O.5.1    | Accurate identification and assessment of how environmental impacts are influenced by products are complex and require careful consideration and may involve the need for consultation with experts. |        | P       |
| O.5.2    | One example of such techniques, life cycle assessment (LCA), is the subject of standardization by ISO/TC 207/SC 5 and in ISO 14040.  |        | P       |
| O.6      | Relevant ISO technical committees  |        | P       |
| O.7      | Guidance on environmental impact assessment (EIA) principles   |        | P       |
| O.8      | Guidance on design for environment (DFE) principles  |        | P       |
| O.9      | Reference documents  |        | P       |
| <b>P</b> | <b>Annex P (informative)</b><br><b>Terminal lugs for low voltage switchgear and controlgear connected to copper conductors</b>   |        | ---     |
| P.1      | Table P.1 – Examples of terminal lugs for low voltage switchgear and controlgear connected to copper conductors  |        | P       |

## Tables

| <b>ANNEX 1</b>    | <b>Components</b>          |            |                              |          | <b>P</b>                 |
|-------------------|----------------------------|------------|------------------------------|----------|--------------------------|
| object/part No.   | manufacturer/<br>trademark | type/model | technical data               | standard | mark(s) of<br>conformity |
| Plastic enclosure | Various                    | Various    | V-0                          | UL 94    | UL                       |
| PCB               | Various                    | Various    | V-1 or better,<br>105°C min. | UL 94    | UL                       |
|                   |                            |            |                              |          |                          |

| <b>7.2.2</b>                    | <b>TABLE: HEATING TEST, THERMOCOUPLES</b> |        |                 | <b>P</b> |
|---------------------------------|---|--------|-----------------|----------|
|                                 | room temperature t1 (°C) .....            | 19,9   |                 | ---      |
|                                 | room temperature t2 (°C) .....            | 19,9   |                 | ---      |
|                                 | test In (V) .....                         | 80A    |                 | ---      |
| temperature rise dT of part/at: |   | dT (K) | required dT (K) |          |
| Internal wire                   |   | 23.6   | 80              |          |
| Terminal                        |   | 25.8   | 50              |          |
| Enclosure                       |   | 16.0   | 50              |          |
| Connector                       |   | 26.7   | 50              |          |
| C5                              |   | 36.4   | 75              |          |
| C8                              |   | 36.2   | 75              |          |
| PCB                             |   | 30.5   | 105             |          |
| Solid Relay                     |   | 38.0   | Ref.            |          |
| K1                              |   | 33.6   | 85              |          |
| K2                              |   | 33.8   | 85              |          |
| C4                              |   | 32.0   | 75              |          |
|                                 |   |        |                 |          |

| <b>7.2.3.2</b>                        | <b>TABLE: DIELECTRIC TESTS</b> |                  | <b>P</b>              |
|---------------------------------------|--------------------------------|------------------|-----------------------|
| test voltage applied between:         |                                | Test voltage (V) | Breakdown<br>(Yes/No) |
| L and N                               |                                | 1500Vac          | No                    |
| L+N and accessible parts              |                                | 1500Vac          | No                    |
| Solid insulation of plastic enclosure |                                | 1500Vac          | No                    |
|                                       |                                |                  |                       |
|                                       |                                |                  |                       |

| <b>7.2.3.3</b> | <b>CLEARANCES</b> |                         | <b>P</b> |
|----------------|-------------------|-------------------------|----------|
|                |                   | Minimum clearances (mm) |          |

## Tables

| Description                                   | Rated impulse withstand voltage: | 2500V |
|---|----------------------------------|-------|
| 1. between separated live parts by open       | >2.0                             | >3.0  |
| 2. between live parts of different polarity   | >2.0                             | >3.0  |
| 3. between live parts and accessible surfaces | >2.0                             | >3.0  |
|   |                                  |       |

| <b>7.2.3.4</b>                                | <b>CREEPAGE DISTANCES</b>        | <b>P</b> |
|---|----------------------------------|----------|
|   | Minimum clearances (mm)          |          |
| Description                                   | Rated impulse withstand voltage: | 2500V    |
| 1. between separated live parts by open       | >3.0                             | >2.5     |
| 2. between live parts of different polarity   | >3.0                             | >2.5     |
| 3. between live parts and accessible surfaces | >3.0                             | >2.5     |
|   |                                  |          |

|  |                                   |                 |
|--|-----------------------------------|-----------------|
| <b>7.2.7</b>   | <b>TABLE: LEAKAGE CURRENT</b>     | <b>P</b>        |
|  | 1,1 times rated voltage (V) ..... | 264V            |
|  |                                   | ---             |
| leakage current I between:                               | I (mA)                            | Required I (mA) |
| through each pole with the contacts in the open position | 0.15                              | 1.5             |
|  |                                   |                 |
|  |                                   |                 |

|                   |                        |                       |            |         |
|-------------------|------------------------|-----------------------|------------|---------|
| 7.1.1.1           | TABLE: GLOW-WIRE TESTS |                       |            | P       |
| part              |                        | Test temperature (°C) | Ignition   | Remarks |
| Plastic enclosure |                        | 960                   | Yes (<10s) | P       |
|                   |                        |                       |            |         |
|                   |                        |                       |            |         |

**Photos**

SB-RLY8c16A-DN

**Photo 1**

- ☐ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☒ top
- ☐ bottom
- ☐ internal



**Photo 2**

- ☐ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☐ top
- ☒ bottom
- ☐ internal



**Photos**

**Photo 3**

- ☐ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☐ top
- ☐ bottom
- ☒ internal



**Photo 4**

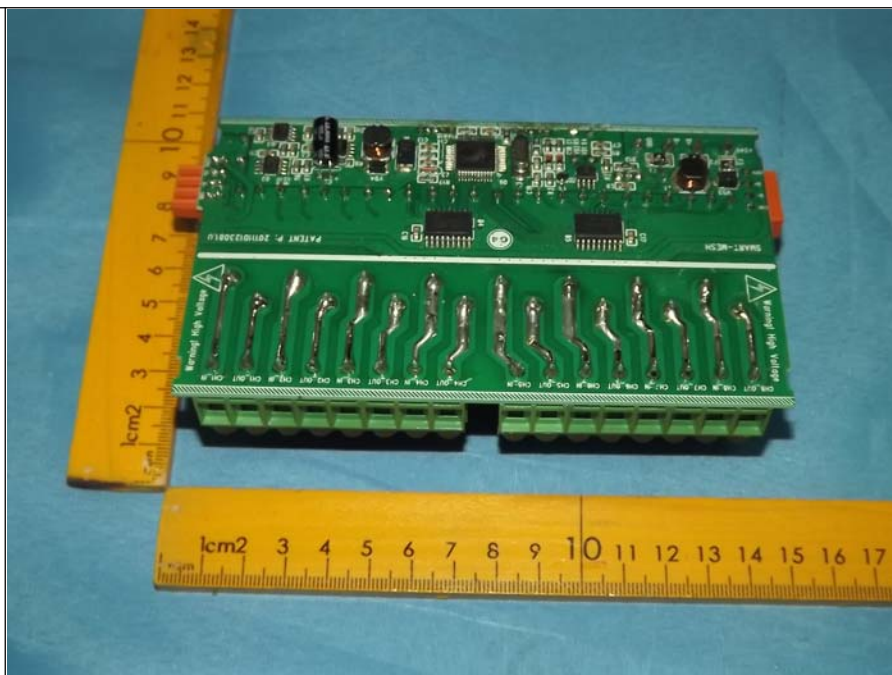
- ☐ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☐ top
- ☐ bottom
- ☒ internal



**Photos**

**Photo 5**

- ☒ front  
☐ rear  
☐ right side  
☐ left side  
☐ top  
☐ bottom  
☐ internal



SB-RLY4c20A-DN

**Photo 6**

- ☒ front  
☐ rear  
☐ right side  
☐ left side  
☒ top  
☐ bottom  
☐ internal



**Photos**

SB-RLY6c16A-DN

**Photo 7**

- ☒ front  
☐ rear  
☐ right side  
☐ left side  
☒ top  
☐ bottom  
☐ internal



**Photo 8**

- ☒ front  
☐ rear  
☐ right side  
☐ left side  
☒ top  
☐ bottom  
☐ internal



**Photos**

SB-RLY12c10A-DN

**Photo 9**

- ☒ front
- ☐ rear
- ☐ right side
- ☐ left side
- ☒ top
- ☐ bottom
- ☐ internal

