SPECIFICATION FOR LOW VOLTAGE SWITCHBOARD SEN

I N D E X

Description

GENERAL CHARACTERISTICS

1.1 STANDARDS
All Low-Voltage switchboards shall comply with Standard BS EN 60439-1, DIN VDE 0660 T.500 section 8.3, and all their electrical and operating characteristics shall be expressed in accordance to these standards.

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1.2 GENERAL OPERATIONAL CONDITIONS
The switchboards shall be for indoor installation, in environmental conditions showing a pollution degree 3 according to BS EN 60439-1.
The reference ambient temperature shall be 35ºC.
Relative humidity shall not exceed 50% at the reference ambient temperature.

1.3 GENERAL DESCRIPTION OF THE SWITCHBOARDS

1.3.1 Structure

- The panel structure shall be made of steel.
- Partition steel plates, fastened to the structure, shall divide the switchboard into compartments.
- The position of the partition steel plates shall be adjustable to easily adapt the height of the compartments in steps of 25mm.
- Each compartment shall be closed by an individual practicable steel door on the front, and by independent steel covers on the sides and back.
- Fully independent compartments shall be provided for:
    - Incoming section
    - Main Busbar
    - Cabling
    - Switch-gear
    - Metering and protections

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Extensions of the switchboard, by addition of similar structures, shall be possible both to the right and to the left of the initial structure.

1.3.2 Covers and doors

All accessible parts of the switchboard shall be conveniently earthed by their assembly means, and shall not require any supplementary specific Earthing lead.
When installed, covers and doors shall ensure a minimum IP30 degree of protection according to Standard BS EN 60529.

- **Side- and back-covers**

Side- and back-covers shall be flush-mounted on the structure by means of spacers and self-tapping screws, which shall ensure the Earthing of the covers.
For ease of maintenance, the covers shall be interchangeable and re-usable on any compartment of the same height.

- **Doors**

The doors shall be provided with internal hinges, ensuring the Earthing of the door.
The minimum opening angle of the door shall be 130 to 180 degrees.
The doors shall be pre-punched to accommodate at any time:

- Door locks
- Meters
- Plates for auxiliary components
- Louvers for ventilation

Doors for switchgear compartments shall be provided with an interlock, avoiding the opening of the door without previously switching-off the voltage supply to the compartment.
Doors for Busbar, cable and meter compartments shall be equipped with a lock, to avoid unauthorised access to the compartments.

1.3.3 Compartments

The different compartments formed by the partition plates, shall comply with the following conditions:

- **Incoming and Busbar compartments**
    - The incoming and the busbar compartments shall be separated from the other compartments by moulded plastic finger-proof shrouds.
    - The main Busbar compartment shall be located at the rear of the switchboard, in a top or middle position.
    - The Busbar compartment shall contain all phase and Neutral conductors, duly marked L1, L2, L3, and N.
    - Protective conductors shall be located in a separate compartment, and shall be duly marked PE or PEN.
    - The Busbar shall be made of flat copper bars, of the same cross-section over the whole width of the switchboard, and allow extensions of the switchboard both left and right.
    - All fixed connections shall be maintenance-free.
    - Separation links to adjacent columns shall be accessible from the front of the switchboard.
    - The Busbar shall be supported by insulators, made of flameproof and leakage-proof material
    - For rated currents of 630A and above, flat copper bars shall be used, both for the Busbar and for the in-coming and out-going feeders.

- **Cable compartment**
  - The cable compartment shall contain the out-going terminals for main and control circuits.
  - The cable compartment shall be located to the right of the switchboard.
  - The cable compartment shall be separated from the other compartments by metallic shutters providing a degree of protection of minimum IP20 according to Standard BS EN 60529, to avoid the accidental downfall of parts from upper compartments.
  - Out-going feeders shall have a degree of protection of minimum IP20 according to Standard BS EN 60529, to avoid accidental contacts
  - For out-going feeders of 630A and above, copper bars shall be provided as terminals, to allow the connection of several cables in parallel.
  - All connection terminals and cables shall be mounted in such a way as to avoid any traction or compression forces being exerted on them.
  - The bars and cable supports shall be designed to withstand the presumed short-circuit current.
  - Incoming and outgoing cables shall enter the compartment by the top and the bottom, with front and rear access provided to the connections.

- **Switch-gear and metering compartments**
  - Switch-gear and metering compartments shall be equipped with universal fixing plates, with holes in fixed steps allowing for the mounting of the different switch-gear and metering and protection components
  - Suitable incoming devices using breaker or fuse-switch technology with corresponding ratings and breaking capacity shall protect each switchgear compartment out-going feeder.
  - Meters and signal lamps shall be mounted on the hinged door of the compartment, which shall be pre-punched to accommodate standard instruments and signalling lamps and push buttons

1.3.4 Form of internal separation

Switchgear and metering compartments shall be separated from each other by finger-proof partitions. Busbar and cable compartments shall be separated from the switchgear and metering compartments by finger-proof partitions.
The manufacturer shall indicate the Form of separation of the compartments according to informative Annex D of Standard BS EN 60439, Form 4b being the minimum required.

1.3.5 Protection and finish

Protection against corrosion
- A zinc coating, providing protection against corrosion according to Standard EN 10142, shall protect all steel parts forming the structure.
- All ferrous parts e.g. hinges, mounting parts, shall be protected by an electro-galvanic zinc coating.

Protection shall be verified in accordance with Standard BS EN 50298.
Following tests shall be made:
- "Wet heat", 6 cycle 24hours with 95% relative humidity at 40ºC, according to Standard IEC 68-2-30
- "Salt fork", 2 cycle 24hours at 35ºC, according to Standard IEC 68-2-11

- **Finish**
  - Covers and doors shall be made of 2mm steel sheet to ensure stability
  - All edges shall be bent-over to avoid sharp edges
  - All external doors and covers shall be flush-mounted to the structure.
  - No hinges, fixing screws or bolts shall be visible from the front of the switchboard
  - All external parts shall show a uniform colour, preferably RAL 7035, applied through an epoxy powder painting of minimum 75 thickness.

2. ELECTRICAL CHARACTERISTICS

Switchboards shall be designed according to the following electrical characteristics:

- **Rated operational voltage Ue: 690V a.c.**
- **Rated insulation voltage Ui: 1000V**
- **Impulse withstand voltage: 8kV 1.2/50 s**
- **Rated frequency: 40-60Hz**
- **Minimum Rated short time withstand current Icw**
  For Busbars phase conductors with:
  - Rated currents up to 1000A: **50kA 1s**
  - Rated current 1250A: **65kA 1s**
  - Rated currents 1600A up to 4000A: **80kA 1s**
- **Minimum Peak withstand current Ipk**
  For Busbar phase conductors with:
  - Rated currents up to 1000A: **105kA$_{pk}$**
  - Rated current 1250A: **143kA$_{pk}$**
  - Rated currents 1600A up to 4000A: **176kA$_{pk}$**

- **Minimum Cross-sections for Neutral conductor:**
  Busbars with phase conductors with rated currents:
  - Up to 1250A: **300mm^2**
  - 1600A & 2000A: **400mm^2**
  - 2500A & 3200A: **800mm^2**
  - 4000A: **1200mm^2**

- **Minimum Cross-sections for PE or PEN conductors:**
  Busbars with phase conductors with rated currents:
  - Up to 1000A **300mm^2**
  - Over 1000A **400mm^2**

3. TESTING AND CERTIFICATION

Upon delivery, the manufacturer of the switchboard shall carry out tests with the fully equipped switchboard, according to the relevant Standards indicated below.
For each of the tests, the manufacturer, indicating the results of the tests, shall provide a valid certification.

3.1 TESTS ACCORDING TO BS EN 60439-1

3.1.1 Type tests made according to clause 8.2

- **Verification of temperature-rise limits** (clause 8.2.1)
  Maximum temperature-rise with fully loaded compartments shall not exceed the values indicated in Table 2 of BS EN 60439-1.

- **Verification of the dielectric properties** (clause 8.2.2)
  Test Voltage for main circuits shall be 3500V a.c. r.m.s.
  Test voltage for auxiliary circuits shall be 1500V a.c. r.m.s
  Test voltage for the Impulse voltage withstand test shall be 8kV 1.2/50 s
  Clearance and creepage distances shall be in accordance with Tables 14 & 16 of Standard BS EN 60439-1.
  There shall be no unintentional disruptive discharge during the tests
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- **Verification of short-circuit withstand strength** (clause 8.2.3)
  Test current for **short-circuit withstand current Icw** shall be at least;
  For Busbars phase conductors with:
  - Rated currents up to 1000A: **50kA$_{rms}$ 1s**
  - Rated current 1250A: **65kA$_{rms}$ 1s**
  - Rated currents 1600A up to 4000A: **80kA$_{rms}$ 1s**

  Test current for **impulse withstand current Ipk** for shall be at least,
  For Busbar phase conductors with:
  - Rated currents up to 1000A: **105kA$_{pk}$**
  - Rated current 1250A: **143kA$_{pk}$**
  - Rated currents 1600A up to 4000A: **176kA$_{pk}$**

During the tests for short-circuit withstand strength, we have verified:

- That Busbar-compartment doors and covers remained closed during the test,
- That full arc containment is achieved.

An accredited laboratory shall provide the certificate for the results of these tests.

- **Verification of the effectiveness of the protective circuit** (clause 8.2.4)
  All parts of the switchgear combinations shall be effectively connected to the protective conductor, and this connection shall show a resistance below 0.1Ohm.
  After the test for the verification of short-circuit withstand strength of the protective circuit, the protective conductor shall not be impaired.
- **Verification of clearance and creepage distances** (clause 8.2.5)
  It shall be verified that clearance and creepage distances are in accordance with Tables 14 & 16 of Standards BS EN 60439-1, considering a pollution degree 3.
  Minimum values for creepage and clearances combinations shall be used when dielectric properties are tested.
  Withdrawable assemblies, if any, shall additionally endure dielectric tests in their “test” and “disconnected” positions.

- **Verification of Mechanical operation** (clause 8.2.6)
  A minimum of 50 mechanical operations shall be made on the mechanical functions of individual components and groups after installation into the assembly. At the same time, the operation of the functions of coupled & interlocking devices and mechanisms shall be checked.
  After the testing is complete the apparatus, interlocks, etc., shall operate properly and practically the same as before the test.

- **Verification of the degree of protection** (clause 8.2.7).
  The degree of protection shall be verified according to BS EN 60529.

- **EMC tests** (clause 8.2.8)
  Only components complying with EMC requirements shall be used within the assembly.
  If exceptionally required, the manufacturer shall provide a CE Declaration of Conformity, no further testing being required.

3.1.1 Routine tests (clause 8.3)

For the fully assembled and installed switchboard, the following routine tests shall be carried out:

- **Checking of Assembly, wiring & electrical operations** (clause 8.3.1)
- **Dielectric test** (clause 8.3.2)
- **Checking of protective measures & electrical circuits** clause 8.3.3)
- **Verification of insulation resistance** (clause 8.3.4)

Before commissioning the switchboard, the manufacturer, or the installer acting on his behalf, shall issue a compliance certificate stating all these routine tests having been made with positive results.

3.2 TESTS ACCORDING TO OTHER STANDARDS

Where required, for specific functions or components built into the switchboard, specific compliance certificates may be required from the manufacturer.
In particular, compliance to the following Standards may be required:

- BS EN 60204-1 Electrical equipment for industrial machines
- BS EN 60364-4-41 Preventive Measures.
- BS EN 60529 Ingress Protection
- BS EN 60664-1 Isolation Co-ordination.
- BS EN 60947-4-1 Motor Starters with Co-ordinated Short Circuit Protection, with voltage ranges & product ratings to VDE 0106 T100 (BGV A2) Type 2 coordinated.

4. INSTRUCTIONS FOR INSTALLATION, OPERATION AND MAINTENANCE

The manufacturer shall specify in his documents or catalogues the conditions for the installation, operation and maintenance of the assembled switchboard and the equipment therein.
These documents may also include the recommended extent and frequency of maintenance, and a list of recommended spares for the switchboard and equipment therein.