

SPECIFICATION FOR LOW VOLTAGE AIR CIRCUIT BREAKERS M-PACT

I N D E X

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1. GENERAL CHARACTERISTICS

1.1 Standards

All Low-Voltage circuit breakers shall use air as insulating means ("Air circuit breakers", ACB) and comply with IEC Standard 947-1, 947-2 (BS EN 60947-2) and 947-3. All their electrical and operating characteristics shall be expressed in accordance with these standards.

1.2 General operational conditions

The reference ambient temperature shall be 40°C.

1.3 General characteristics of the circuit breakers

- 1.3.1 The operating mechanisms of the circuit breakers shall be of the "stored-energy quick-make" and "free-trip" type. They shall ensure "positive on" and "positive off" indications.
- 1.3.2 Their Thermal Rated Current **I_{th}** shall be at least equivalent to the nominal current of the circuits they have to protect,
- 1.3.3 Their Rated Operating Voltage **U_e** shall be at least equivalent to the rated voltage of the installation
- 1.3.4 Their Rated Insulation Voltage **U_i** shall be at least 750V AC.
- 1.3.5 Their Service Breaking Capacity **I_{cs}** shall be at least equivalent to the maximum presumed three-phase short-circuit current which may occur on their out-going terminals.
- 1.3.6 Their Rated Making Capacity **I_{cm}** shall allow the breakers to be closed on the maximum presumed three-phase short-circuit which may occur on their out-going terminals
- 1.3.7 In order to ensure discrimination, all breakers of ratings above 630 Amp shall be of **Category B**. Their short-circuit current withstand capacity **I_{cw}** for 1 second shall be at least equal to the current corresponding to their Service Breaking Capacity **I_{cs}**.

2. PROTECTIONS TO BE PROVIDED BY THE ACB

The ACB shall provide protection against overloads, short-circuits, and, for specific breakers, Ground Fault Protection.

All ACB of rated currents above 160 Amp shall be equipped with solid-state trip units, not requiring any external auxiliary supply source for short-circuit and overload protection.

All settings shall be programmable on the field, without the use of any external device.

A means of connection shall be provided for an external test device, allowing for periodical tests of the status of the electronics of the trip unit.

To avoid un-authorized tampering, the trip unit shall be sealable once adjusted (key-lock, or seal), behind a transparent door or plate, allowing the settings to be visible.

2.1 Protection against over-loads ("Long Time" protection LT and LTD)

- 2.1.1 The curve shall be of the inverse time/current type
- 2.1.2 To be adapted to the loads to be protected, the setting current **I_r** of the LT protection shall be adjustable by steps between 0.4 and 1.0 times the rated current **I_n** of the ACB.
- 2.1.3 The LT protection shall be adjustable by steps, allowing for curve- types adapted to line- or motor-protection.
- 2.1.4 A "pre-alarm" device shall be provided, to allow eventual load-shedding before an overload trip occurs.
- 2.1.5 A "thermal memory" shall be provided, adjustable to the type of load to be protected.

2.2 Protection against short circuits

- 2.2.1 Delayed short-circuit protection **ST**: to allow discrimination with down-stream breakers, a delayed short-circuit protection shall be provided, with thresholds adjustable by steps, and ranging from 1.5 to 12 times **I_r**. The delay of this ST protection shall be adjustable from 0.1 to 1 second
- 2.2.2 Instantaneous short-circuit protection **I**: an instantaneous short-circuit protection shall be provided, over-riding the ST protection, with its threshold adjusted to the current corresponding to the maximum breaking capacity of the ACB.

2.3 Ground Fault Protection

- 2.3.1 ACB for specific Ground Fault Protection **GF** shall be equipped, next to the overload and short-circuit protections, with trip units ensuring Restricted-, Unrestricted- or Stand-by-earth fault protection (UEF, REF, SDF, to be defined on wiring diagrams).
- 2.3.2 UEF and SEF protections shall include an I^2t sensing device, allowing for an adjustable delay in the tripping time, to ensure discrimination with other down-stream ACB.

2.4 Over-ride protection and self-protection of the trip unit

- 2.4.1 Closing on a short-circuit, the breaker shall trip ("trip-free") instantaneously. A specific "over-ride" protection, independent of the trip unit, shall ensure the trip when closing the ACB onto a short-circuit. This "over-ride" trip shall be un-operative if the short-circuit occurs with the breaker already in its closed position.
- 2.4.2 The solid-state trip unit shall be self-protected, and ensure the trip of the ACB in case of its malfunction. It shall enclose an "excess temperature" device and signal, which shall trip the breaker if the temperature inside its installation cubicle reaches a temperature, which may damage the ACB or the trip unit.

3. MONITORING AND SIGNALLING

The ACB shall be equipped with the following monitoring and signalling devices.

3.1 "Dry" Auxiliary and bell-alarm contacts on the ACB

- 3.1.1 Each ACB shall be equipped with a minimum of **5 free NO** and **3 free NC** auxiliary contacts, operating simultaneously with the ACB and able for 10 Amp and 250V a.c.
- 3.1.2 Each ACB shall be equipped with at least **1 NO** "bell-alarm" contact, which will be operated only when the breaker will trip on fault. This contact will only recover its open position after the reset operation of the ACB.
- 3.1.3 Each ACB shall be equipped with both a local indicator and an auxiliary contact indicating "springs charged" when its closing mechanism is ready for operation.

3.2 Alarm contacts on the Trip Unit

- 3.2.1 The trip unit shall have distinct local signalisations on its front part, showing its status :
 - in-service
 - Over-load pre-alarm (current 1.1I_r, 60% of thermal memory consumed)
 - Tripped on over-load
 - Tripped on ST-protection
 - Tripped on I-protection
 - Trip unit malfunction.
- 3.2.2 The trip unit shall provide 3 out-put signals, indicating:
 - pre-trip alarm (current 1.1I_r, 60% of thermal memory consumed)
 - tripped on external fault (overload or short-circuit)
 - "load-shedding required" alarm
- 3.2.3 The trip unit shall also provide an out-put signal for "trip unit malfunction":.

3.3 Monitoring devices

- 3.3.1 A display shall show:
 - the current flowing through the ACB (phase by phase)
 - the number of mechanical operations of the ACB
- 3.3.2 The trip unit shall keep a record of up to the last 16 trips
- 3.3.3 The trip unit shall have at least 4 inputs for external tripping signals, allowing the ACB to be remotely tripped.

3.4 Communication

- 3.4.1 The trip unit shall be able to communicate bi-directionally, via an RS485 serial connection and MODBUS protocol
- 3.4.2 Out-put signals shall at least be able to communicate the signals a.m. in 3.2.2, 3.2.3, 3.3.1 and 3.3.2.

4. OPERATION OF THE ACB

4.1. Closing of the ACB

All ACB shall be equipped with a "stored energy" closing mechanism

4.1.1 **Local operation:** the springs required to store the closing energy shall be charged by means of a charging handle. The "close" operation will be carried out by means of the same charging handle, or by a green-painted push-button clearly marked "ON"

4.1.2 **Remote operation** (for ACB with remote control only): an electrical motor shall charge the springs required to store the closing energy. The spring-charging shall not take more than 4 seconds. The ACB shall not initiate any "close" operation before its springs are fully charged. The remote "close" order will be transmitted by means of a closing magnet, requiring a pulse time of maximum 50 milliseconds.
In order to allow quick replacement and adaptation to a different voltage, the closing coil shall be easily accessible from the front of the ACB, and require no tools for its replacement ("snap-on")

4.2 Opening the ACB

4.2.1 **Local operation:** the ACB shall be opened by means of its operating handle, or by a red push-button clearly marked "OFF"

4.2.2 **Remote operation:** The ACB shall be opened remotely by means of a shunt-trip coil, able to operate with voltages equal or above 70% of its rated voltage. The minimum pulse time in order to ensure its proper operation shall be of a minimum of 50 milliseconds.

The Shunt-trip coil shall be easily accessible from the front of the ACB, and require no tools for its replacement ("snap-on")

5. INSTALLATION OF THE ACB

The ACB shall be installed in appropriate cubicles inside the Switchboard, with the appropriate Busbars or cables, recommended by the manufacturer of the ACB for its nominal rated current. Dimensions and ventilation of the cubicle shall be sufficient to dissipate the heat generated by the ACB at its nominal rated current.

5.1 Clearance distances

The ACB shall not require any clearance distances around its own physical dimensions, even if the cubicle walls are not covered with insulating materials,

5.1.1 **Fixed ACB:** Necessary space for the inspection and eventual replacement of the arc-chutes shall be provided above the ACB.

Terminal blocks of the auxiliary circuits terminals shall be easily accessible from the front of the ACB for wiring.

5.1.2 **Withdrawable ACB:** the ACB for mains incoming feeders, and for feeders out-going from the Busbars, shall be of the withdraw type.

They shall comply with the following supplementary characteristics:

5.1.2.1 The moving part of the ACB shall have 4 positions inside its fixed part:

- a) "Inserted", with main and auxiliary circuits connected.
- b) "Test", with main circuits isolated, and auxiliary circuits connected
- c) "Withdrawn", with main and auxiliary circuits disconnected
- d) "Extracted" (only for dismounting)

- Except in position a), shutters will automatically close the access to the live parts of the mains at the rear of the ACB..

Positions b) and c) shall not require the opening of the cubicle door.

- the ACB shall automatically go into its "tripped" position and open its contacts, and remain open, as long as the withdraw handle is inserted in the withdraw mechanism.

5.1.2.2 The withdrawable mechanism shall be an integral part of the fixed part of the ACB, and the extraction handle will be stored in a convenient space inside this fixed part. The mechanism shall allow an easy withdrawable operation, and give a clear indication of the positions of the ACB inside the fixed part.

5.1.2.3 The fixed part of the withdraw ACB shall be a metallic enclosure. No clearance distances shall be required to any side or to the top of this enclosure, even when installed in a non-insulated cubicle in the Switchboard.

- 5.1.2.4 An auxiliary NO/NC contact inside the fixed part shall allow a remote signalling of the position of the movable ACB inside its fixed part. This contact shall be able to operate 10 Amps and 250V A.C.
- 5.1.2.5 All accessory wiring will be automatically connected/disconnected on inserting/withdrawing the moving part of the ACB.
- 5.1.2.6 To reduce the number of spare ACB, and allow minimum down-time, the fixed part shall have a memory device, storing all the parameters of its movable part, down-loading them automatically into the replacement ACB as soon as it is placed into the movable part and reaches the "test" position.

6. SUPPLEMENTARY SAFETY DEVICES

To ensure highest safety for the operating personnel, the ACB shall be equipped with the following supplementary safety devices:

6.1 **Busbar in- and out-going feeders:** the corresponding ACB shall be equipped with a Castell-type key-lock, allowing to lock the ACB in its "open" position, the insertion of the key being mandatory to be able to close the ACB.

6.2 For withdraw ACB:

- a key-lock shall be provided to lock the ACB in its withdrawn position, the insertion of the key being mandatory to move the movable part into its "inserted" position.
- a padlocking device shall be provided for the shutters, to lock them in the "shutters closed" position whenever the movable part of the ACB is in one of its positions b), c) or d) mentioned in point 5.1.2.1. To avoid any erroneous insertion operation with shutters closed, the padlocking device shall be in a visible place on the front panel of the ACB, next to the withdrawing handle.
- A mechanical mis-insertion device shall be provided to avoid the erroneous insertion of a movable part of a different rating into the fixed part..