INTERPLANT STANDARD - STEEL INDUSTRY		
IPSS	**SPECIFICATION FOR MOULDED - CASE CIRCUIT-BREAKER FOR VOLTAGES NOT EXCEEDING 1000 V ac OR 1500 V dc (*FIRST REVISION*)**	**IPSS:1-04-004-11**
	BASED ON IS/IEC 60947(Part 2):2003	*Fomerly :* IPSS:1-04-004-82

0. FOREWORD

0.1 This Inter Plant Standard has been prepared by the Standards Committee on Switch Gears and Control Gears, IPSS 1:4 with the active participation of the representatives of all the steel plants/units, reputed consulting organizations and established manufacturers of circuit-breakers, and was adopted in November 2011.

0.2 Interplant Standards for steel industry primarily aim at achieving rationalization and unification of parts and sub-assemblies used in steel plant equipment and accessories, and provide guidance in indenting stores or equipment for existing or new installations by individual steel plants. For exercising effective control on inventories, it is advisable to select a fewer number of sizes (or types) from among the products mentioned in this standard for the purpose of company standards of individual steel plants. It is not desirable to make deviations in technical requirements.

0.3 In the preparation of this standard, assistance has been derived from the following:

a) IS/IEC 60947(Part 2):2003 `Low voltage switchgear & controlgear – Part 2 : Circuit Breakers

1. SCOPE

1.1 This Interplant Standard, which covers the requirements of manually operated 2, 3 and 4-pole moulded- case circuit-breakers for use on voltages not exceeding 1000 V ac at a frequency of 50 Hz or 1200 1500V dc, is generally based on IS/IEC 60947(Part 2):2003 `Low voltage switchgear & controlgear – Part 2 : Circuit Breakers.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IEC 60050(44 1): 1984, International Electrotechnical Vocabulary (IEV) – Chapter 441:Switchgear, controlgear and fuses shall apply.

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3. SERVICE CONDITIONS

3.1 The service conditions for the moulded-case circuit-breakers shall be as given in **Appendix A**.

4. PHYSICAL DIMENSIONS

4.1 The dimensions of the circuit-breakers shall be kept to the minimum in conformity with the adequacy of the rating of the breaker.

5. FRAME SIZE

5.1 The moulded- case circuit-breakers shall be classified by the frame size in relation to the rated continuous current as indicated in **Table-A**.

6. RATED OPERATIONAL VOLTAGE

6.1 The circuit-breaker shall have suitable rating for the following application voltage ratings:

a) 415 V ac,
b) 690 V ac,
c) 220 V dc, and
d) 460 V dc

7. RATED SERVICE BREAKING CAPACITY

7.1 The rated breaking capacity of moulded- case circuit-breaker shall be as given in Table . A

8. NUMBER OF TRIPPING ELEMENTS

8.1 Each pole of the circuit-breaker shall be provided with its own tripping elements for overload and short-circuit protection. Common trip bar mechanism shall allow simultaneous operation of all the three poles.

9. CONSTRUCTION

9.1 General Construction - The moulded- case circuit-breaker shall be of robust construction made from superior quality heat resistant insulating materials and shall comply with the following requirements:

a) The terminals shall be suitable for terminating aluminium cables with lugs conforming to IS 8309: 1993 `Specification for compression type tubular terminal ends for aluminium conductors of insulated cables'. Wherever required, suitable busbar extensions along with phase barriers to be supplied by the manufacturers for terminating aluminium cables.

b) Live parts shall be adequately protected and covered to avoid any accidental contact - Terminal block shall have phase barrier/shrouds made of non hygroscopic insulating materials.

c) All parts/components including the insulating materials to be incorporated in the moulded- case circuit-breaker shall be of adequate design and strength for giving satisfactory performance without suffering damage under sustained operating conditions, which would render the moulded- case circuit-breaker unserviceable.

d) The front cover of the moulded- case circuit-breaker shall be fixed with screws to facilitate inspection maintenance of internal components replacement of accessories.

e) The operating mechanism and the tripping device for the moulded-case circuit-breaker shall be provided within the moulded case. The moulded- case circuit-breaker shall be capable of being switched `OFF/ON' by manual operation and also capable of automatically breaking the circuit by tripping on account of overload or short-circuit faults.

f) The moulded- case circuit breakers shall be fast acting and operating time shall be as per characteristic curves, fixed / adjustable setting.

g) MCCBs shall indicate suitably for isolation and this should appear clearly with its symbol on MCCBs as specified in IS /IEC60947.

10. OPERATING MECHANISM

The operating mechanism shall comply with the following:

a) All the poles of the moulded- case circuit-breaker shall be operated simultaneously.

b) The tripping device provided in the moulded- case circuit-breaker shall be fixed/adjustable type, but preferably of adjustable type. It shall not be possible to have access to the calibrating mechanism of the tripping device without opening the front cover so as to prevent tampering with the calibrating mechanism by unauthorized persons.

c) The moulded- case circuit-breaker shall be so designed that in frame sizes larger than 100 A, the over-current tripping device (overload and short-circuit) can be changed/replaced by the over-current tripping device of desired rating available for the particular frame size.

d) The screws or nuts fitted particularly to the moving parts of the breaker shall be so provided as to prevent slackening due to vibrations in the course of operation or due to the mounting situation of the moulded- case circuit-breaker.

e) Locking arrangement shall be provided in the OFF position to prevent inadvertent closing of the breaker.

f) The operating mechanism shall have quick make and quick break and trip free feature.

10.1 **On and Off Indication** - The moulded- case circuit-breaker shall clearly indicate ON/OFF and trip positions. MCCB shall not be able to be switched on, unless it is put in `OFF' position first.

10.2 **Operating Devices** - The moulded- case circuit-breaker shall be capable of being operated manually through the operating knob and door operating device if provided, will offer as a standard door inter-locking and pad locking facility to ensure safety of operating personnel during maintenance.

10.2.1 The moulded- case circuit-breaker shall have thermo-magnetic or static releases or micro-processor based for overload and short circuit protection in adjustable setting range.

If agreed to between the supplier and purchaser, following devices shall also be provided:

a) No-volt/under-voltage trip device,

b) **Shunt trip device**: The moulded case circuit-breaker shall trip without any difficulty within the range of 70 to 110 % of ac rated trip operating coil voltages and 75 to 110 % of dc rated trip operating coil voltages.

Preferred voltages for shunt trip coils are as follows:

For ac - 110, 240 and 415 V
For dc - 24, 48, 110, 220 and 460 V.

c) Auxiliary contact block having one pair of normally open and one pair of normally close contacts with provision for change-over from normally open to normally closed and vice-versa.

d) Trip contact for trip/alarm indication.

Note : a and b shall be optional while c& d shall be mandatory

10.2.2 The auxiliary contacts shall be rated as follows:

a) Thermal current shall not be less than 4 A, and

b) The contact shall be able to break a current of 2A at AC 15, 415 V ac and power factor 0.4 lag and 0.25 A at 230 V dc and a time constant of 10 milliseconds.

10.2.3 MCCB shall have releases in the following configuration for different applications :

i) MCCB with magnetic and thermal over load.
ii) MCCB with magnetic only.
iii) MCCB with magnetic, thermal and earth fault protection.
iv) MCCB with magnetic and earth fault protection.

Preferably setting shall be adjustable.

11. **TESTS** - MCCB shall be tested as per clause No. 8 of IS/IEC 60947: 2003 (Part 2)

The tests to verify the characteristics of circuit-breakers include the followings as per IS/IEC 60947 (Part 2): 2003 :

a) Type tests (see 8.3), and
b) Routine tests (see 8.4).

11.1 **Type Tests** – In order to avoid repetition of identical texts applicable to the various test sequences, the general test conditions have been grouped together at the beginning of this sub-clause under three headings:

a) test conditions applicable to all sequences (sub-clauses 8.3.2.1 to 8.3.2.4 of IS/ IEC 60947 (Part 2)

b) test conditions applicable to temperature-rise tests (sub-clause 8.3.2.5),

c) test conditions applicable to short-circuit tests (sub-clause 8.3.2.6)

Wherever appropriate, these general test conditions refer back to, or are based on, the general rules of Part-1.

Each test sequence refers back to the general test conditions applicable. This requires the use of cross references, but enables each test sequence to be presented in a much simplified form.

Throughout this clause, the term `test' has been used for every test to be made; "verification should be interpreted as `test for the verification and has been used where it is intended to verify the condition of the moulded-case circuit-breaker following an earlier test in a test sequence whereby it may have been adversely affected.

In order to facilitate locating a particular test condition or test, an alphabetical index is given in sub-clause 8.3.1, using the terms most likely to be used (not necessarily the exact terms appearing in the relevant sub-clause heading).

11.1.1 Verification of temperature-rise limits - The circuit-breaker shall be tested in accordance with 7.2.2 of IS/ IEC 60947 (Part-2):2003 Temperature-rise limits for insulated coils and various materials and parts shall not exceed the values specified in **Tables** B and 4 C, respectively.

11.1.2 Verification of dielectric properties - The circuit-breaker shall be capable of withstanding the tests specified in 7.2.3 of IS /IEC 60947 (Part-2):2003 .

11.1.3 *Verification of rated short-circuit making and breaking capacities* - This test shall be conducted to determine the performance of the circuit-breaker in clearing a short-circuit in conformity with the rated rupturing capacity of the circuit-breaker as given in **Table A**.

11.1.4 *Verification of mechanical operation and of mechanical and electrical endurances* - The circuit-breaker shall be tested in accordance with 8.4.1 of IS /IEC 60947 (Part-2): 2003 for the number of operations specified in **Table D**. the circuit-breakers shall be tested separately on ac and dc. The manufacturer shall declare actual electrical life of MCCB at the rated current and voltage.

11.1.5 *Verification of overload performance* - The circuit-breaker shall be tested in accordance with clause 8.3.3.4 of IS /IEC 60947 (Part-2): 2003 for the number of close-open cycles as indicated in Table D.

11.1.6 **Verification of operating limits and characteristics of overcurrent opening releases** - The moulded- case circuit-breaker shall be tested in accordance with 8.3.5.1 of IS/ IEC 60947 (Part-2): 2003 .

11.2 **Routine Tests** - These tests are carried out on each and every moulded-case circuit-breaker to check the requirements which are likely to vary during production. The routine tests shall include the following:

a) Mechanical operation test (clause 8.4.1 IS / IEC 60947 (Part-2),

b) Calibration of overcurrent release (clause 8.4.2 IS / IEC 60947 (Part-2),

c) Calibration of undervoltage release (clause 8.4.2 IS / IEC 60947 (Part-2),

d) Dielectric test (clause 8.4.3 IS / IEC 60947 (Part-2),

e) General inspection, and

f) *Insulation resistance test* - Insulation resistance between phases and live part to Earth shall not be less than 5 M-Ohm with 1000 V insulation resistance tester.

11.2.1 *Mechanical operation test* - The moulded- case circuit-breaker shall be tested in accordance with 8.4.1 of IS / IEC 60947 (Part-2):2003.

11.2.2 Calibration of overcurrent release - Where the moulded- case circuit-breaker shall be tested in accordance with 8.4.2 at 200% current.

11.2.3 Under-voltage release – Where the moulded- case circuit-breaker is provided with an under-voltage tripping arrangement, there shall be no difficulty in closing the circuit-breaker at 85% of the rated operating voltage.

11.2.4 Dielectric test - The moulded- case circuit-breaker shall be tested in accordance with 8.4.3 of IS/ IEC 60947 (Part-2):2003.

11.2.5 General inspection - The moulded- case circuit-breaker shall be inspected for general construction, material used, finish and quality of contact parts, as listed in 9.1.

12. ACCOMPANYING DOCUMENTS

The manufacturer shall supply the following along with each moulded- case circuit breaker :

a) Certificate of conformity to the requirements of type tests mentioned in this standard,

b) Certificate of conformity to the requirements of routine tests mentioned in this standard, and

c) Characteristic curves.

13. DERATING OF MOULDED- CASE CIRCUIT-BREAKERS FOR HIGHER AMBIENT TEMPERATURE

13.1 A table indicating the derating factors for moulded- case circuit-breakers for use in hotter locations is under preparation. Till such time this table is published as an addendum to this standard, the purchaser shall stipulate the derated values.

14. MARKING AND DESIGNATION

14.1 The moulded- case circuit-breaker shall be marked indelibly with the following details in a conspicuous place on the body of the moulded- case circuit-breaker as per IS / IEC 60947 (Part-2):

a) Manufacturer's name or trade-mark,
b) Type designation,
c) Frame size,
d) Rated insulation voltage (Ui),
e) Rated operational voltage (Ue),
f) Rated current ac/dc (Ie),
g) Reference to ambient temperature for overcurrent thermal tripping device (temp),
h) Rated service breaking capacity (ICS),
i) Range of overload protection,
j) Utilization category,
k) Suitability for isolation shall be indicated with its symbol on MCCB.
l) Range of short-circuit protection,
m) Year of manufacture, and
n) Reference to this IPSS

NOTE: Standard symbols indicated above within brackets may be used for marking the above information.

TABLE - A (Rated service breaking capacity of MCCB : Ics)

Current Rating	Rated service breaking capacity at rated ac service voltage & P.F. 0.25	Rated service breaking capacity in Amp. At rated dc voltage and L/R - 10 ms.
100 Amp.	MCCB shall be designed for service breaking capacity of 25 kA, 40 kA ,50 kA and 65 kA.	MCCB shall be designed for service breaking capacity from 4 kA and upto 40 kA.
250 Amp.		
400/630/800 Amp.		
1000/1200/1600 Amp.		

TABLE - D

Number of Operating Cycles

1	2	3	4	5
Rated Current (A)	Number of operating cycles per hour*	Number of operating cycles		
		Without current	With current**	Total
$I_n \leq 100$	120	8500	1500	10000
$100 < I_n \leq 315$	120	7000	1000	8000
$315 < I_n \leq 630$	60	4000	1000	5000
$630 < I_n \leq 2500$	20	1600	500	3000

* Column 2 gives the minimum operating rate. This rate may be increased with the consent of the manufacturer; in this case the rate used shall be stated in the test report.

** During each operating cycle the moulded- case circuit breaker shall remain closed for a sufficient time to ensure that the full current is established, but not exceed 2s.

A P P E N D I X - A

(Clause 3)

SERVICE CONDITIONS FOR MOULDED- CASE CIRCUIT-BREAKERS

A-1. *Ambient Temperature* - The reference ambient temperature shall be 45^{o}C.

A-2. *Altitude* - Altitude shall not exceed 1000 metres.

A-2.1 For installations at altitude higher than 1000 metres, it is necessary to take into account the reduction of the dielectric strength and the cooling effect of the air. The circuit-breaker so used shall be designed or used according to an agreement between the supplier and the purchaser.

A-3. *Ambient Air* - The ambient air may contain fair amount of conductive dust.

A-4. *Humidity* - Maximum humidity shall be 100 %, however, both 100 % humidity and maximum temperature are not likely to occur simultaneously.

A-5. For applications where corrosive and inflammable gases are prevalent, the moulded- case circuit-breakers shall be specially designed to meet the given needs.

A-6. The moulded case circuit-breakers shall be suitable for use on mobile equipment and cranes with vibration and shock value.- IG and 3G respectively as per IEC 571.

TABLE - B

TEMPERATURE-RISE LIMITS FOR INSULATED COILS OVER AN AMBIENT TEMPERATURE OF 40°C

Class of Insulating Material*	Temperature-Rise Limit Measured by Resistance Method (Coil in Air) °C
A	85
E	100
B	110
F	135
H	160

* According to IS 1271:1953 `Classification of insulating materials'.

TABLE - C

TEMPERATURE-RISE LIMITS FOR VARIOUS MATERIALS AND PARTS (Clause 11.1.1)

Sl No.	Type of Material and Description of Part	Temperature-Rise Limit Measured by Thermocouple in ^{o}C Over an Ambient Temperature of 40^{o}C
i)	Contact parts in air (main, control and auxiliary contacts):	
	a) Copper	45
	b) Silver or silver-faced*	†
	c) All other metals or sintered metals	‡
ii)	Bare conductors including non-insulated coils	†
iii)	Metallic parts acted as springs	§
iv)	Metallic parts in contact with insulating materials	‖
v)	Terminals for external insulated connections	70¶
vi)	Manual operating means:	
	a) Parts of metal	15
	b) Parts of insulating materials	25

* The expression `silver faced' includes solid silver inserts as well as electrolytically deposited silver provided that a continuous layer of silver remains on the contacts after the endurance tests and short-circuit tests. Contacts faced with materials the contact resistance of which is not significantly altered by oxidation are treated as silver-faced contacts.

† Limited solely by the necessity of not causing any damage to adjacent parts.

‡ To be specified according to the properties of metals used and limited by the necessity of not causing any damage to adjacent parts.

§ The resulting temperature shall not reach a value such that the elasticity of the material is impaired. For pure copper, this implies a total temperature not exceeding 75°C.

‖ Limited solely by the necessity of not causing any damage to insulating materials.

¶ Temperature-rise limit of 70°C is a value based on the conventional tests. A circuit-breaker used or tested under installation conditions may have connections, the type, nature and disposition of which will not be the same as those adopted for the test; a different temperature-rise of terminals may result and it may be required or accepted.

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