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SPECIFICATION NO.

SPEC./E-12/1/04

18

SPECIFICATION AND TEST SHEDULE OF d.C. MINIATURE CIRCUIT BREAKER (MCBs) FOR USE ON RLY. ROLLING STOCK FOR LIGHTING AND VENTILATION CKTS.

MARCH-1992

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SPECIFICATION NO.SPEC/E-12/1/04

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
RAILWAY BOARD

SPECIFICATION AND TEST SCHEDULE OF DC-MINIATURE CIRCUIT BREAKERS(MCBs) FOR USE ON RAILWAY ROLLING STOCK FOR LIGHTING AND VENTILATION CIRCUITS

MARCH 1992

[This superseds earlier specification No.SPEC/E-12/1/01(Provl)]

Issued by

RESEARCH DESIGNS AND STANDARDS ORGANISATION
MANAKNAGAR, LUCKNOW

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TECHNICAL SPECIFICATION FOR DC MINIATURE CIRCUIT BREAKERS(MCBs) FOR LIGHTING AND VENTILATION CIRCUITS

0. FOREWORD

0.1 This standard is prepared for the guidance of the manufacturers, indenting units and inspection units in respect of requirements of MCBs for dc application on Railway rolling stock for lighting and ventilation circuits.

0.2 In the preparation of this standard, assistance has been derived from the following specifications :-

(i) BS:3871 Part-I Specification for miniature air-break circuit breakers for ac circuits.

(ii) IS:8828-1978 - Specification for miniature air break circuit breakers for voltages not exceeding 1000 volts.

0.3 This specification supersedes RDSO's test programme No.EL/TL/21 for the testing of dc MCBs used on rolling stock and Specification No. SPEC/12/1/01(Provl.) issued in October 1985.

1. SCOPE:

1.1 This specification covers direct current miniature air circuit breakers with fixed unadjustable time/current characteristics for use on Railway rolling stock.

1.2 The object of this Standard is to cover the performance requirements, constructional features and mounting arrangements etc. for d.c. MCBs intended for protection of cables/wiring for short circuits and where precise over-load protection is not an essential requirement i.e. mainly for train-lighting application on coaching stock.

1.3 The d.c. MCBs for use on EMUs, diesel and electric locomotives intended for protection of circuits and motors etc.,where even a slight overload is detrimental to equipments and, therefore, needs to be protected, are not covered by this Specification

1.4 The d.c. MCBs covered by this Specification shall be suitable for protection of lights and fans circuits of the following systems :-

(i) 24 V dc train lighting system.
(ii) 110V dc train lighting system.
(iii) 110V dc EMUs, diesel & electric locomotives.

2. TERMINOLOGY:

2.1 Miniature circuit breaker : A compact mechanical device for

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making and breaking a circuit both in normal conditions and in abnormal conditions such as over current and short circuit. In abnormal conditions, the circuit is broken automatically.

2.2 Opening Time : The time interval between the application of the test current and the instant of contact seperation.

2.3 Total operating time : The sum of the opening time and the arcing time.

3. RATING:

3.1 The MCBs shall be of single pole design.

3.2 Rated Voltage :THE MCBs shall have rated voltage of 130V dc.

3.3 Rated current : The preferred rated current of MCBs shall be 1.5, 2.5, 5, 10, 15, 20, 30, 35, 40, 50, and 60 A.

3.4 Short circuit capacity: The MCBs shall have the ability to withstand prospective short circuit current of 1000 A in a circuit with L/R ratio greater than or equivalent to 5 milli-seconds.

4. DESIGN & CONSTRUCTION :

4. 1 General :

4.1.1 Material shall be suitable for the particular application and capable of passing the appropriate tests.

4.1.2 The metallic portions of the mechanism shall be either inherently resistant to or so treated as to make them resistant to atmospheric corrosion.

4.1.3 Circuit breaker shall be arranged for manual closing and opening and for automatic tripping on over current and short circuit.

4.1.4 The circuit breaker shall be free from nuisance tripping; caused by vibrations, transient current & ambient temperature etc.

4.1.5 After tripping, it shall be possible to reset the MCB within 30 seconds.

4.1.6 The mechanism shall be such as to provide a wiping motion across contacts every time they open or close. The MCB will open and close with snap action and shall not stop in middle position.

4.1.7 In case of welding of contacts , the MCB shall not show false indication i.e. open position.

4.2 Enclosure :

4.2.1 The moulding material of the enclosure shall be heat

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resistant and fire proof. The material shall have good mechanical strength and tracking resistance.

4.2.2 The design of the arcing chamber shall be such as to cool and blow the arc efficiently.

4.2.3 The ventilating outlets from circuit breaker shall be so situated that the discharge of gases or hot air from arc chambers will not cause electric break down.

4.2.4 The construction shall be such that gas cannot collect at any point where ignition can be caused during or after operation by sparks arising from normal operation of a circuit breaker.

4.2.5 The design of the enclosure shall be such as to prevent the mal-functioning of MCBs due to ingress of dust.

4.3 Dolly : The dolly of MCB shall be made sturdy and shall be moulded from suitable high strength material to withstand service conditions on Railway rolling stock.

4.3.1 Both the 'ON' and 'OFF'positions of the circuit breaker shall be clearly indicated. The indication shall be clearly visible to the operator when the circuit breaker is mounted in the normal manner.

4.3.2 The international practice i.e. 'ON' position of MCB corresponding to 'UP' position of its dolly shall be preferred.

4.4 Mounting arrangements and terminal details of MCBs:

4.4.1 On coaches for trainlighting services, the MCBs shall be base mounted with terminals connected to the busbar/terminal block provided on junction board. For interchangeability of various MCBs, it is necessary that the MCBs are supplied with suitable mounting base to the arrangement,mounting and fixing/terminal dimensions as per Drg.No.SKEL-3700.

4.4.1.1 MCBs will be so mounted that it will be possible to remove any of the MCBs from panel board for replacement without any need to disturb the adjoining or other MCBs there.

4.4.2 The terminals shall be of substantial mechanical strength and shall provide adequate electrical contact for the appropriate size of the cables used. The terminals shall be so provided to afford flexibility of use of either copper or aluminium cable and sockets suitable for connections.

4.4.3 The terminal shall be such that the conductors terminated in a socket may be connected by means of screw to ensure necessary contact pressure. The current from the termination to the socket and vice versa shall pass through the contact surface and not through fixing screw.

4.4.4 Terminals shall be such that they cannot turn or be displaced when the connecting screws are tightened and such that the conductor can not become displaced.

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4.4.5 Terminals shall be so mounted that the appropriate wire or cable may be connected without impairing the normal performance of the unit.

4.4.6 No contact pressure shall be transmitted through insulating materials and the gripping of the conductor shall take place between metal faces.

4.4.7 The terminals shall be clearly and indelibly marked for those circuit-breakers which require distinction between the supply side and the load side.

4.5 MARKING

4.5.1 The MCBs shall be indelibly marked with the following particulars. Marking shall be such that it will be visible and legible when MCB is installed :-

(a) Reference to Specification.
(b) Make and trade mark.
(c) Type designation and S.No.
(d) Rated voltage.
(e) Rated current.

4.5.2 Railway insignia shall be incorporated in the moulding of all MCBs to be supplied to Railways. Month and year of manufacture shall be marked suitably.

5. SERVICE CONDITIONS

5.1 The MCBs covered under this Specification shall be suitable for use in following conditions of service :-

(i) Ambient temperatures varying from 0 to 50 degree C, relative humidity upto 100% and height upto 1000 m above sea level.

(ii) The MCBs shall be suitable for operation in atmosphere polluted with dust/smoke and laden with salt.

5.2 The miniature circuit breaker along with its mounting arrangements shall be suitable to withstand continuous vibrations and shock loads of magnitude of 3g encountered on Railway rolling stock. The MCBs shall not give rise to nuisance trippings under vibrations in service.

5.3 The MCBs should be robust and sturdy to withstand rough handling in service and during maintenance.

6. TESTS

6.1 The tests are classified as Type tests, Acceptance tests and the Routine tests.

6.2 All the tests i.e. Type, Acceptance and Routine tests shall be conducted at rated voltage.

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6.3 The test voltage shall be measured at source terminals with full load current.The impedence of the supply source and test circuit shall be such that the voltage regulation shall not exceed ± 15 percent.

6.4 Type tests shall be carried out to check if the MCB design meets the requirements of the Specification. These tests shall be conducted by RDSO or their authorised representative and the recommendations regarding the use of the MCB for railway application will be issued on the basis of these tests. These tests shall be carried out at manufacturer's premises or any other place mutually agreed to with manufacturer and, therefore, the manufacturer is required to have all the facilities for conducting these tests at their premises. The following tests shall constitute Type tests :-

(i) Preliminary checking.
(ii) High voltage test.
(iii) Insulation resistance test.
(iv) Milli volt drop test.
(v) Over current calibration test.
(vi) Temperature rise test.
(vii) Overload performance test.
(viii) Endurance test.
(ix) Short circuit capacity test.
(x) Time current characteristics test.
(xi) Vibration test.

6.4.1 The sequence of Type tests and the number of samples required shall be in accordance with Appendix 'A'

6.5 Routine Tests:-The routine tests are to be carried out by the manufacturers at their premises on all MCBs as a part of their production process. This is to ensure that MCBs manufactured are functional and are of standard quality. These tests shall include:-

(a) Preliminary checking.
(b) Insulation resistance test.
(c) High voltage test.
(d) Over current device calibration test at 2.5 IN.
(e) Milli volt drop test.

6.6 Acceptance Tests:-

6.6.1 These tests shall be carried out by the inspecting authority as mentioned by the purchaser to ensure that the supply of MCB conforms to specification. The tests will be carried out on samples as per the sampling plan indicated in Table 1. The following tests shall constitute the acceptance tests:-

(a) Insulation resistance test.
(b) High voltage test.
(c) Milli volt drop test.
(d) Over current device calibration test.
(e) Short circuit capacity test.

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6.6.2 The manufacturers shall keep a record of Type tests and Routine tests for inspection of the inspecting officer and if desired by him, any of the tests mentioned under Type tests/Routine tests will be repeated.

6.6.3 The MCBs for Acceptance tests will be tested as per sampling plan indicated in Table 1 which generally conforms to single sampling plan, AQL 2.5 and I class of inspection of IS: 2500(part 1) - 1973.

TABLE 1

Lot size	Sample size
0-100	3
100-500	5
500 and above	8

The samples will be selected in random order. Each of the samples taken should pass the Acceptance tests and failure of any sample in any of the tests will result in rejection of the lot.

6.6.4 The test sequence of tests to be conducted on each sample of MCBs shall be as under:-

S.No.	Description
1.	Preliminary checking.
2.	Insulation resistance test.
3.	Milli volt drop test.
4.	High voltage test.
5.	Overcurrent device calibration test at 1.15, 1.5 and 2.5 IN.
6.	Short circuit capacity test.

7. The circuit breaker shall be mounted in a vertical plane and shall be wired with the cable of copper conductor of size specified below for all the tests :-

Cable sizes for tests

Circuit breaker current rating	Cable size (sq.mm)
Upto 20 A	4
21 to 30 A	6
31 to 60 A	16

8. TEST PROCEDURE

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8.1 Preliminary checkings

(i) Visual examination - The general workmanship and finish of MCB including mounting base etc.shall be satisfactory. Marking shall be legible and indelible.

(ii) Dimensions (outline)- The dimensions shall conform to the drawing specified.

(iii) Dolly- It shall be sturdy to meet the rough service conditions on rolling stock. Dolly will operate with snap action.

8.2 High voltage test- For this test, the circuit breaker shall be dry and clean. An alternating voltage of 2000V RMS,50Hz and of approximately sine wave form shall be applied for one minute between the following parts :-

(a) Between the incoming and outgoing terminals with the miniature circuit breaker in open position.

(b) Between terminals and metal parts with circuit breaker in closed position.

The miniature circuit breaker shall be deemed to have passed the test if there is no flashover or break down across contacts.

8.3 Insulation resistance test- The insulation resistance shall be measured with a 500V dc meggar :-

(a) Between terminals with MCB in open condition.
(b) Between terminals and metallic parts.

The insulation resistance shall not be less than 1 mega.ohm.

8.4 Millivolt drop test- The millivolt drop shall be measured across the terminals by passing the rated current after steady state condition is reached.

The steady state condition is reached when last 3 consecutive readings are approximately constant.

8.5 Over current calibration test- The over-current calibration test shall be conducted at ambient temperature at rated voltege.The MCB will carry the test current specified in Table 2 below. The current specified are at calibration temperature of 40 deg.C and if test is conducted at different ambient temperature,the test current will be adjusted as per temperature correction factor applicable to MCBs.

8.5.1 Twenty numbers ON/OFF operations (make & break) shall be conducted manually on load at rated voltage before starting of the over current calibration test at each of the test current as specified in Table 2 at the rate of 4 make and break operations per minute.

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TABLE 2

Test Current (IN=Rated current)	Duration of Test	Tripping Time Min.	Max.	Referance Caliberation temp.
1.15 IN	1 hour	-	No tripping	40 deg.C
1.50 IN	1 hour	-	1 hour	40 deg.C
2.5 IN	-	-	60 Secs.	40 deg.C
6.0 IN	-	-	10 Secs.	40 deg.C

Note:- 1. Before starting the tests 20 Nos. 'ON'/'OFF' operations shall be conducted as per Clause 8.5.1

2.When the MCB is tripping automatically during the overload test, the 5 readings of tripping time shall be recorded and average of 3 readings falling in middle will be taken.

3. If the circuit breaker does not latch in at the specified rate of operation, the rate should be reduced sufficiently so that the circuit breaker will just stay in. In such an event, the actual time taken for latching in, on each occasion shall be recorded during the tests.

8.6 Temperature rise test: This test shall be conducted at rated voltage. The rated current shall be passed until the MCB attains a steady temperature. The steady-state condition of temperature is reached when the temperature rise does not exceed 1 deg.C/hour.

The temperature rise of various parts shall be recorded. The values shall not exceed from the specified values as under:-

(i) Terminals of circuit breakers fitted with contacts having adequate and durable facings of silver not subject to progressive deterioration. ... 50 deg.C.

(ii) Manual operating means(dolly) and parts of enclosures likely to be handled when operating the circuit breaker. ... 25 deg.C.

8.7 Overload Performance Test:

8.7.1 The overload performance test for MCB shall be carried out at 6IN at rated voltage and with circuit time constant of 5 milli seconds. The test shall be done at battery supply.

8.7.2 The circuit breaker shall be subjected to 35 make- break operations closing and opening manually and 15 make-break operations closing manually and opening automatically at the rate of 4 make-break operations/minute. During each cycle the circuit breaker shall remain closed for a maximum period of 10 seconds.

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Note: If the circuit breaker does not latch in at the specified rate of operation, the rate should be reduced sufficiently so that the circuit breaker will just stay in. In such an event the actual time taken for latching-in, on each occasion shall be recorded during the tests.

8.7.3 At the conclusion of the overload performance test, the temperature rise test and over-current calibration test at 2.5 IN shall be conducted in accordance with clauses 8.6 & 8.5. The circuit breaker shall be deemed to have failed the test, if it does not pass the O.C.C test at 2.5 IN, or if the temperature rise at the terminals is exceeded by more than 10 deg.C, the temperature rise permitted in clean and new conditions.

8.8 Endurance Test:

8.8.1 On-load endurance test:- Circuit breaker shall be operated at its full rated current at rated voltage by manual or equivalent means. 'ON' and 'OFF' cycles rate and number of cycles shall be as indicated in Table-3.

8.8.2 'OFF' load endurance test:- Circuit breaker shall be operated at no load by manual or equivalent means. 'ON' and 'OFF' cycle rate and number of cycles shall be as indicated in Table-3.

TABLE -3

Rate of operation (cycles) per hour	With full rated current	Without current
240 ± 30	6000	4000

Note: Each 'ON'/'OFF' cycle shall approximately be 2 seconds 'ON' and 13 seconds 'OFF'.

8.8.3 The MCBs will be deemed to have passed the test if it meets the following requirements:-

(i) It passes calibration test at 2.5 IN.

(ii) There is no appreciable variation in milli-volt contact drop.

8.9 Short-circuit test: The short circuit test shall be conducted by passing 1000A dc at 130V dc for 10 shots(duty cycles).

8.9.1 Test duty cycle: The short circuit making and breaking capacity tests shall be conducted according to the following test duty:-

O-t-Co.

Where 'o' represents breaking operation, 'Co'-represents a

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making operation followed after the appropriate opening time by a breaking operation and 't'-represents specified time interval. The time interval 't' shall be 3 minutes or the resetting time of the circuit breaker whichever is longer. The actual value of 't' shall be stated in the test report.

8.9.2 Circuit requirements: The test shall be conducted on battery supply. The battery shall be in a state of fully charged condition. The time constant of the circuit shall be 5 milli seconds.

8.9.2.1 The combination of batteries shall be such that the voltage regulation shall not exceed ± 15%.

8.9.2.2 The test voltage on load, prospective current and tripping time at short circuit current shall be measured on a storage type oscilloscope.

8.9.3 MCB will be deemed to have passed the test if it meets the following requirements after short circuit test:-

(i) Within 3 minutes of the conclusion of the test, the insulation resistance measurement as per clause 8.3 shall be recorded.

(ii) Over current calibration test shall be conducted at 2.5 IN (5 trippings) as per clause 8.5.

(iii) Milli-volt drop test across the terminals shall be recorded by passing the rated current 'IN' and there shall not be appreciable variation in milli-volt drop.

8.10 Time current characteristic tests:

8.10.1 The test is intended for checking the time/current characteristics of the breakers as declared by the manufacturers. The time/current characteristics of the circuit breakers shall be ascertained by causing the circuit breakers to operate at not less than 6 different currents so chosen as to facilitate production of the curve supplied by the manufacturers.

8.11 Vibration Test:- The vibration test shall be conducted at a vibration level of 3g at frequency of 50 cycles. The duration of test shall be two hours. The MCB shall be mounted on Vibration Table in vertical plane and dc current of 1.15 IN(corrected to ref. temperature of 40 deg.C) value shall be passed by connecting samples of MCBs in series. Any tripping during vibration shall be recorded. If the MCB is tripping repeatedly, the test will be stopped after 5 such trippings. MCB should not trip during the test.

8.11.1 The over current calibration test at 1.5 IN, 2.5 IN & 6 IN shall be repeated for 5 trippings after the vibration test to check the performance of MCBs.

9. SCHEDULE OF PARTICULARS AND TECHNICAL DATA:

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9.1 Technical details including the operating principle of the circuit breaker shall be furnished by the manufacturer.

9.2 The detailed drawing of circuit breaker giving overall dimensions and mounting arrangements shall be furnished by the manufacturer.

9.3 Operating characteristics of MCBs indicating operating time will be furnished by the firm. Temperature correction factor, if applicable, shall also be provided.

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APPENDIX 'A'

PROTOTYPE TEST

S.N.	Description of test	As per cl.No.	No. of samples 1	2	3	4	5	6	7	8
1.	Visual examination and outside dimensions.	8.1	x	x	x	x	x	x	x	x
2.	High voltage test.	8.2	x	x	x	x				
3.	Insulation Resistance test.	8.3	x	x	x	x				
4.	Milli-volt drop test	8.4	x	x	x	x				
.	Over- current calibration test.	8.5	x	x	x	x				
6.	Temperature rise test	8.6	x	x	x	x				
7.	Overload performance test at 6 IN.	8.7			x	x				
8.	Endurance test.	8.8	x	x						
9.	Short Circuit test.	8.9					x	x		
10.	Time current characteristic test.	8.10							x	x
11.	Vibration test	8.11	x	x			x	x		

NOTE: X- Indicates that test is to be conducted on the sample.

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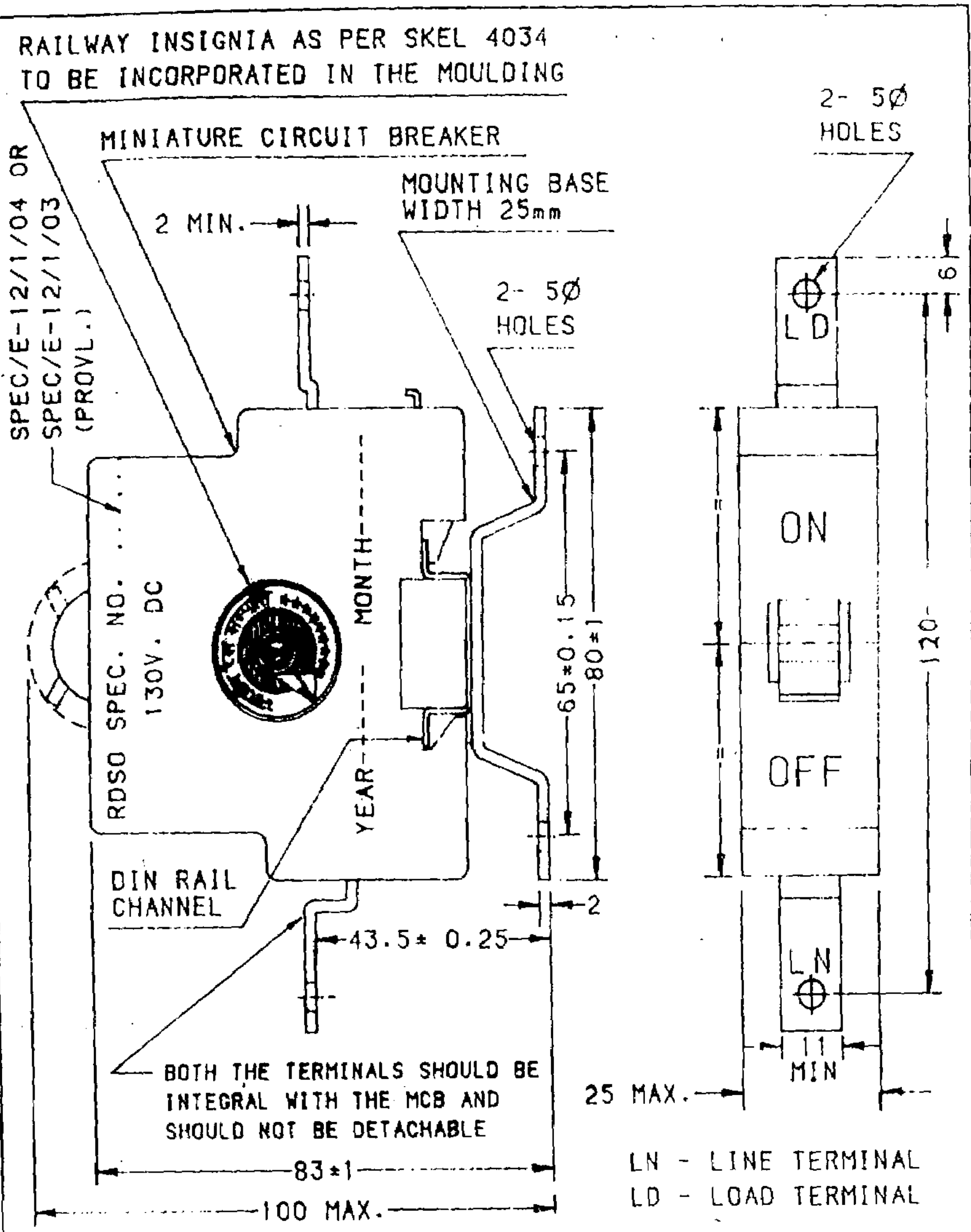

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ALT.No.	DESCRIPTION	SIGN.	DATE

REF:-	SCALE:- 1:1	APPROVED:

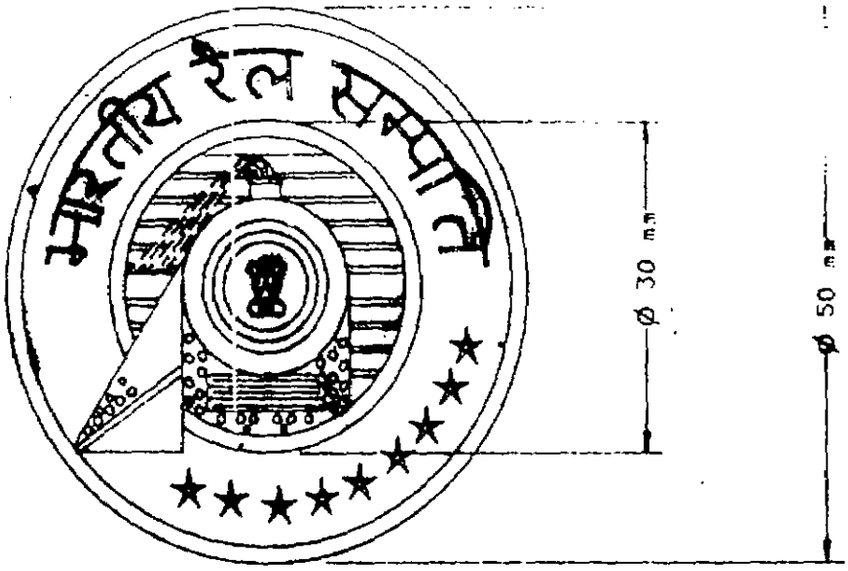
दिष्ट धारा लघु परिपथ भंजक की बाहरी परिमाप (रेलवे चल-स्टाक प्रयोग हेतु)

OUT LINE DIMENSIONS OF dc MCB'S

(FOR USE ON RAILWAY ROLLING STOCK)

अ.अ.मा.सं. विद्युत निदेशालय	विद्युत आरेख 3700

Dt 14-6.94



NOTE:-

COMPLETE INSIGNIA SHALL BE MINIATURISED 17-20 mm FOR USE ON MCB'S.

1	REVISED		3-8-94
ALT. No.	DESCRIPTION	SING.	DATE
REF:-	SCALE:- N.T.S.	APPROVED:- FOR D.C.	

RAILWAY INSIGNIA FOR MARKING ON dc MCB'S

(FOR USE ON RAILWAY ROLLING STOCK)

Dt.	14-6-94
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RDSO.ELEC.DTF | SKEI 4034

AMENDMENT NO. 1 JUNE - 1993.

Specification No.SPEC/.E - 12/1/04 of March'92 for dc miniature circuit breakers (MCBs) for lighting and ventilation circuits on Railway Coaches.

(Page 3 clause 4.4.2) - Substitute the following for the existing clause.

"4.4.2 - The terminals shall be made from one piece material. No screwed joints etc. shall be acceptable. The terminals shall be of substantial mechanical strength and shall provide adequate electrical contact for the appropriate size of the cables used. The termianls shall be so provided to afford flexibility for use of either copper or aluminium cable and sockets suitable for connections."

(Page 4 clause 4.5.2) - Substitute the following for the existing clause.

"4.5.2 - Railway insignia as per SKEL.4034 shall be incorporated in the moulding of all MCBs to be supplied to Railways."

(Page 7 clause 8.4) - Add the following at the end of the clause.

"The value of the milli volt contact drop and percentage variation shall be declared by the manufacturer for their product."

(Page 9 clause 8.8.3(ii)- **

(Page 10 clause 8.93 (iii) - Substitute the following for the existing clause.

"Milli volt drop test across the terminals shall be recorded by passing the rated current 'IN' and the value obtained in the test shall not exceed from the value declared by the manufacturer."

(Page 11 clause 9.3) - Add the following new clause at the end of this clause.

"9.4 - The manufacturer shall give the information as per APPENDIX -B to RDSO."

** Substitute the following for the existing clause.

"The value of the milli volt contact drop obtained in the test shall not exceed from the value declared by the manufacturer."

(Clause - 9.4)

Information to be given by the manufacturer

B-1 Current rating of the mcbs for which approval is sought for .....

B-2 Brand of the mcb to be offered for Railway use. .....

B-3 Drawings showing all details of the mcbs (based on SKEL.3700) .....

B-4 Drawing of the terminals indicating material, grade and current carrying capacity. .....

B-5 Characteristic curves for all ratings of the mcbs at 40°C .....

B-6 Value of the milli volt contact drop and percentage variation .....

B-7 Weight of the mcb for each current rating .....

B-8 Colour of the body of the mcb .....

B-9 Colour of the dolly of the mcb.....

C-10 Material and grade used for manufacturer of body & dolly of the mcbs and fire retardent class of the material and specification to which it conforms to .....