Machine	Make	Name plate details H.P.	Rated current	Rated Voltage	Type	Max.running current at Voltages (Amps) 290 VAC	380VAC	400 VAC	Locked rotor/starting currents at voltages (amps) 290VAC	380VAC	400VAC	Remarks
MVMT	SIEMENS	35	50	380+22½%	IRA-2-164-2	59.0	53.0	41.2	196	240	210	Max.current in one of the phase has been recorded.
	NGEF	35	53.5	-do-	AJ 200MK2	58.0	46.8	-	208	284	-	
	HBB	35	50.0	-do-	QP 200 M2A	66	62	-	210	280	-	
	BBL	30	45	-do-	60SS16-4	-	45.0	-	-	-	-	
MVRH	SIEMENS	30	43	-do-	IRA2-164-4	46.8	42.4	30.0	200	244	244	
	NGEF	30	41.5	-do-	AJ600 M4	39.6	38.8	-	220	264	-	
	BBL	3.0	4.2	-do-	OR 29d2	-	4.2	-	21.2	28.0	32.2 at 440V	
MVSL	CAL.FAN	3.0	4.25	-do-	-	3.55at 300V	4.63at 410V	5.9at 460V	28.5at 300V	42.0at 420V	48.0 at 460V	
	HBB	3.0	4.8	-do-	QK 11 2-M2m	5.7	5.0	-	29.0	34.0	-	
	BBL	2.0	3.4	-do-	OR29d2	-	3.4	-	-	22.5	-	
MVSI	HBB	2.7	4.4	-do-	QK112-M2m	4.25	3.9	4.0at 320V	24.0	34.0	26.0at 320V.	
MPV	SIEMENS	10.0	16.0	-do-	IRA2-164-1	25.6	27.6	25.5	89.2	113.2	152 at 460V	
	BBL	10.0	16.5	-do-	50D14-46	-	21.16Av.	-	79.2	120	160at 480V	
	HBB	10.0	19.0	-do-	Q200M6/4b1	26.6	27.3	21.6at 460V	100	137.5	167.5 at 460V	
MCP	KIRLOSKAR	10.0	15.0	-do-	SPDP180b	19.4	16.5	18.8at 500V	80	100	-	
	NGEF	12.6	15	-do-	AJ180L6y11	26.8Av.	36.5	17.7Avat 460V	108Av at 300V	142.4Av. at390V	152Av.at 422V.	
	HBB(2)	11.0	16.0	-do-	K15d2/H	26.9	25.4	21.1at 460V	113.0	126.0	168.5A at 460V	
	SIEMENS	12.6	20	-do-	ILA2-136	25at 320V	25.0	25 at 460V	-	-	-	

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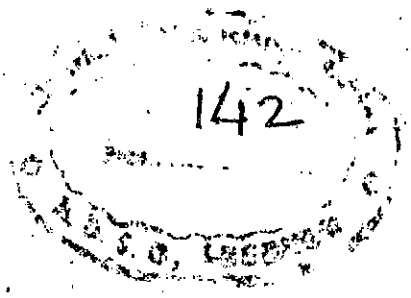
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Normal life in terms of on-load operations, frequency of operating cycle per hour and load factor for continuous duty and intermittent duty.

).0 During initial service of 3 years, in case of any failure, mal-operation and service problems, the manufacturer shall be prepared to carry out investigation tests and improve the designs in consultation with RDSO.

- the test is considered to be satisfactory if there is no resulting damage or abnormality in operation.

(iii) Tests to simulate the effect of shunting shocks:

In the direction corresponding to longitudinal movement of the vehicle on which it is to be mounted, the apparatus shall be subjected for 2 minutes to 50 Hz. vibrations of such a nature that the maximum acceleration is equal to 3g (amplitude 'a'=0.3mm).

(iv) At the end of the test, the following checks shall be made:

- No screw or nut is loose,
- The elastic inserts, if any, have correctly fulfilled their purpose.
- No distortion or corrosion of any component.
- Resistance value is not altered,
- Insulating blocks or body are not cracked or broken.
- Firmness of soldering and other connection inside the MCCB.
- Proper functioning of the complete unit without any attention or maintenance.

8.0 SCHEDULE OF PARTICULARS AND TECHNICAL DATA

8.1 Technical details including the operating principle of the MCCB shall be furnished by the manufacture.

8.2 The detail drawing giving overall dimensions and mounting arrangement shall be furnished.

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

8.4 Test reports with relevant specification of the materials used in the fabrication of the various components.

8.5 Details of aux. contact(alarm switch) and power contacts shall be submitted as per the following description-

- Contact arrangement ,
- Contact gap,
- Max. Wear limit,
- Rating of contact in terms of current, voltage and no. of operation for the following type of service:

  a) Continuous duty,

  b) Max. make duty,

  c) Max. break duty,

  d) Cyclic duty.

7.2.2 Test for withstanding vibration and shock

7.2.2.1 The following conditions are to be satisfied during the test.

a) that the vibration is of sine wave form, that the frequency 'f' of vibration is between 1 and 50 Hz and that the amplitude 'a' is expressed in mm. is given as function of 'f' by the equations:

$a=\frac{25}{f}$ for values from 1 Hz to 10 Hz.

$a=\frac{250}{f^2}$ for values from 10 Hz. &, upto 50 Hz.

b) that the srresses arising from sudden vibration in vehicle speed corresponding to maximum acc eleration of $\pm 3g$ (g being acceleration due to gravity)

7.2.2.2 Method of testing: The equipment shall be secured in a convinient position to a machine producing vibration of since wave with adjustable amplitude and frequency and then shall be subjected to the following tests:

i) Determination of resonant frequency:

In order to determine the possible existence of critical frequencies producing resonance, the frequency shall be varied progressively over the whole range of 1 Hz to 50Hz within a time of not less than 4 minutes, the amplitude of the oscillations being that indicated as a function of the frequency. If resonance is produced, the corresponding frequency shall be maintained for a few minutes in each case with the apparatus alive. A check shall be made that no ill effects result on the operation of the apparatus. ((the dropping out of any part of the equipment, sparking at the contacts, temp. rise etc.)

ii) Test with sustained vibration: The apparatus at full load shall be subjected to a test with sustained vibration for a period of two hours in each plane either:

- at the critical frequency, if any such will defined ** as mentioned in the above para,
- otherwise at a frequency of 10 Hz.
- in both cases, the amplitude of the vibrating table is adjusted to the value corresponding to the frequency concerned.
- as an investigation test, the equipment may be subejcted to sustained vibration onload for a longer period (25 Hz. to 50 Hz.)

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** frequency has been detected in the course of test

TABLE-1

	Test Details	Reference : IEC-157-1 Type test	Routine test
	a) Verification of temp. rise limits.	8.2.2	-
*	b) Verification of Dielectric properties	8.2.3	8.3.3
**	c) Short circuit making and breaking capacity test	8.2.4	-
***	d) Endurance (Mech.&Elect.)	8.2.6	-
****	e) Verification of overload performance	8.2.7	-
	f) Verification to tripping characteristics	8.2.8	8.3.2

NOTE: * After keeping the MCCB in a humid chamber for 24 hrs. at 90% R.H. the above test shall be repeated and leakage currents shall be recorded at 1, 1.5, 2.0 2.5kV.

** Short circuit making and breaking capactiy test shall be conducted under P2 performance catagory and data shall be recorded on oscillograms and submitted.

*** The aux. contacts (alarm switch) shall be loaded at dc 125V, 2A, L/R=100Mili seconds. No. of operations shall be

-with full rated current = 10,000
-without current = 20,000
TOTAL = 30,000
} For complete unit.

**** The test shall be done after mounting the MCCB on vibrating table set to vibrate 10 CPS at 30m/sec^2 for 15 operations in each plane.

7.2 The following tests shall also be conducted on the prototype in addition to the tests mentioned in Table 1.

7.2.1 Insulation resistance Measurement

Insulation resistance of all the three phases shall be recorded between terminals with MCCBin open condition and between terminals and metallic parts, with 1000VDC meggar.

For new MCCBs the min. IR value will be 100 mega ohms.

....6/-

4.2.5 The firm should supply the MCCB fitted over a 3mm thick adaptor plate with 4 bolts and nuts in corners. The actual dimensions shall be ascertained.

4.2.6 After tripping it shall be possible to reclosethe MCCB within 15 Sec.

4.2.7 A prominent indicator will be provided on 'ON' side of the operating knob to give a clear visual indication that the MCCB has tripped.

4.3 MARKING

4.3.1 The MCC B shall indelibly marked with the following particulars. Marking shall be clearly visible in installed position.

a) Reference to specification,
b) Make and trade mark,
c) Type designation and identification no.
d) Rated voltage,
e) Rated current,
f) Short circuit breaking capacity,
g) Manufacturing month and year.

5.0 DRAWINGS

5.1 General outline dimensional drawings of the MCCB and its mounting arrangement shall be furnished with the tender. Details of the internal arrangement such as actuating system, release mechanism, whether static or dynamic trip system adopted release coil construction shall also be furnished.

6.0 TECHNICAL DOCUMENTS

6.1 The manufacturer shall supply the technical documents like maintenance instructions, type test report, test certificates, tripping characteristics curve, method of conducting calibration test in th sheds for testing the new MCC Bs as well as MCCBs in service, spapepart catalogue with the first batch of supply. The firm should specify recommended torque value for fastners used in electrical terminals.

7.0 TESTS

7.1 To verify the characteristic of the MCCB and to check if the MCCB design meets to the requirements of specifications the type and routine tests shall be carried out as per the reference clauses indicated in the table 1 below which generally conforms to IEC 157-1 (latest edition).

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4.0 DESIGN AND CONSTRUCTION

4.1 GENERAL

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

4.1.2 The MCCB shall be of manual closing and opening and with automatic tripping on abnormal conditions as laid down in para 1.2;

4.1.3 The MCCB shall be free from nuisance tripping caused by vibration, manual taping, transient current, ambient temperature rise etc.

4.1.4 Only lug arrangement with bolt and nut and spring washers shall be provided for fastening incoming/outgoing power cables.

4.1.5 A suitable insulated shroud shall also be provided over the terminals to protect against accidental contact with live parts.

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

4.1.7 The ventilating outlets from MCCBs shall be so situated that the discharge of gases or hot air from arc chambers will not cause damage to the internal components.

4.1.8 The construction shall be such that gas cannot collect at any point where ignition can be caused during or after operation by sparks arising/normal operation of a MCCB./during.

4.1.9 The design of the enclosure shall be such as to prevent the malfunctioning of MCCBs due to ingress of dust. Entry of dust shall be prevented through arc chambers and aperture for the operating knob.

4.2 SPECIAL FEATURES

4.2.1 MCCB shall trip between 120 to 240 seconds while protecting against a single phase fault(at 163% of the rated current of the MCC B).

4.2.2 At 400% of the rated current the over current release should actuate and trip the MCCB within 4 to 5 seconds.

4.2.3 MCCB should be capable of withstanding the starting current (kick) and should not give any tripping during starting period of each induction motor.

4.2.4 An alarm switch with 1 NO/1NC contact having breaking capacity of 2.0 Amps. at 125 VDC with a L/R of 100 milli seconds shall be provided. The interlocks shall be utilised for the MCCB trip indications.

....4/-

TECHNICAL SPECIFICATION FOR MOULDED CASE CIRCUIT BREAKER (MCCB)

0. FOREWORD

0.1 This standard is prepared for the guidance of the manufacturer, indenting units and inspection units in respect of requirements of MCCB for loco application on railway rolling stock.

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

(i) IS 2516 - 1977 AC Circuit Breaker requirements and tests,

(ii) IEC 157-1-1973- Low Voltage Switchgear and control gear- Circuit Breaker.

(iii) IEC-77

0.3 Deviations : Any deviation from this specification calculated to improve the performance, utility and efficiency of the MCCB, proposed by the manufacturer, will be given due consideration provided full particulars with justification thereof are furnished in the Tender.

1.0 SCOPE

This specification covers the requirements for ac, Moulded Case Circuit Breakers (MCCBs) with inverse time characteristic to be used for protection of 3Ø squirrel cage type AC induction motors of 25kV AC electric rolling stock.

1.1 MCCB should conform to IEC 157-1 (Latest Edition) in addition to special requirements specified in this Specification.

1.2 MCCBs shall protect the motors against the following:

a) Single phasing protection during starting and running,

b) Sustained overload protection during running,

c) Short circuit protection, and

d) Locked rotor protection in case of bearing failure/seized.

2.0 SERVICE CONDITION

2.1 The MCCB shall be suitable for service in ambient temperature varying from 0°C to 55°C, relative humidity upto 100% and height up to 1000 meter above sea level.

2.2 It should satisfactorily operate under the atmosphere polluted with oil fumes/dust and corrosive gases, laden with salt.

..2/-

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..2/-

2.3 The MCCB alongwith its mounting arrangement shall be suitable for traction duty and shall withstand continuous vibrations and shocks of magnitude of 3g in all the 3 planes encountered on the electric locomotives.

2.4 The MCCB should be robust and sturdy to withstand rough handling in service and during maintenance.

2.5 SUPPLY SYSTEM

2.5.1 Power is available to the locomotive at 25kV 50Hz AC and is supplied to a transformer. The transformer has two secondaries, one supplying power to the traction motors and the other supplying a rotating phase convertor (ARNO)

The three phase supply for the induction motors is obtained from the convertor which converts single phase supply into 3-phase supply at nominal input value of 380V 50 Hz. The generated voltage across phases varies between 290 to 500V. The maximum unbalance between phases is around 5% i.e. the ratio of negative sequence voltage to the positive sequence voltage. The unbalance(difference between minimum and maximum phase current/-AV current) in the current drawn by the motor is still more and is of the order of 30 to 40%.

divided by

2.5.2 In the distribution network of the traction power supply, neutral sections are provided to facilitate the change over of traction load from one sub-station to another substation or from one phase to another phase. On each instance when the running loco approaches the neutral section, the loco circuit breaker is tripped off and switched on by the driver after passing the neutral section. Obviously entire starting sequence of the auxiliary machines and other equipment is repeated after each neutral section. It is desirable that MCCB should not give tripping while closing the DJ after passing neutral section, when change of phase takes place.

3.0 RATINGS

3.1 MCCB shall be of three pole design.

3.2 System Voltage - 500 VAC.

3.3 Rated Current: The current rating of the MCCB shall be suitably selected based on the motor rating and continuous maximum current under worst allowable service conditions.

3.4 Short circuit capacity- The MCCB should be able to clear a S/C current of 20 kA at 415V.

3.5 An alarm switch contact block with 1 NO/1NC interlocks shall be required and these auxiliary contacts shall be suitable for DC 11 duty at 125 VDC, 2 Amps, L/R 100 ms.

.....3/-

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SPECIFICATION NO. SPEC/E-12/1/02

GOVERNMENT OF INDIA

MINISTRY OF TRANSPORT

DEPARTMENT OF RAILWAYS

(RAILWAY BOARD)

D R A F T

SPECIFICATION AND TEST PROGRAMME

OF

MOULDED CASE CIRCUIT BREAKER (MCCB)

for use on

ELECTRIC LOCOMOTIVES

SPECIFICATION NO.SPEC /E-12/1/02

14th NOVEMBER ., 1986

ISSUED BY

RESEARCH DESIGNS AND STANDARDS ORGANISATION

MANAK NAGAR, LUCKNOW.

E-12/1/02