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INDIAN RAILWAY STANDARD SPECIFICATION FOR NON DETERIORATING TYPE OF LOW VOLTAGE ELECTRIC FUSES FOR RAILWAY SIGNALLING (Tentative)

Serial No. S78-92

0. FOREWORD

0.1 This specification is issued under the fixed serial No. S 78 The final number indicates the year of original adoption as standard or in case of revision, the year of last revision.

ADOPTED 1992

0.2 This specification requires reference to the following Indian Railway Standard (IRS) and Indian Standard (IS) specifications and International Electrotechnical Commission publication.

IRS: S23	Electrical and Electronic based signalling and Interlocking Equipment.
IRS:S75	Terminal blocks for signalling installation.
IS:193	Soft Solder
IS:410	Cold rolled brass-sheets, strips and foils.
IS:2096	Carriers and bases used in rewireable type electrical fuses up to 650V.
IS:2112	Grades of silver and silver alloys.
IS:8080	Silver coated copper wire.
IS:9000	Basic environmental testing procedure for electronic and electrical equipment.
IEC:269.1	Low voltage fuse
IS: 9224 Pt. I & II	Low voltage fuses

0.3 Wherever in this specification any of the above mentioned specification is referred to by number only without mentioning the year of issue the latest issue of the specification is implied, otherwise the particular issue referred to is meant.

0.4 This specification is intended chiefly to cover the technical provisions and it does not include all the necessary provisions of a contract.

1. SCOPE

1.1 This specification covers the technical requirement of non-deteriorating type of low voltage fuses intended for protecting circuits of nominal voltage up to 110V.

1.2 All electrical tests except wherever it has been specially mentioned shall be made with d.c. voltage.

2. TERMINOLOGY

2.1 For the purpose of this specification, the following definitions shall apply.

2.1.1 Fuse : A switching device, which by the fusion of one or more of its specially designed and proportioned components open the circuit, in which it is inserted and breaks the current, when the same exceeds a given value for a sufficient time. The term fuse covers all the parts forming the complete switching device.

2.1.2 Fuse Element : The part of the fuse which is designed to melt when the fuse operates.

2.1.3 Fuse Link : The part of the fuse including the fuse element which requires replacement by new link when the fuse has operated.

2.1.4 Fuse link contact : The conducting part of fuse link designed to engage with fuse base contact or fuse carrier contact.

2.1.5 Fuse base : The fixed part of the fuse provided with terminals for being connected to the system. The fuse base covers all the parts necessary for the insulation.

2.1.6 Fuse base contact : The conducting part of the fuse base connected to a terminal designed to engage with a fuse link contact.

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2.1.7 Enclosed fuse link : A fuse link in which the fuse element is totally enclosed, so that during operation it cannot produce any harmful external effects due to development of an arc, the release of gas or the ejection of flame or metallic particles.

2.1.8 Rating : A term employed to designate the characteristics values that together define the working conditions upon which the tests are based and for which the equipment is designed.

Unless other wise stated all tests shall be carried out under following conditions :

a. Temp - 15 to 35°C b. Relative Humidity 45% to 75%

Any corelation curve/s shall be provided by the manufacturer.

2.1.9 Prospective current of a circuit : The current that would flow in a circuit if a fuse situated therein was replaced by a link of negligible impedance without any other change in the circuit or of the supply.

2.1.10 Prospective breaking current : The prospective current at a time corresponding to the instant of the initiation of the arc in a fuse during a breaking condition.

2.1.11 Breaking capacity : The prospective breaking current that a fuse is capable of breaking at a stated recovery voltage under prescribed conditions.

2.1.12 Pre-arcing time : The time between the commencement of a current large enough to cause the fuse element(s) to melt and the instant when the arc is initiated.

2.1.13 Arc-ing time : The interval of time between the instant of initiation of arc and the instant of final arc extinction.

2.1.14 Time current characteristic : A curve giving the virtual time(e.g. prearcing time or operating time) as a function of prospective breaking current under stated conditions of operation as given in para 2.1.8.

.1.15 Time current zone : The time-current zone is the range contained by the minimum pre-arcing time-current characteristics and the minimum operating time-current characteristics under stated conditions of operation as given in para 2.1.8

.1.16 Operating time : The sum of prearcing time and arcing time.

1.17 Operating Voltage : It is the nominal voltage of the operating circuit at which the fuse including link is expected to work satisfactorily. The nominal operating voltage shall be specified by the purchaser.

.1.18 Rated Voltage - All the fuse fitting, however, should be rated to work satisfactorily at twice the operating voltage. Further in view of universal fuse fittings for different rated voltages, all the fuse fittings will be deemed to be rated for 240V ac/dc.

.1.19 Recovery Voltage - The voltage appearing across the fuse after the breaking of the current.

.1.20 Rated Current - A value of the current the fuse link can carry continuously without deterioration under specified conditions.

.1.21 Conventional Fusing Current(If)- A value of current specified as that which causes operation of the fuse-link within a specified time (Conventional time.)

General Requirements :

The fuse link shall have non-deteriorating time current characteristics. The fuse links shall be so designed and constructed so as to carry continuously any value of current up to its rated current without permanently changing its time current characteristics. The time current characteristic deems to have changed, if the fuse when tested, at an ambient temperature of 27°C, crosses relevant time current zone.

The design of the fuse shall be instrinsically reliable. The properties of components viz. fusible element, filler material, solder alloy etc. shall not deteriorate with

3.3 The fusible element shall be manufactured using either of the following materials :

i) Pure silver to IS:2112
ii) Silver plated copper wire to IS:8080
iii) Silver copper alloy.

3.4 The fuse shall be enclosed in a filler material which shall be pure silica in which iron content shall not be more than 0.05%. The filler material shall provide mechanical support to the fuse wire and reduce its normal operating temperature by improving the dissipation of heat .

3.5 The fusible element shall be soldered to the end caps with tin lead solder alloy (grade Sn 60) to IS:193. Alternatively, spot welding of fusible elements to end caps may be adopted.

3.6 The body of the fuse shall be manufactured using one of the following materials :-

i) Porcelain to IS:2086
ii) Steatite
iii) Cordierite.

3.7 The end caps of fuses shall be manufactured using brass sheet, Cu Zn 37 alloy, half hard to IS: 410.

3.8 The fuses shall be manufactured as per either (i) size 14 x 51 of data sheet III-1 or (ii) size 00 of data sheet 11 of IS:9224 Part II.

4. Rating

4.1 Rating of fuses shall be selected from the following :- 1A, 2A, 4A, 6A, 10A, 16A & 20A.

5. Fuse bases :

5.1 The fuse base shall be manufactured in accordance with one of the following :

i) SA 23748 Fuse Block (PBT base)
ii) Fuse base as per data sheet III of IS:9224 Pt.II-79
iii) Fuse base as per data sheet 12 of IS:9224 Pt.II-79

5.2 Fuse bases as described in subclause 5.1(i) shall be manufactured using 30% glass filled "Polybutylene Teraphalate" suitably compounded with flame retardents as per IRS:S75.

6. Marking

6.1 The fuses and fuse bases shall be clearly marked for identification.

i) Name/trade mark of the manufacturer.
ii) Reference to this specification.
iii) Rated voltage
iv) Rated current

7. Inspection and testing :

7.1 Type test

7.1.1 The type test shall be conducted to verify compliance of fuses to the specification. The following shall constitute type test

a) Insulating properties test (Clause 7.3.1)
b) Resistance test (Clause 7.3.2)
c) Rated current test (Clause 7.3.3)
d) Breaking capacity test (Clause 7.3.4)
e) One hour non-fusing test (Clause 7.3.5)
f) Five seconds fusing test (Clause 7.3.6)
g) Overload test (Clause 7.3.7)
h) Time-current characteristics (Clause 7.3.8)
i) Test of raw materials (Clause 7.3.9 to Clause 7.3.11)
j) Vibration Test. (Clause 7.3.12)

7.1.2 Sequence of Type test

10 samples of each rating will be needed for the type test with following sequence.

1) Resistance Test (Clause 7.3.2)-All samples.
2) One hour non-fusing test (Clause 7.3.5)-Two
3) Overload test (Clause 7.3.7)-Two
4) Five second fusing test (Clause 7.3.6)-Two
5) Test for raw material (Clause 7.3.9 to Clause 7.3.12)-One sample drawn from overload test samples

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6) Breaking capacity test (Clause 7.3.4 & 7.3.4.1) two samples each.

7) Insulating properties test (Clause 7.3.1)-two samples after 5 seconds fusing test.

8) Vibration test (Clause 7.3.12) -Two samples.

As far as rated current test and time current characteristics curves and corresponding time current zone are concerned, it shall be provided by manufacturer which will be verified by the purchaser or its nominee on as many samples which will enable him to draw a suitable curve. Deviations up to ± 10% before and after the rated current test from the curve already provided shall be permitted.

7.2 Acceptance Test.

7.2.1 The following shall constitute acceptance test :

Test	Test Quantity
a)Dimensional check	ITQ (7.3.1)
b)Resistance test	ITQ (7.3.2)
c)One hour-non-fusing test	ITQ (7.3.5)
d)Five second fusing test	DTQ x 0.5(7.3.6)
e)Overload test	DTQ x 0.5 (7.3.7)

Time current characteristics. 7.3.9

Where ITQ-Inspection test quantity.

DTQ-Destructive test quantity.

7.2.2 The test quantities ITQ and DTQ shall be selected at random from the lots offered for inspection which shall be equal to the quantity ordered plus DTQ.

7.2.3 The test quantities ITQ and DTQ shall be as per Table I.

TABLE I

Lot size	Tests(a),(b) &(c) Clause 7.2.1		Tests(d) & (e) Clause 7.2.1	
	ITQ	Max.allowable defectives.	DTQ	Max. allowable defectives
100-1000	15	0	5	0
1,001-5,000	20	0	7	0
5,001-10,000	25	1	10	0

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7.3 Test and Test Procedure.

7.3.1 Dimensional Check : The fuses shall be checked for compliance with clause 3.8 of this specification.

7.3.2. Insulating Properties:

7.3.2.1 Insulating properties of fuse base: The fuse bases shall be tested for insulating properties in terms of Clause 4 of IRS:S75.

7.3.2.2 Insulating properties of fuse link: The fuse shall be vertically clamped on a horizontal conducting plate which in turn can be placed on insulating surface. The fuse shall be blown at a voltage greater than 220V and then a test voltage of 2 KV ac shall be applied between two caps for one minute on activated fuse. No break down shall occur.

7.3.3 Resistance Test : The resistance of fuse at the rated current measured between its terminals shall not vary by more than ± 10% from nominal value. The nominal value will be calculated after taking average resistance of ten samples selected at random out of ITQ. The value of resistance so determined shall be such that when the fuse is carrying its rated current at room temperature(15° -20°C), the potential drop, measured between the end caps of the fuse, shall not exceed the values given below :

Rated Current	Potential Drop
1A	600 mv
2A	500 mv
6A	300 mv
10A and over	200 mv

7.3.4 Rated Current Test : The fuse shall be submitted to a pluse test for 100 hours. Each cycle shall consist of an 'ON' period of one hour and an 'OFF' period of 6 minutes. The test current shall be equal to 1.05 times the rated current. The fuse link shall be tested for time current characteristics after this test as per clause 7.3.9. There shall not be any deviation from the time-current characteristic.

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7.3.5 Breaking capacity test : The fuse shall be capable of opening satisfactorily a circuit adjusted for 10 times the rated current, at rated ac voltage.

A fuse link shall be acceptable if -

i) The fuse link shall operate without external effect or damages to the components of the complete fuse.

ii) There shall be no permanent arcing, flash over or any ejection of flames which may be dangerous to the surroundings.

iii) Fuse links shall not be so damaged that their replacement might be difficult or dangerous for the operator.

7.3.6 One hour non-fusing test(Inf) When the current as specified below is passed through the fuse, it shall not blow within a period of one hour.

Rated Current (In)	Non-fusing current(Inf)	
	Type g..I	Type g..II
1A	1.5A	1.2A
2A	3A	2.4A
4A	6A	4.8A
6A	9A	7.2A
10A	15A	12A
16A	23A	19A
20A	28A	24A

7.3.7 Five second fusing current (I5)

When the current as specified below is passed through the fuse, it shall blow in not more than 5 seconds.

Rated current(In)	Fusing current (I5)
1A	3.6A
2A	7.2A
4A	15A
6A	22A
10A	38A
16A	65A
20A	75A

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7.3.8 Overload test : The fuse shall be subjected to a pulse test for 50 pulses for type test and 20 pulses for acceptance test. Each pulse shall consist of 'ON' period of 5 seconds and 'OFF' period of 12 minutes and the current equal to 80% of the current determined from the manufacturer's minimum prearcing time current characteristics for a prearcing time of 5 seconds/ Alternatively, this current (i.e. 5 sec. fusing current) may be taken as the 5 sec. fusing current declared by the manufacturer. The fuse shall not blow after this test.

/shall be passed through the fuse during 'ON' period.

7.3.9 Time current characteristic shall be verified in accordance with clause 8.4.3.3 of IEC publication No. 269-1(1986) as detailed below :

For the purpose of time current characteristic the rated breaking capacity shall be specified by the manufacturer.

The conventional fusing current shall be as per the following table :

Rated Current	Conventional fusing current If	
	Type gr.I	Type gr.II
1A	2A	1.5A
2A	4A	3A
4A	8.5A	6.5A
6A	11A	9.5A
10A	19A	16A
16A	28A	25A
20A	35A	32A

The following periods are determined :

i) From the instant of closing the circuit until the instant when the voltage measurement shows the beginning of arc.

ii) From the instant of closing the circuit when the circuit is definitely broken.

The value of prearcing and operating time so determined, referred to the obscissa corresponding to the values of prospective current, shall be within the time current zone indicated

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by the manufacturer or as specified by the purchaser.

7.3.10 Raw material test : The raw material used in the construction of fuses and fuse bases shall be tested in accordance with relevent specification as described in clause 5 and clause 5-

7.3.10.1 The raw material not covered by this specification shall be specified by the manufacturer alongwith relevent specification, if any, and tests thereon No change in this material will be permitted without specific permission.

7.3.11 Chemical Analysis for end caps : From the finished fuses end caps shall be removed and tested for chemical analysis. Care should be taken to remove protective coating. The chemical analysis shall be within tolerance specified in IS:410.

7.3.12 The fuse shall be able to withstand acceleration up to 1 'g' in frequency range of 1Hz to 100Hz. The test shall be conducted on all the 3 axis for 2 hours duration in each axis. The test shall be conducted as per IS:9000 Pt.VIII. The duration of endurance for critical frequency will be 10 hrs.

7.3.12.1 The resistance of the fuse measured after this test shall not vary more than 10% of the original value measured as per clause 7.3.3.

8. Rejection : The fuses which do not comply with any of the requirements of this specification and/or anyother specification and/or of drawings as approved by the purchaser shall be rejected.

9. Packing : The fuse shall be suitably packed in order to facilitate convenient handling and to protect against loss or damage during transit and storage.

10. Warranty : Warranty of the product shall be in accordance with IRS: S 23.

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11. Once the type approval is granted, it shall remain valid for a period of three years from the date of issue subject to the condition that no change shall be allowed in the design, material and method of manufacture of fuse.

12. Information to be furnished by the purchaser :

1) Operating voltage.

2) Rated current.

3) Whether with cylindical end cap or with knife edge.

13. Information to be furnished by the manufacturer.

1) Operating voltage/current.

2) Whether the fuse conforms to gI or g II characteristics.

3) The time current characteristics and correlation curve, if any, as per clause 2.1.8.

4) Any other information manufacturer would like to add.

5) The manufacturer shall also supply the samples required for type approval tests free of cost and shall bear the cost of testing, of such parameter/parameters for which testing facility does not exist at their premises and tests are required to be done at an approved laboratory.