RDSO SPECIFICATION FOR THERMOPLASTIC POLYURETHANE INSULATORS FOR RAILWAY SIGNALLING

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Abstract This document specifies technical specification for Thermoplastic Polyurethane Insulators For Railway Signalling.			

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AMENDMENTS

Version	Chapter/ Annexure	Amendment	Effective date
RDSO/SPN/168/2001		FIRST ISSUE	2001
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0 FOREWORD

0.1 This specification requires reference to the following Indian Railway Standard (IRS) and International Standard (IEC/ISO) specifications.

IRS:S 23	:	Electrical and electronic based signalling and interlocking equipment
ISO 37 : 1994(E)	:	Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties.
ISO 34-1: 2004		Rubber, vulcanized or thermoplastic - Determination of tear strength
ISO1183-1: 2004(E)	:	Plastics – Methods for determining the density of non-cellular plastics – Part 1
ISO 604 : 2002(E)	:	Plastics - Determination of compressive properties.
ISO 306 : 1994(E)	:	Plastics – Thermoplastic materials – Determination of Vicat softening temperature (VST)
IEC 60243-1: 1998	:	Electric strength of insulating materials – Test methods – Part 1 & Part 2
ISO 62 : 1999(E)	:	Plastics – Determination of water absorption
ISO 180 : 2000	:	Plastics – Determination of Izod impact strength
ISO 868 : 1985(E)	:	Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)

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

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

1. SCOPE

1.1 This specification covers the requirements of insulating components of rail insulation joints, insulated split stretcher bars, insulated rod joints, etc.

1.2 Insulating components shall be made of Thermoplastics Polyurethane (TPU) material.

1.3 Wherever reference is made to 'Insulator' in this specification, it shall be taken to mean any of the insulating components.

2. TERMINOLOGY

2.1 For the purpose of this standard, terminology given in IRS:S 23 shall apply.

2.2 Lot and lot size: Lot is a collection of insulators of one type and size manufactured by same process under similar conditions of production and offered for inspection at a time and the number of insulators in a lot will form lot size.

3. GENERAL REQUIREMENTS

3.1 The insulators shall conform to RDSO/railway drawings as per requirement of the purchaser. Where they are not expressly indicated, tolerances of ±1.0 mm may be adopted for linear dimensions and hole centres. Slight deviation in bends of channel side plates may be permitted provided there is no problem in actual fitment.

3.2 The insulators shall be moulded from Thermoplastics Polyurethane compound on automatic injection moulding machine.

3.3 The surface of the insulators shall be smooth, and free from moulding defects, such as bubbles, surface streaks, splash marks, bum marks, voids, surface sinking, grazing and blistering of surface, windows, warping, weld lines, laminations, jetting, cracks etc. All edges shall be neatly finished.

3.4 The raw material shall be resistant to oil contamination. A guarantee shall be given by the manufacturer that no re-constituted or recovered material has been used for the manufacture of insulators.

4. TESTS AND PERFORMANCE REQUIREMENTS

4.1 Unless specifically called for in the individual test specifications, all tests shall be conducted under ambient conditions.

4.2 Type Tests: Two sets of rail insulation joints of 90 R or 52 kg. or 60 Kg. rail section as per RDSO drawings alongwith three no. of every type of dumb-bells/test specimens as specified for following type tests, shall be submitted for type tests. Following tests shall be carried out -

a) Raw material test (Clause 4.4)
b) Visual Inspection Test (Clause 4.15)
c) Checking of dimensions (Clause 4.16)
d) Indentation hardness (Clause 4.7)
e) Compressive strength (Clause 4.6)
f) Izod impact strength (Clause 4.8)
g) Tear strength (Clause 4.9)
h) Vicat softening temperature (Clause 4.10)
i) Density determination test (Clause 4.13)
j) Water absorption Test (Clause 4.12)
k) Chemical Test (Clause 4.14, Appendix 'A')
l) Insulation Resistance test (Clause 4.11)

4.2.1 A minimum of three number of every type of insulators shall be tested for visual inspection and checking of dimensions. A minimum of three insulators /test specimens shall be tested for rest type test. Individual insulator/test specimen should pass.

4.3 Acceptance Tests: Following tests shall be conducted, as applicable–

a) Visual Inspection Test (Clause 4.15)
b) Checking of dimensions (Clause 4.16)
c) Indentation hardness (Clause 4.7)
d) Insulation Resistance test (Clause 4.11)
e) Tensile Strength of finished product (Clause 4.5)
f) Elongation at break of finished product (Clause 4.5)
g) Izod impact strength (Clause 4.8)
h) Tear strength (Clause 4.9)
i) Density determination test (Clause 4.13)
j) Chemical Test (Clause 4.14, Appendix 'A')

4.3.1 The actual number of insulators to be selected from a lot shall be in accordance with Table 1 and 2 as given below. If the number of defective sample are more than permitted as per these tables, the lot shall be considered as non conforming to the requirements of the specification.

Table 1

Lot Size	Sample size	Defective samples permitted
Up to 100	3	0
101 to 200	4	0
201 to 500	7	0
501 to 800	10	0
801 and above	13	1

Table 2

Lot Size	Sample size	Defective samples permitted
Up to 1000	2	0
1001 and above	3	0

4.3.2 Sampling procedure for acceptance tests for visual inspection and checking of dimensions shall be as per Table 1 for every type of insulator.

4.3.3 Sampling procedure for rest acceptance tests except density determination and chemical tests shall be as per table 2.

4.3.4 Density determination and chemical tests shall be conducted on one sample. No failure is permitted.

4.3.5 Tensile Strength and elongation at break of finished product, density determination, tear strength and chemical tests are destructive tests. Samples used for these tests shall not be used further.

4.3.4 Rail insulation joints shall be checked for acceptance tests as per Cl. 4.3, as applicable.

4.3.7 Insulators other than rail insulation joints shall be checked for visual inspection, dimensions, density and chemical test.

4.4 Raw material test

4.4.1 Following properties shall be checked-

(i) Tensile strength

(ii) Elongation at break

(iii) Dielectric strength

4.4.2 The tests for tensile strength and percentage elongation shall be conducted on Type 1 dumb-bells as per ISO 37. The speed of testing shall be 200 mm/minute. Tensile strength and elongation shall not be less than 50 MPa. and 300% respectively.

4.4.3 Dielectric strength shall be measured as per IEC 60243-1. Test specimens shall be of 100 mm diameter and 1 $\pm$ 0.1 mm thickness. Dielectric strength shall not be less than 15 kV/mm.

4.5 Tensile strength and elongation at break tests on finished product shall be conducted as per ISO 37. Test specimens as per Type 1 of ISO 37 shall be cut from channel side plates. Speed of testing shall be 200 mm/minute. Tensile strength and elongation at break shall not be less than 44 MPa. and 300% respectively.

4.6 Compressive strength shall be measured as per ISO 604. Test specimens shall be as per Type B of Table 2 of ISO 604. Test speed shall be 5 mm/min. Compressive strength shall not be less than 15 MPa.

4.7 Indentation hardness shall be determined as per ISO 868 on end post. Five measurements of hardness shall be taken on every end post atleast 6 mm apart. The average value of hardness for every test specimen shall not be less than 70 on Shore "D" scale.

4.8 Izod impact strength shall be determined as per ISO 180. Test specimen of length 80 $\pm$ 2 or 63.5 $\pm$ 2 mm and width 10 $\pm$ 0.2 mm shall be cut from end post. Notch shall be 'Type A' type. An impact force of 25 joules shall be applied. It should not break upto 450 kilojoules per square meter.

4.9 Tear strength shall be checked as per ISO 34-1 on bushes of insulation rail joints. Bush shall be cut along the length at one point to convert round surface into open area. From this trouser test piece shall be prepared as per Appendix 'B'. Cut of depth 40 $\pm$ 5 mm shall be made at the centre of the width of the test piece. It is important that the last 1 mm (approximately) of the cut is made with a razor blade or a sharp knife. Grips are separated at a speed of 100 mm/min. with steadily increasing traction force until the test piece starts tearing. Tear strength shall not be less than 100 kN/m.

4.10 Vicat softening temperature shall be measured as per ISO 306 on test specimens of 10 mm diameter/square and thickness between 3 to 6.5 mm taken from insulator. Test method shall be A 50 using a force of 10 N $\pm$ 0.2 N and a heating rate of 50° $\pm$ 5° C/Hour. Vicat softening temperature shall be between 185° C to 195° C.

4.11 Insulation resistance of end post pressed between two metallic sheets shall be more than 100 Mega ohm at 500 Volts.

4.12 Water absorption test- Determination of water content absorbed after immersion in water for 24 $\pm$ 1 hour shall be done as per method 1 of ISO 62. Test specimens shall be cut from channel side plate for both length and width of 61$\pm$ 1 mm. Test results shall be expressed in 'Percentage by mass of water absorbed' and shall not be more than 0.4%.

4.13 The density determination test shall be conducted as per ISO 1183-1. Test method shall be Method A – Immersion method. Test specimens of weight between 1-10 gms. shall be cut from insulator. Density shall lie between 1.22 and 1.26.

4.14 Chemical test shall be conducted on insulator as per Appendix 'A'.

4.15 Visual Inspection Test: The insulators shall be visually inspected for compliance with the requirements of clause 3.3 of this specification

4.16 Checking of Dimensions: The dimensions of the insulators shall be checked for conformity with the drawings as per clause 3.1 of this specification.

4.17 Routine Tests: The following tests shall be conducted by the manufacturer as routine tests besides other tests, as deemed necessary, to ensure quality and compliance of this specification:-

a) Visual Inspection Test (Clause 4.15)
b) Checking of dimensions (Clause 4.16)
c) Indentation hardness (Clause 4.7)
d) Insulation Resistance test (Clause 4.11)
e) Tensile Strength of finished product (Clause 4.5)
f) Elongation at break of finished product (Clause 4.5)
g) Izod impact strength (Clause 4.8)
h) Tear strength (Clause 4.9)
i) Density determination test (Clause 4.13)
j) Chemical Test (Clause 4.14, Appendix 'A')

4.17.1 Manufacturer shall perform visual inspection test on all the insulators. Manufacturer shall perform rest routine tests on atleast 3 insulators of every lot, as applicable. Manufacturer shall give a certificate to the purchaser or his nominee to this effect before a lot is put up for inspection.

5 MARKING

5.1 Every insulator shall be clearly and indelibly marked to indicate the following:-

(a) Name or trade mark of the manufacturer.
(b) Drawing number
(c) Rail section for which suitable, as applicable.
(d) Raw material used - TPU
(e) Year of manufacture.

5.2 The marking on end post shall be on lower portion.

5.3 The requirements of clause 5.1 shall not apply to insulating bushes.

6. PACKING

6.1 The insulators shall be so packed as to permit convenient handling and to protect against loss or damage during transit and storage.

APPENDIX 'A'

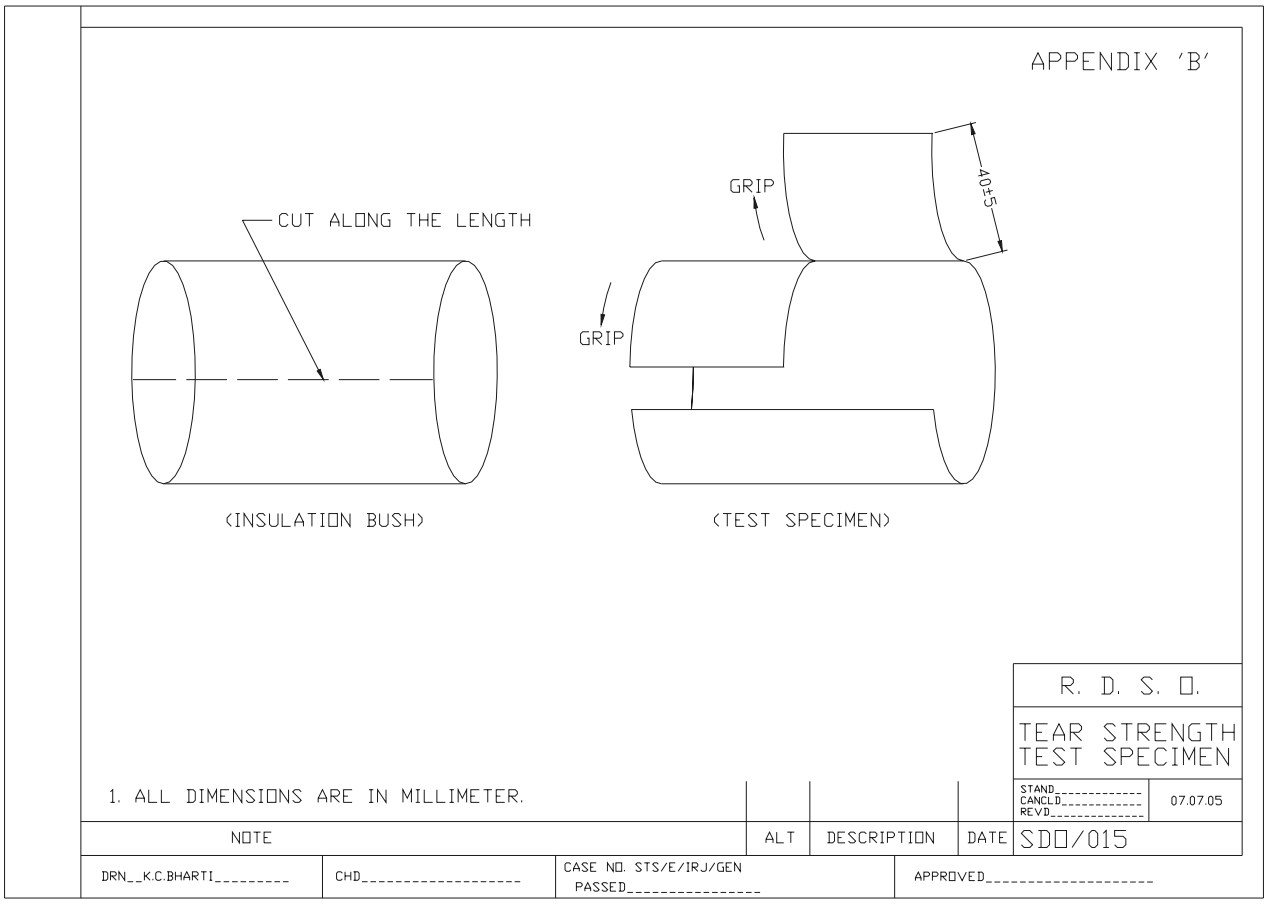
Chemical Test

Chemicals:	DMSO (Dimethylsulfoxide) 4- (Dimethylamino) – Benzaldehyde Acetic acid (100%)
Equipment:	Test tubes One way pipettes Small spatula Small stirrer
Safety regulations:	Gloves, protective glasses Read safety regulations of the used chemicals

Prepare a solution of 100 mg of the substance in Dimethylsulfoxide (2 ml).
Add 5 ml of acetic acid.
Add 100 mg of 4-(Dimethylamino)- Benzaldehyde

After a few minutes a yellow colour appears.
Always run a blind probe (well known TPU) to compare the results.

APPENDIX 'B'


APPENDIX 'B'
CUT ALONG THE LENGTH
GRIP
40±5
GRIP
(INSULATION BUSH)
(TEST SPECIMEN)
R. D. S. O.
TEAR STRENGTH TEST SPECIMEN
1. ALL DIMENSIONS ARE IN MILLIMETER.
STAND.
CANCLD.
REVD.
07.07.05
NOTE
ALT
DESCRIPTION
DATE
SDO/015
DRN. K.C.BHARTI
CHD.
CASE NO. STS/E/IRJ/GEN
PASSED
APPROVED