सत्यमेव जयते

भारत सरकार **GOVERNMENT OF INDIA**

रेल मंत्रालय **MINISTRY OF RAILWAYS**

सं0 टी0आई0/एसपीसी/ओएचई/जीएएलएसटीबी/0040 रिविजन–1

No. TI/SPC/OHE/GALSTB/0040 Rev.1

(अप्रैल /2022 April/2022)

शीर्षक– टेक्निकल स्पेसिफिकेशन फार गैल्वेनाईज्ड स्टील स्ट्रैंडेड वायर फार ट्रैक्शन बॉन्ड फार 25 केवी एसी इलैक्ट्रिक ट्रैक्शन सिस्टम

Title-Technical Specification for Galvanised Steel Stranded Wire for Traction Bonds for 25kV AC Electric Traction System

		हस्ताक्षर/Signature
अनुमोदित Approved by	प्रधान कार्यकारी निदेशक (कर्षण संस्थापन) Principal Executive Director (TI)	26/4/22
अनुशंसित Recommended by	कार्यकारी निदेशक (कर्षण संस्थापन) Executive Director (TI)	26/4/22

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NOTE: (i) This Specification is the property of RDSO. No re-production shall be done without the permission of DG (TI) RDSO.

(ii) All clauses of this Specification shall be enforced form cut-off date 31.07.2022.

Prepared by	Checked by/Issued by
SSE/TI 25/4/22	JD/TI-II 25.4.2022

Signature Not Verified
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Date: 2026.06.16 14:39:19 IST
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Location: New Delhi

Scope: This specification covers the scope of manufacture, supply and testing of galvanised steel flexible traction bond for use in 25 kV A.C. 50 Hz Electric Traction System on Indian Railway.

The present revision has been made to update reference of standard specifications to incorporate A & C slips 1 & 2.

1. Service Conditions: The bond is intended to be used as traction bond i.e. structure bond, longitudinal bond and cross bond, not being under tension, for electrically connecting the traction mast/structure, overhead line structure to rail/earth, two rails of a track, one rail of a track to the other rail of track.
2. Environmental Conditions:
   The Bond is intended for openline use generally in moist tropical climatic conditions. The areas where bond is used may have heavy rainfall, salinity and industrial pollution and may have severe lightenings. The generally limiting weather conditions that the bond has to withstand in service are indicated below:

(i)	Maximum ambient temperature	: 65° C
(ii)	Average Ambient temperature during day	: 35° C
(iii)	Maximum Relative Humidity	: 100%
(iv)	Annual Rainfall Range	: 1750mm to 6250mm
(v)	Maximum number of thunder storm days per annum	: 35
(vi)	No. of Rainy days per annum	: 120
(vii)	Average Wind Pressure	: 216 kg/mm2
(viii)	Altitude	a. For Normal Area -not exceeding 1000 b. For Mountainous area -2500 m from sea level

4. Governing Specifications:

4.1 Reference Specification:

Reference has been made to the following Indian Standards in this specification:

IS 2363: 1981(R2017):Glossary of terms relating to Wire Rope.

IS: 6594/2018:Technical Supply Conditions for Steel Wire Ropes and Strands.

IS: 4826/1979 (R2016): Hot Dipped Galvanized Coating on Round Steel Wires

IS: 1608/2005: Mechanical Testing of Metals – Tensile Testing.

IS: 6745/1972 (R2016): Methods for determination of Mass of Zinc Coating on Zinc Coated Iron & Steel Articles.

IS: 2633/1986 (R2016): Methods for Testing Uniformity of Coating of Zinc Coated Articles.

IS: 279-1981: Galvanized steel wire for telegraph and telephone purposes.

4.2 In case of any conflict or disparity between the contents of the above specifications and the specification, the latter shall prevail.

4.3 Any deviation from this specification calculated to improve the performance, efficiency and utility of the equipment proposed by the manufacturer will be given due consideration provided full particulars with justification thereof are furnished. In such a case the manufacturer shall propose design according to this specification and indicate the deviations (s) separately in a "Statement of Deviations".

5.0 Material of Bond: Resistivity of Galvanised Steel Wires used in making Bond shall not exceed 14.5×10^{-6} Ohm-cm at 20°C. The material shall have the composition as given below:

Carbon:	:	0.10% Max
Silicon	:	0.03% Max
Manganese	:	0.38% to 0.62%
Phosphorous:	:	0.03% Max
Sulphur	:	0.03% Max

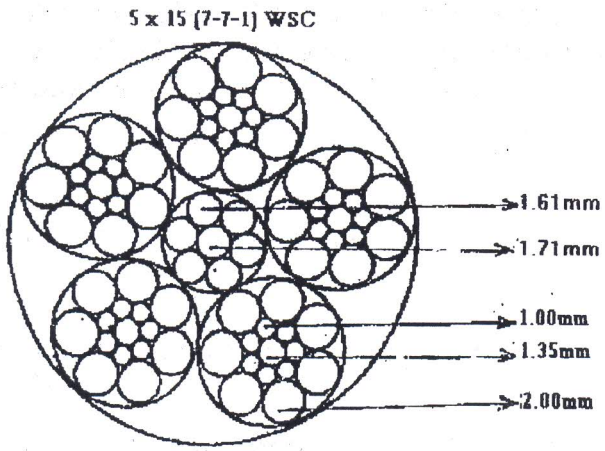
6.0 Diameter of Bond & Wire:

The nominal diameter of bond shall be 18mm with a tolerance of + 4%, -1% ovality shall not exceed 4%. The diameter of individual wires of covering strands and that of core strand shall be as per table-I and table-2 respectively.

7.0 Construction & Laying:

Bond shall consist of 5 covering strands laid over central strand (Core strand). Each of the covering strands shall have 15 wires laid as 7-7-1 and core strand shall have 7 wires laid as 6-1.

Cross Section of bond is shown for reference as under:



Nominal sizes of wires used in Bond shall be as per Table 1 & 2.

Table-1

7.1 Covering Strands:

	No. of Wires	Nominal dia (mm)	Tolerance (mm)
Outer Layer	7	2.00	+0.050, -0.030
Middle Layer	7	1.00	+0.040, -0.030
Core Wire	1	1.35	+0.040, -0.030

Table-2

7.2 Core Strand:

	No. of Wires	Nominal dia (mm)	Tolerance (mm)
Outer Layer	6	1.61	+0.040, -0.030
Core Wire	1	1.71	+0.040, -0.030

7.3 Laying:

7.3.1 The axial length of one complete turn of the helix formed by the strands is lay length.

7.3.2 Lay of bond shall be ordinary i.e. all the five covering strands shall be laid up over core strand in Right Hand direction. All the 15 wires in each covering strand shall be laid up in one operation only, in Left Hand direction. Direction of 6 covering wires of core strand over core wire shall be Right Hand.

7.3.3 Lay length of bond shall not exceed 126 mm.

7.3.4 Bond shall be preformed.

7.4 Joints in Wires:

Joints in wires to be used in bond shall be avoided as far as possible, but, where necessary, those shall be as widely apart as far as possible, but, in no case more than one wire shall be joined in any length of 10 meter of Bond.

The joints shall be either brazed or welded. If the joint is brazed, it shall be properly scarfed. If joint is welded it shall be properly annealed. Localised damage to zinc coating in the process of brazing or welding, shall be restored by cold galvanizing or by using zinc paint.

Strength of joint shall not be less than 90% of the original strength of wire.

8.0 Galvanising of Individual Wires:

8.1 Wires used in Bond shall be hot dip galvanised and shall meet the requirements of Heavily Coated Wires as per IS:4826 as under:

Before Stranding				After Stranding		
Nominal dia (mm)	Mass of Coating (gm/m2) Minimum	No. Of Dips		Mass of Coating (gm/m2) Minimum	No. Of Dips	
		1 min.	½ min.		1 min.	½ min.
1.00	170	2	-	162	1	1
1.35	200	2	-	190	1	1
1.61	230	2	1	219	2	-
1.71	230	2	1	219	2	-
2.00	240	3	-	228	2	1

8.2 Wires shall also pass Adhesion Test as per IS: 4826/1979 (R2016) satisfactorily.

8.3 On demand, record should be made available to inspecting officer in respect of results of galvanising tests done on wires before stranding.

9.0 Tensile Strength of Individual Wires:

Tensile Strength of wires from bond shall be minimum 45 kgf/mm2 and maximum 75 kgf/mm2. Tensile Test shall be carried out on samples of wires from outer layer and middle layer of Covering Strands and outer layer wires of Core Strand. However, tensile strength of Core Wire of Covering Strands and Core Strand and that of outer layer wires of Core Strand shall be the same.

10.0 Resistance, Mass & Breaking Strength of Bond:

The maximum Resistance, Approximate Mass and Minimum Breaking Strength of Bond shall be as per Table 3:

Table-3

Maximum Resistance Ohm/km @ 20°C	Minimum Breaking Load (kgf)	Approx. Mass kg/meter
1.021	6230	1.3

11.0 Tests:

11.1 Any changes required in the process of manufacture or the prototype as desired by Director General (Traction Installation)RDSO, Lucknow/CORE, Prayagraj shall be carried out expeditiously by the manufacturer.

11.2 Type testing schedule: Prior to giving a call to the Director General (Traction Installation)/RDSO, Lucknow/CORE, Prayagraj for inspection and testing of the prototype, the manufacturer shall submit a detailed test schedule for each of the tests and the number of days required to complete all the tests as on one stretch. Once the schedule is approved, the tests shall invariably be done accordingly. However, during the process of type testing or even later, the purchaser reserves the right to conduct any additional test (s) besides those specified herein, to his satisfaction or for gaining additional information and knowledge. In case any dispute or disagreement varies between the manufacturer and representative of the Director General (Traction Installations)/RDSO, Lucknow/CORE, Prayagraj during the process of testing as regards the procedure for type tests and/or the interpretation and acceptability of the results of type test, it shall be brought to the notice of the Director General (Traction Installations)/RDSO, Lucknow/CORE, Prayagraj as the case may be, whose decision shall be final and binding.

11.3 The manufacturer shall offer prototype for approval as per the direction of Director General (Traction Installations)/RDSO, Lucknow/CORE, Prayagraj within the period stipulated. The bond shall be inspected and tested at manufacturer's work by RDSO/CORE representative. The manufacturer shall arrange all the necessary machinery, apparatus, labour and assistance required for conducting the tests without any extra cost.

11.4 Sampling:

Outer layer wires of Covering Strands shall belong to one heat of steel only and shall be drawn under identical conditions. Likewise, middle layer wires of Covering Strands shall also belong to one heat of steel only and drawn under identical conditions. All the reels/coils of the bond made from such wires manufactured under one closing shall constitute a lot. The manufacturer shall give undertaking conforming to heat number.

11.4.1 Sample Size for acceptance tests:

11.4.1.1Bond:

Sample from each lot shall be selected at random to ascertain lots' conformity to the requirements of this specification. The number of reels/coils per lot to be selected for tests shall be as per Table 4.

Table-4

No. of reels/coils in the lot	No. of Samples to be selected	No. of reels/coils in the lot	No. of Samples to be selected
Up to 3	1	41 to 75	5
4 to 10	2	76 to 100	6
11 to 20	3	101 to 150	7
21 to 40	4	151 to 250	8
		Above 250	10

11.4.1.2 Sampling of individual wires from Bond:

From each sample of bond selected as above, approximately one-meter length of bond shall be utilized for conducting tests on individual wires. All the outer layer wires and middle layer wires of all the covering strands of bond shall be separately grouped and well mixed.

Out of total 35 wires belonging to outer layer of strands, 6 wires at random shall be selected for visual examination, measurement of diameter and same 6 wires shall be utilized for conducting tensile test. Of remaining 29 wires, 6 wires at random shall be selected for conducting galvanising tests. Similarly, out of 35 wires belonging middle layer, 6 wires at random shall be selected for measurement of diameter and same 6 wires shall be utilized for conducting Tensile Test. Of remaining 29 wires, 6 wires at random shall be selected for conducting galvanising tests.

11.5 Sampling for Type Test:

Each test shall be conducted on individual wires from three samples of bond. Selection of wire samples shall be as per clause 11.4.1.2. Similarly all the type tests shall be conducted on three samples of bond except short circuit test which shall be conducted on two samples of bond.

11.6 Type Test:

The following type tests shall be carried out in the presence of representative of Director General (Traction Installation)/RDSO, Lucknow/CORE, Prayagraj

11.6.1 Tests on Wires:

(i) Visual Examination

(ii) Measurement of Diameter of individual wires
(iii) Tensile test on wires
(iv) Galvanising tests
(v) Chemical composition

11.6.2 Tests on Traction Bond:

(i) Visual Examination
(ii) Measurement of Diameter
(iii) Measurement of Lay Length
(iv) Preforming Test
(v) D.c Resistance Test
(vi) Breaking Strength Test
(vii) Approximate Mass
(viii) Short Circuit Test

11.6.3 In case test facility for short circuit test is not available with the manufacturer, after satisfactory type test results on other tests, identified samples for short circuit test be sent to an Govt/NABL accredited laboratory.

12.0 Test Methods:

12.1 Visual Examination:

Bond shall be free from laying defects like loose wires or overlapped wires or unevenly laid wires in the strands or likewise in strands, in rope. The laying shall appear to be consistent and regular. Wires used in bond shall appear to be sound, free from splits, surface flaws, rough, jagged and imperfect edges. The zinc coating on wire surface shall be uniform, adherent, reasonably smooth, and free from flux, ash and dross inclusions and also free from bare patches, black spots, pimples, lumpiness, runs, rust stains, blisters and bulky white deposits. Lying in bond shall be as per clause 7.3.2.

12.2 Measurement of Diameters:

The measurement of diameter of individual wire shall be done with a micrometer having a minimum sensitivity of 0.01mm. Average of two measurements at same points approximately at right angles to each other shall be the actual diameter of wire. The values shall be as per Table-1 & 2 of clause 7.

The diameter of bond shall be measured in accordance with Annex-A of IS: 6594/2018. The value of the diameter shall be as per clause 6.0.

12.3 Tensile Test on Wires:

The tensile test on wires shall be conducted in accordance with IS: 1521/1972and the value shall be as per clause 9.0.

12.4 Galvanising Test on Wires:

Wires shall be tested for mass of zinc coating as per IS: 6745/1972(R2016), uniformity of zinc coating as per IS: 2633/1986 (R2016) and adhesion of zinc coating as per clause 5 of IS: 4826/1979 (R2016) and shall meet the requirement of clause 8.0.

12.5 Chemical Composition:

Chemical analysis shall meet the requirement of material specified in clause 5.0.

12.6 Preforming Test:

Preforming test on the bond shall be carried out by unlaying at one end of the bond, two strands opposite to each other for approximately two lay lengths. When these two strands are re-laid into the bond the strands shall resume their position in bond.

12.7 Measurement of Lay Length:

Lay length shall be measured for the complete bond by taking out lay print. The value shall be as per clause 7.3.3

12.8 D.C. Resistance Test:

Measurement of resistance shall be done by Kelvin Bridge or Digital Micro Ohmmeter. For converting measured resistance at ambient temperature to resistance @ 20° C, Annex-A to this specification be referred to. The value shall be as per Table-3 of clause 10.0.

12.9 Breaking Strength Test:

Breaking strength test on bond shall be carried out as per Annex-B of IS: 6594/2018. The value shall be as per table-3 of clause 10.0

In case, sample of Bond for Breaking Strength Test is prepared by Ferrule Secured Eye Terminals (Mechanical Splicing) as per IS 5245 : Part 2 : 2013 a reduction in test result upto 7% of specified breaking strength can be considered.

12.10 Approximate Mass:

Measurement of weight shall be done by taking a sample of one meter length using standard weight. The value shall be as per table-3 of clause 10.0.

12.11 Short Circuit Test:

Short Circuit Current of 6 kA(rms) shall be applied for duration of 1 second on 3 meter long bond with lugs crimped at each end.

The sample should withstand the current without any arcing or flashover. No current interruption shall be observed during test.

The maximum temperature measured immediately after short circuit test should not exceed 91°C if ambient temperature is between 15°c to 30°c and 101°c if ambient temperature is above 30°c.

13.0 Acceptance Criteria for Prototype:

13.1 The samples offered for type tests in accordance with clause 11.6 shall pass all the type tests.

13.2 Only after clear written approval of the results of the tests on the prototype is communicated by Director General (Traction Installation)RDSO, Lucknow/CORE, Prayagraj to the manufacturer, he shall take up bulk manufacture of the galvanized stranded wire which shall be strictly with the same material and process of manufacture as adopted for the prototype. In no circumstance shall material other than those adopted during the manufacture of prototype be used for bulk manufacture.

14.0 Acceptance Tests:

14.1 All the tests in clause 11.6 shall be carried out except short circuit test in the presence of representative of Director General (Traction Installation) RDSO, Lucknow/CORE, Prayagraj or to the purchaser.

14.2 The tests shall be conducted as laid down in the relevant clauses thereof.

14.3 Retest:

If more than one wire fails in any of the tests, two more samples of wire drawn from surplus wire samples selected as per clause 11.4.1.2 shall be tested. Retest shall be restricted to test in which failure occurred. During retest both the samples shall pass the test. If both the samples do not pass the test, lot shall be considered not acceptable.

If the sample of bond fails in any of the tests, two more samples of bond from the same lot shall be drawn and tested. Retest shall be restricted to test in which sample of bond failed. During retest both the samples shall pass the test. If both the samples do not pass the test, lot shall be considered not acceptable.

15.0 Packing:

The bond shall be delivered to the consignee properly wound on transit worthy wooden reel generally conforming to IS 1778 : 1980(R2004) in specified length unless otherwise coil packing of specified packing length or weight is specified or unless supply of Bond is specified to be in specified cut lengths. Coil/Reel as the case may be must be securely wrapped with polyethylene wrapper. In case of supply in reel, the minimum ground clearance should be 5mm.

Each coil/reel should be suitably labelled or stencilled, as the case may be which should contain following information:

1.0 Description
2.0 Diameter
3.0 Construction
4.0 Length of Wire
5.0 Weight of Wire (Net Weight)
6.0 Gross Weight
7.0 Production Sr. No.
8.0 Manufacturers Name
9.0 Month and Year of Manufacturer
10.0 Purchase Order No. and
11.0 Name of Consignee

16.0 Oiling:

During stranding stage, while being laid each strand shall get oiled. Double refined linseed oil or mineral oil with suitable additives, which resist white rust formation, may be used. Corrosion protective oil to IS 1154: 2000(R2005) shall be applied on the traction bond to protect the bond from corrosion during service.

17.0 Greasing:

Before crimping of lugs with the galvanized bond, a grease manufactured out of low volatile virgin mineral oil using over based calcium sulphonate complex thickener having NLGI grade-2 and shear table characteristics with age resistant and inherent water resistant

property containing copper shall be applied on the galvanized bond to protect the galvanized film on the wires.

18.0 End Lugs:

End Lugs shall be in accordance with Annex- B to this specification.

Wherever enquiry specifies supply of bond with Lug, offer manufacturer should be deemed to be with supply of Lugs duly crimped or loose as the case may be.

If lug is specified to be supplied duly crimped, slipping strength of crimped lug shall not be less than 1200 kgf. Only one sample per lot, minimum 2 meter long duly crimped with lug at each end shall be subjected to Slipping Strength Test.

Unless otherwise specified clearly, the supply of Bond shall be with plain end only.

19.0 Crimping:

lugs shall be crimped with Dowell's hand operated hydraulic tools SYE-150/HCT-150 with dies model noJER-12 at about crimping pressure of 450kg/cm2. Minimum three crimps on barrel portion of lugs shall be made to get proper joint.

20.0 All the provisions contained in RDSO's ISO procedures laid down in documents no ISO9001:2015 Document No:QO-D-8.1-11 Version No: 1.3 Date Effective: 01.07.2020 or latest(Title-"Vendor change in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contract floated by railways to maintain quality of products supplied to railways".

21.0 The "Make in India" policy-2017 of Government of India shall be applicable.

Annexure-A

Formula for converting Resistance measured at ambient temperature to Resistance at 20^{o} C

$$R20 = Rt \times \frac{1}{1+0.00403\,(T-20)}$$

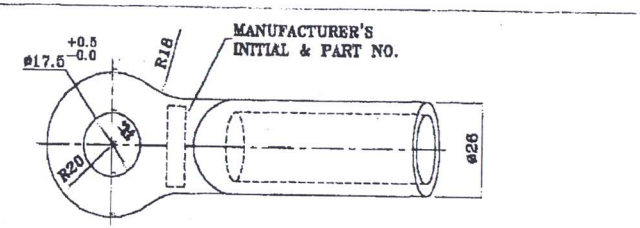
Where,

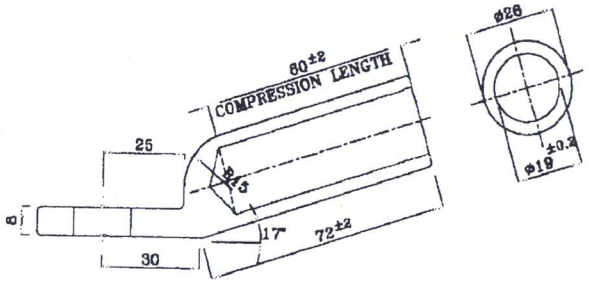
R20 = Resistance at 20o C

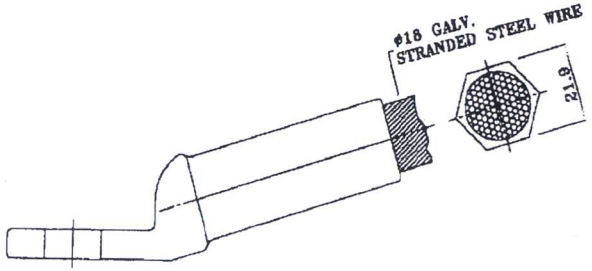
Rt = measured Resistance at ambient temperature

T = Ambient temperature during measurement

Annex - B







ASSEMBLY AFTER COMPRESSION

REF.	DESCRIPTION	PART NO.	MATERIAL	SPECIFICATION	NUMBER OFF
1	18mm LUG (FORGED)	SB-18	FORGED STEEL GALVD.	IS:2004 CLASS 2 STI/OHE/13	2

NOTES :-

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE STATED.
2. DIMENSIONAL TOLERANCE SHALL BE AS PER RDSO SPECIFICATION NO. ETI/OHE/46.
3. CONDITION - ANNEALED
4. SLIPPING STRENGTH - MINIMUM 1200 Kgf.
5. THE LUG TO BE COMPRESSED WITH HYDRAULIC COMPRESSION FROM ROUND TO HEXAGON.
6. COMPRESSIVE LOAD -80 t (APPROX.)
7. ZINC RICH PAINT OR EPOXY PAINT SHALL BE APPLIED AT THE COMPRESSED PORTION OF THE 18mm. LUG AFTER COMPRESSION FOR PROTECTION FROM RUSTING.
8. USAGE : THE LUG SHALL BE USED WITH 6X18(7/7/1) GLV. STEEL STRAN. WIRE FOR TRACTION SUPD.
9. MANUFACTURER'S INITIAL & PART NO. SHALL BE PROVIDED AS SHOWN AND SHALL BE DISTINCTLY VISIBLE AFTER GALV.

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18mm LUG (FORGED)
(Compression Type)

ADE/TI-II

DTI-II

REF.

CROSS REF:-

DATE	MOD.	NATURE OF MOD.	INITIALS

R.D.S.O.

	DATE	NAME	
DR	26.3.04	R.K.PAL	TI/DRG/OHE/GYHLUG/HD30/00001/04/0
TC			
CK	29.3.04	A.SRIV.	SCALE:-1:1 SUB-SCALE