GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

TECHNICAL SPECIFICATION
FOR
BIMETALLIC (ALUMINIUM-COPPER) STRIP

SPECIFICATION NO. TI/SPC/OHE/STRIP(Al-Cu)/0901

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Signature	D.S Meena	Bhardwaj Chaudhary	Sanjay Agarwal
Date			
Designation	SSE/Conductor	Director(TI)	ED(TI)

Copy number

Issued by…….. Signature Date……..

Issued to…….

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SPECIFICATION FOR BIMETTALIC (ALUMINIUM-COPPER) STRIP

1.0 SCOPE

This specification covers the requirements of bimetallic strips (aluminium-copper) to be used between aluminium and copper surfaces of electrical junctions carrying current, to avoid galvanic corrosion. This specification supersedes RDSO's specification No. ETI/OHE/55(5/85). Old Specification no. ETI/OHE/55(4/90) is re-designated and updated to TI/SPC/OHE/STRIP(Al-Cu)/0901 in-line with TI document no. TI-WI-7.5.1- 1 ver 1.0

The "Make in India" Policy of Government of India shall be applicable.

2.0 MATERIAL

The bimetallic strip shall be manufactured by bonding aluminium of EC grade, conforming to IS:737-~~1974~~ 2008(Revised 2013) or latest(wrought aluminium and aluminium alloy sheet and strip for general engineering purposes) and copper sheets, conforming to grade Cu-CATH-1 or Cu-CATH-2 or Cu-FRHC of IS:191-2007 or latest(Specification for copper), together by rolling under high pressure in several operations till the desired thickness is achieved. The ratio of thickness of aluminium and copper shall be 4:1, in the finished condition. The bimetallic strip shall be soft annealed before supply.

3.0 DIMENSIONS AND PERMISSIBLE VARIATIONS

3.1 The thickness of bimetallic strip shall be 1mm or 2mm as specified by the purchaser. The thickness shall be uniform through-out.

A tolerance of $^{+0.06}_{-0.06}$ mm for the strip of 1 mm thickness

and a tolerance of $^{+0.09}_{-0.07}$ mm for the strip of 2mm thickness is permissible.

3.2 The bimetallic strip shall be supplied in convenient lengths of 500mm and above, in steps of 100mm. The width of strip shall be as per the requirements of the purchaser.

4.0 TESTS

4.1 Before giving call to R~~DSO/The Chief Electrical Engineer~~Director General (TI)/RDSO /Purchaser for inspection and testing of the prototype, the manufacturer shall submit a detailed test schedule of each test, venue of test and duration of each test and the total number of days required to complete the tests at one stretch. Once the schedule is approved, the test shall invariably be done accordingly. However, during the process of type testing or even later, RDSO/Purchaser's representative reserves the right to conduct any additional test(s) besides those specified herein, on any equipment/subsystem or systems so as to test the system to his satisfaction or for gaining additional information and knowledge. In case any dispute or disagreement

arises between the manufacturer and representative of the Director General (TI)/RDSO /Purchaser ~~RDSO/The Chief Electrical Engineer~~ during the process of testing as regards the type tests and/or the interpretation and acceptability of the type test results, it shall be brought to the notice of the Director General (Traction Installation, RDSO/ ~~The Chief Electrical Engineer~~ Purchaser as the case may be, whose decision shall be final and binding.

4.2 Only after clear written approval of the results of the tests on the prototype is communicated by the purchase to the manufacturer, he shall take up bulk manufacture of the strip which shall be strictly with the same material and process as adopted for the prototype. In no circumstances, shall materials other than those approved in the prototype be used for bulk manufacture on the plea that they had been obtained prior to the approval of prototype.

4.3 The following tests shall constitute as type tests and acceptance tests. The sample shall be taken as indicated against each test :-

i) Visual examination – All samples.
ii) Measurement of thickness- Three samples.
iii) Density – One sample.
iv) Electrical resistivity test – One sample.
v) Erichsen cupping test – Two samples.
vi) Torsion test – Two samples.
vii) Reversible bending test – Two samples.
viii) Bend test – Two samples with copper surface outside and two samples with aluminium surface outside.

5.0 TEST METHODS

5.1 VISUAL EXAMINATION:

The bimetallic strip shall be examined visually. It shall be clean, bright, smooth and free from harmful defects.

5.2 MEASUREMENT OF THICKNESS :

The thickness of bimetallic strip, when measured by means of micrometer gauge, shall be as per clause 3.1. any measured value outside the specified limiting values shall be a cause for rejection.

5.3 DENSITY :

The mass of a sample of bimetallic strip of suitable size shall be weighed preferably by a digital balance and the density calculated. The density shall not be less than 3.70 gm/cm^3.

5.4 ELECTRICAL RESISTIVITY TEST :

A bimetallic strip of size 200x15mm shall be taken and its resistance shall be measured with the help of Double Kelvins Bridge/ Digital/analog micro ohm meter or

by milli volt drop test and resistivity calculated after correction for temperature variation. The electrical resistivity at 20 degree Celsius shall not be more than 2.70 micro ohm cm. This test shall be conducted as per the arrangement shown Annexure-I.

5.5 ERICHSEN CUPPING TEST :

This test shall be conducted as per IS: 10175-~~1982~~ 2018 or latest -~~"Method for modified Erichsem cupping test for metallic sheet and strip"~~ "metallic materials-sheet and strip-erichsen cupping test". The test consists of clamping the bimetallic test piece under controlled pressure between retaining ring and die and pressing the test piece into the die by means of a ball, or penetrator having a spherical head, until rupture commences. The depth of penetration thereby obtained is measured. For the purpose of this test the arrangement shown in Fig.1 of IS: 10175-2018 shall be used. Two samples of bimetallic strips shall be tested, one with the aluminium surface on the penetrator side and the other with the copper surface on the penetrator side. The sample shall be deemed to have passed the tests if the depth of the penetration is not less than 5mm.

5.6 TORSION TEST

Two samples of the bimetallic strip shall be tested. A strip of size 5mm wide and 120mm long shall be firmly fixed on a torsion testing machine so as to prevent it from slipping within the strips during the test. One grip of the machine shall be fixed while the other shall be free to rotate. The strip shall be subjected to torsion by rotating the movable grip through one complete revolution (360 degrees), bringing it back to the original mounted position by a complete turn in the opposite direction. The process shall be continued till the test piece breaks. The broken ends of the test piece shall be examined. The sample shall be deemed to have passed the test if there is no sign of separation between the two metallic strips.

5.7 REVERSIBLE BENDING TEST :

For the purpose of this test, two samples of the bimetallic strip shall be subjected to transverse bend test made on pieces cut with their major axes at right angles to the direction of rolling. The test consists of bending by hand a 200mm length of strip of 30mm width through 90 degree and back, or alternately on either side of the vertical so that the axes of the straight and bent portions of the strip remain in the same plane. The test piece shall be held between the blocks having a radius of 7mm. During each bending operation the strip shall touch the periphery of the block. The bending shall not be accompanied by any twisting of the Strip. The process shall be continued till the sample breaks. The broken ends shall be carefully examined. The test pieces shall be deemed to have passed the test if there is no sign of separations between the two metallic strips.

5.8 BEND TEST :

30mm wide samples of suitable length are bent round a mandrel of the following specified diameter once and examined. There shall not be any sign of separation or slipping between two metal sheets or coracle or fracture on surface.

S.N.	Thickness of strips (mm)	Radius of mandrel(mm)	
		Copper exterior	Aluminium exterior
1.	1	7.5	4.0
2.	2	10.0	6.0

6.0 CRITERIA FOR ACCEPTANCE :

The strips shall be offered in lots of 20kg or less. Samples shall be selected at random for tests. Should any sample fail in any one of the tests, two more samples shall be taken from the same lot and the particular test shall be repeated. If any of the samples fails in the re-test, the lot shall be rejected.

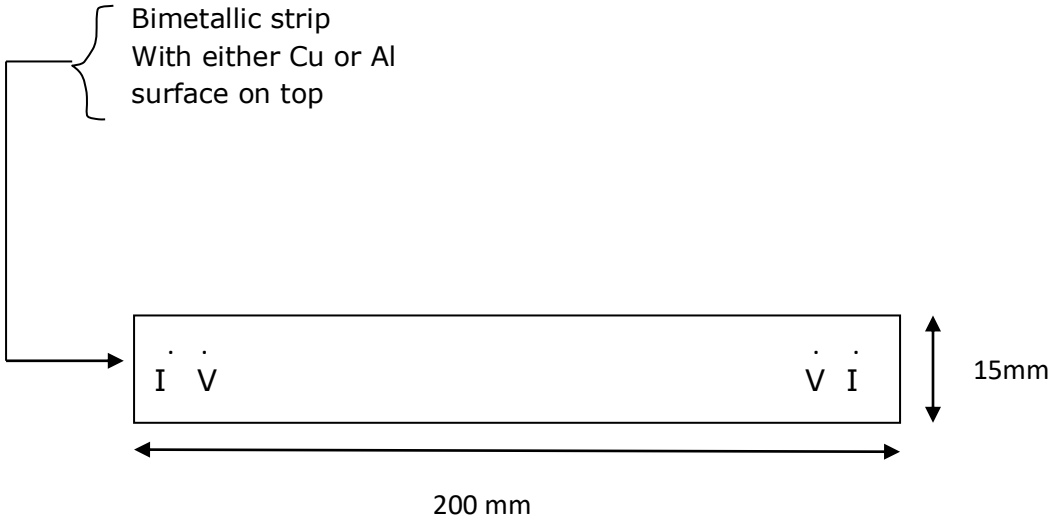
7.0 IDENTIFICATION :

Each strip passed by the inspector shall bear the mark (preferable by line stenciling with removable non-corrosive paint) of the inspector, manufacturers identification symbol and month & year of manufacture.

8.0 PACKING :

Unless otherwise specified, the strip shall be greased and packed with interleaving paper to avoid any chafing. Grease (IOL) (servogem-2) ~~BPCL (shell alumina 2)~~ and paper shall be neutral and non-corrosive. The whole package shall be wrapped in good quality water-proof paper in such a manner as to avoid ingress of moisture and dust, and shall be placed in a box or crate so as to ensure safe transportation of material.

ANNEXURE-I
To Specification no. TI/SPC/OHE/STRIP(Al-Cu)/0901



V = Position of Voltage probe

I = Position of current probe