

**TECHNICAL SPECIFICATION FOR ALL ALUMINIUM STRANDED ALLOY
CONDUCTORS (AAAC)**

[1] SCOPE:

This specification covers details of All Aluminium Alloy Conductor (AAAC) for use on overhead lines. The sizes of the conductor cover under this specification are as under:

1	Code Name	AAAC Weasel	AAAC Rabbit	AAAC Dog.
2	Size	7/2.5 mm	7/3.15mm	7/4.26 mm
3	area in mm ²	34 mm ²	55 mm ²	100 mm ²

The AAAC Conductors shall generally conform to IS: 398 (Part-IV), IEC:104-1987 except where otherwise specified herein.

[2] APPLICABLE STANDARDS:

The conductor shall conform to the following Indian/International Standards, which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification.

In the event of the supply of conductor conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent to those specified. In case of award, salient features of comparison between the standards proposed by the Contractor and those specified in this document will be provided by the Contractor to establish their equivalence.

SL .NO.	Indian Standard	Title	International Standard
1	IS:398 (Part-IV)	Aluminum Alloy stranded conductor	IEC : 208-1966 BS-3242-1970
2	IS : 9997-1988	Aluminum Alloy Redraw Rods	IEC 104-1987
3	IS : 1778-1980 Reels	Reels and Drums for bare conductors	BS:1559-1949

[3] PROPERTIES OF WIRES:

The Properties of aluminum alloy wires to be used in the construction of the stranded conductors shall be as in the following table.

TABLE - I Aluminium Alloy wires used in the construction of stranded Aluminium alloy conductors.

Diameter in mm			Final modulus of Elasticity, GN/sqm (kg/sq cm)	Coefficient of linear Expansion/° C	Mass Kg/Km	Minimum breaking load before stranding	Minimum breaking load after stranding	Resistance (at 20°C) ohm /KM Max.
Nominal	Min.	Max						
2.5	2.47	2.53	0.6324 * 10	23.0 * 10	13.25	1.52N	1.44 KN	6.845
3.15	3.12	3.18	0.6324 * 10	23.0 * 10	21.04	2.41N	2.29 KN	4.290
4.26	4.22	4.30	0.6324 * 10	23.0 * 10	38.48	4.4N	4.18 KN	2.345



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[4] PROPERTIES OF CONDUCTORS:

The properties of stranded all aluminum alloy conductors of various sizes shall be as in the following table.

TABLE- II ALL ALUMINIUM ALLOY CONDUCTORS (AAAC)

Nominal alloy area	Strands & wire dia.	Sectional Area	approx. overall dia.	approx. mass	Calculated resistance at 20°C (max)	Approx. breaking load.
sq. mm	mm	sq. mm	mm	Kg/KM	Ohm/KM	KN
34	7/2.5	34.36	7.5	94.00	0.990	10.11
55	7/3.15	54.55	9.45	149.2	0.621	16.03
100	7/4.26	99.77	12.78	272.86	0.339	29.26

[5] WORKMANSHIP

All the Al-alloy strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasions, etc., after drawing and also after stranding.

The finished conductor shall be smooth, compact, uniform and free from all imperfections including kinks (protrusion of wires), scuff marks, dents, pressmarks, cut marks, wire cross over, over riding, looseness (wire being dislocated by finger/hand pressure and/or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spot (on account of reaction with trapped rain water etc.), dirt, grit etc.

[6] JOINTS IN WIRES

No joint shall be permitted in any layer of finished conductor.

[7] STRANDING

In all constructions, the successive layers shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outer most layers of wires shall have a right hand lay. The lay ratio shall be as follow.

Number of wires in conductor	3/6 Wire layer		12 Wire layer		18 Wire layer	
	Min	Max	Min	Max	Min	Max
7	10	14	-	-	-	-

[8] MATERIALS - ALUMINUM ALLOY

The wire shall be of heat treated aluminum, magnesium silicon alloy having a composition appropriate to the mechanical & electrical properties as specified in IS 398(Part-4).



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The Aluminum Alloy strands drawn from heat treated aluminum alloy redraw rods conforming to Type B as per IEC:104-latest amendment. The chemical composition conforms to IS 1997-91, as given below:

Elements	Percent
Si	0.50-0.90
Mg	0.60-0.90
Fe	0.50 max
Cu	0.10 max
Mn	0.03 max
Cr	0.03 max
Zn	0.10 max
B	0.06 max
Other Element (Each)	0.03 max
Other Element (Total)	0.10 max
Al	Remainder

[9] STANDARD LENGTH

The standard length of the conductor shall be 2000 meters. A tolerance of +/-5% on the standard length offered by the Bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths. The conductor drums shall be adequate to wind one or more standard length of 2000 meters of SQUIRREL/WEASEL/RABBIT/RACOON/DOG/ PANTHER AAA conductor.

Random lengths will be accepted provided no length is less than 70% of the standard length and the total quantity of such random lengths shall not be more than 10% of the total quantity ordered.

Bidder shall also indicate the maximum single length, above the standard length, he can manufacture in the guaranteed technical particulars of offer. The Owner reserves the right to place orders for the above lengths on the same terms and conditions applicable for the standard lengths during the execution of the Contract.

[10] TESTS AND STANDARDS

The following tests to be conducted for AAAC conductors shall conform to IS 398(Part - IV) 1979 and IEC 888 & 889.

10.1 TYPE/PERIODIC

The following tests shall be conducted on samples of each type of conductor:

- a) UTS test on stranded conductor)

Annexure-A



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- II. Contractor shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that adequate facilities are available in the laboratories and the tests can be completed in these laboratories within the time schedule guaranteed by them.
- III. In case of failure in any type test, the Contractor is either required to manufacture fresh sample lot and repeat all the tests successfully once or repeat that particular type test three times successfully on the sample selected from the already manufactured lot at his own expenses. In case a fresh lot is manufactured for testing, then the lot already manufactured shall be rejected.
- IV. The entire cost of testing for the acceptance and routine tests and Tests during manufacture specified herein shall be treated as included in the quoted unit price of conductor, except for the expenses of the inspector/Owner's representative.
- V. In case of failure in any type test, if repeat type tests are required to be conducted, then all the expenses for deputation of Inspector/Owner's representative shall be deducted from the contract price. Also if on receipt of the Contractor's notice of testing, the Owner's representative does not find 'The material or testing facilities' to be ready for testing the expenses incurred by the Owner for re-deputation shall be deducted from contract price.

10.6 ADDITIONAL TESTS

- I. The Owner reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises, at site or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the materials comply with the Specifications.
- II. The Owner also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Contractor's premises or at any other test centre. In case of evidence of non-compliance, it shall be binding on the part of Contractor to prove the compliance of the items to the technical specifications by repeat tests, or correction of deficiencies, or replacement of defective items all without any extra cost to the Owner.

10.7 SAMPLE BATCH FOR TYPE TESTING

- I. The Contractor shall offer material for selection of samples for type testing only after getting Quality Assurance Plan approved from Owner's Quality Assurance Deptt. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by Owner.
- II. The Contractor shall offer at least three drums for selection of sample required for conducting all the type tests.
- III. The Contractor is required to carry out all the acceptance tests successfully in presence of Owner's representative before sample selection.



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10.8 TEST REPORTS

- I. Copies of type test reports shall be furnished in at least six copies along with one original. One copy will be returned duly certified by the Owner only after which the commercial production of the material shall start.
- II. Record of routine test reports shall be maintained by the Supplier at his works for periodic inspection by the Owner's representative.
- III. Test Certificates of tests during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Owner.

[11] INSPECTION

- I. The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where conductor shall be manufactured and representative shall have full facilities for unrestricted inspection of the Contractor's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.
- II. The Contractor shall keep the Owner informed in advance of the time of starting and of the progress of manufacture of conductor in its various stages so that arrangements can be made for inspection.
- III. No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Owner in writing. In the latter case also, the conductor shall be dispatched only after satisfactory testing for all tests specified herein have been completed.
- IV. The acceptance of any quantity of material shall in no way relieve the Contractor of any of his responsibilities for meeting all requirements of the Specification, and shall not prevent subsequent rejection if such material is later found to be defective.

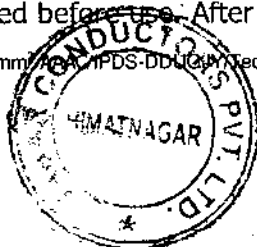
[12] TEST FACILITIES

The following additional test facilities shall be available at the Contractor's works:

- I. Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.
- II. Standard resistance for calibration of resistance bridges.
- III. Finished conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 meters per minute). The rewinding facilities shall have appropriate clutch system and free of vibrations, jerks etc. with traverse laying facilities.

[13] PACKING

- a. The conductor shall be supplied in non-returnable, strong, wooden drums provided with lagging of adequate strength, constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The Contractor shall be responsible for any loss or damage during transportation handling and storage due to improper packing. The drums shall generally conform to IS: 1778-1980, except as otherwise specified hereinafter.
- b. The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5 KN.
- c. The Contractor should submit their proposed drum drawings along with the bid.
- d. The Contractor may offer more than one length of the conductor in a single drum.
- e. All wooden components shall be manufactured out of seasoned soft wood free from defects that may materially weaken the component parts of the drums. Preservative treatment shall be applied to the entire drum with preservatives of a quality, which is not harmful to the conductor.
- f. The flanges shall be of two ply construction with a total thickness of 64 mm with each ply at right angles to the adjacent ply and nailed together. The nails shall be driven from the inside face flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2mm. There shall not be less than 2 nails per board in each circle. Where a slot is cut in the flange to receive the inner end of the conductor the entrance shall be in line with the periphery of the barrel.
- g. The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.
- h. Barrel studs shall be used for the construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.
- i. Normally, the nuts on the studs shall stand protruded of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be counter sunk. The ends of barrel shall generally be flushed with the top of the nuts.
- j. The inner cheek of the flanges and drum barrel surface shall be painted with a bitumen based paint.
- k. Before reeling, card board or double corrugated or thick bituminous water-proof bamboo paper or HDPE sheet shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper should be dried before use. After reeling the conductor the exposed surface



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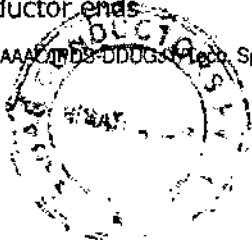
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- l. of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.
- m. A minimum space of 75 mm for conductor shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/ galvanized steel wire. Each protective lagging shall have two recesses to accommodate the binders.
- n. Each batten shall be securely nailed across grains as far as possible to the flange, edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nails shall not protrude above the general surface and shall not have exposed sharp, edges or allow the battens to be released due to corrosion.
- o. The nuts on the barrel studs shall be tack welded on the one side in order to fully secure them. On the second end, a spring washer shall be used.
- p. A steel collar shall be used to secure all barrel studs. This collar shall be located between the washers and the steel drum and secured to the central steel plate by welding.
- q. Outside the protective lagging, there shall be minimum of two binder consisting of hoop iron/ galvanized steel wire. Each protective lagging shall have two recesses to accommodate the binders.
- r. The conductor ends shall be properly sealed and secured with the help of U-nail on the side of one of the flanges to avoid loosening of the conductor layers during transit and handling.
- s. As an alternative to wooden drum Contractor may also supply the conductors in non-returnable painted steel drums. After preparation of steel surface according to IS: 9954, synthetic enamel paint shall be applied after application of one coat of primer. Wooden/Steel drum will be treated at par for evaluation purpose and accordingly the Contractor should quote in the package.

[14] MARKING

Each drum shall have the following information stenciled on it in indelible ink along with other essential data:

- a. Contract/Award letter number.
- b. Name and address of consignee.
- c. Manufacturer's name and address.
- d. Drum and lot number
- e. Size and type of conductor
- f. Length of conductor in meters
- g. Arrow marking for unwinding
- h. Position of the conductor ends



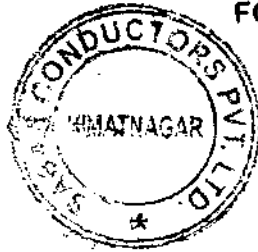
- i. Number of turns in the outer most layers.
- j. Gross weight of drum after putting lagging.
- k. Average weight of the drum without lagging.
- l. Net weight of the conductor in the drum.
- m. Month and year of manufacture of conductor

The above should be indicated in the packing list also.

[15] VERIFICATION OF CONDUCTOR LENGTH

The Owner reserves the right to verify the length of conductor after unreeling at least Two (2) percent of the drums in a lot offered for inspection.

For the balance drums, length verification shall be done by the owner based on report/certification from Manufacturer/Contractor.



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ANNEXURE-A**TESTS ON AAAC CONDUCTORS****[1] UTS Test on Stranded Conductor**

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5 m length between fixing arrangement suitably fixed on a tensile testing machine. The load shall be increased at a steady rate upto 50% of minimum specified UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at steady rate to minimum UTS and held for one minute. The Conductor sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

[2] D.C. Resistance Test on Stranded Conductor

On a conductor sample of minimum 5m length two contact-clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20°C as per IS:398- (Part-V)-1982. The resistance corrected at 20°C shall conform to the requirements of this Specification.

[3] CHEMICAL ANALYSIS OF ALUMINIUM ALLOY

Samples taken from the Aluminum alloy ingots/coils/strands shall be chemically/spectrographically analyzed. The same shall be in conformity to the requirements stated in this Specification.

[4] VISUAL AND DIMENSIONAL CHECK ON DRUMS

The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this Specification.

[5] VISUAL CHECK FOR JOINTS, SCRATCHES ETC.

Conductor drums shall be rewound in the presence of the Owner. The Owner shall visually check for scratches, joints etc. and that the conductor generally conforms to the requirements of this Specification. Two percent (2%) drums from each lot shall be rewound in the presence of the Owner's representative.

[6] DIMENSIONAL CHECK ON ALUMINUM ALLOY STRANDS

The individual strands shall be dimensionally checked to ensure that they conform to the requirement of this Specification.

[7] CHECK FOR LAY-RATIOS OF VARIOUS LAYERS

The lay-ratios of various layers shall be checked to ensure that they conform to the requirements of this Specification.

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[8] TORSION AND ELONGATION TESTS ON ALUMINUM ALLOY STRANDS

The test procedures shall be as per clause No. 10.3 of IEC : 888. In torsion test, the number of complete twists before fracture shall not be less than 18 on a length equal to 100 times the standard diameter of the strand. In case test sample length is less or more than 100 times the stranded diameter of the strand, the minimum number of twists will be proportioned to the length and if number comes in the fraction then it will be rounded off to next higher whole number. In elongation test, the elongation of the strand shall not be less than 4% for a gauge length of 250 mm.

[9] CHECK ON BARREL BATTEN STRENGTH OF DRUMS

The details regarding barrel batten strength test will be discussed and mutually agreed to by the Contractor & Owner in the Quality Assurance Programme.

[10] Breaking Load Test on Individual Aluminium Alloy Wires

The test shall be conducted on Aluminum alloy wires. The breaking load of one specimen cut from each of the samples taken shall be determined by means of suitable tensile testing machine. The load shall be applied gradually Si the jaws of the testing machine shall be not less than 25 mm/min. and not greater than 100 mm./ min. The ultimate breaking load of the specimens shall be not less than the values specified in the Specification.

[11] RESISTANCE TEST ON ALUMINUM ALLOY WIRE

The test shall be conducted on aluminium alloy wires only, conforming to procedure as per IEC: 889. The electrical resistance of one specimen of aluminium wire cut from each of the samples taken shall be measured at ambient temperature. The measured resistance shall be corrected to the value corresponding to 20 degree C. by means of following formula.

$$R_{20} = RT \frac{1}{1 + \alpha \times (T - 20)}$$

Where

R₂₀ = Resistance corrected at 20 degrees C.

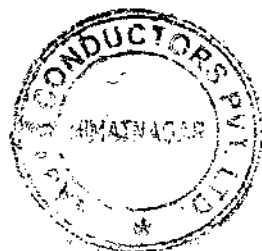
RT = Resistance measured at T degrees C.

alpha = Constant mass temperature coefficient of resistance 0.004.

T = Ambient temperature during measurement

This resistance calculated to 20 degrees C. shall be not more than the maximum value specified in the specification.

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Minimum lay ratio	10	10	10	Yes
Maximum lay ratio	14	14	14	Yes

B1	BIS License number(Copy Enclosed)	CM/L-7066368
B2	Validity Up to	18/12/2016
B3	List of Plant & Machinery.	Enclosed
B4	List of NABL approved test house calibrated Testing equipments.	Enclosed.

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Signature & Seal of Tenderer

PLACE: Himmatnagar



DATE: 12/10/2016

