

TECHNICAL SPECIFICATIONS

SECTION-V

1.0 Technical description of ACSR 'PANTHER' conductor

1.1 Details of conductor

1.1.1 The ACSR conductor shall generally conform to IEC:1089 /IS:398 (part-II) except where otherwise specified herein.

1.1.2 The details of the ACSR PANTHER conductor are tabulated below:

Sl. no.	Particulars	Details
1	Designation as per IEC:1089	ACSR PANTHER
2	Stranding and wire diameter	30/3.00 mm aluminium +7/3.00 mm steel
3	Number of strands	
	(i) Steel core	1
	(ii) 1st steel layer	6
	(iii) 1st aluminium layer	12
(iv) 2nd aluminium layer	18	
4	Sectional area of aluminium	212.1 sq. mm
5	Total sectional area	261.50 sq. mm
6	Overall diameter	21.00 mm
7	Approximate mass	974 (kg/ km)
8	Calculated D.C. resistance at 20 ⁰ centigrade	0.140 ohm/km
9	Minimum UTS	89.67 kN
10	Direction of lay of outer layer	Right hand

1.1.3 The details of aluminium strand are as follows:

- | | |
|---|--------------|
| (a) Minimum breaking load of strand before stranding | 1.17 kN |
| (b) Minimum breaking load of strand after stranding | 1.11 kN |
| (c) Maximum D.C. resistance of strand at 20 ⁰ centigrade | 4.107 ohm/km |

1.1.4 The details of steel strand are as follows:

- | | |
|---|-----------|
| (a) Minimum breaking load of strand before stranding | 9.29 kN |
| (b) Minimum breaking load of strand after stranding | 8.85 kN |
| (c) Minimum no. of twists to be withstood in torsion test
stranding) | 18(before |
| when tested on a gauge length of 100 times diameter
stranding) | 16(before |
| of wire | |

1.2 Workmanship

- 1.2.1 All the aluminium and steel 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.
- 1.2.2 The finished conductor shall be smooth, compact, uniform and free from all imperfections including kinks (protusion of wires), 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.
- 1.2.3 The steel strands shall be hot dip galvanised and shall have a minimum zinc coating of 250 gms/sqm. after stranding. The zinc coating shall be smooth, continuous, of uniform thickness, free from imperfections and shall withstand minimum three dips in standard Preece test. The steel wire rods shall be of such quality and purity that, when drawn to the size of the strands specified and coated with zinc, the finished strands and the individual wires shall be of uniform quality and have the same properties and characteristics as prescribed in IEC: 888.
- 1.2.4 The steel strands shall be preformed and post formed in order to prevent spreading of strands in the event of cutting of composite core wire. Care shall be taken to avoid, damages to galvanisation during pre-forming and post-forming operation.

1.3 Joints in wires

1.3.1 Aluminium wires

- 1.3.1.1 During stranding, no aluminium wire welds shall be made for the purpose of achieving the required conductor length.
- 1.3.1.2 No joints shall be permitted in the individual wires in the outer most layer of the finished conductor. However joints are permitted in the 12 wire inner layer of the conductor unavoidably broken during stranding, provided such breaks are not associated with either inherently defective wire or with the use of short lengths of aluminium wires. Such joints shall not be more than 4(four) per conductor length and shall not be closer than 15 meters from joint in the same wire or in any other aluminium wire of the completed conductor.
- 1.3.1.3 Joints shall be made by cold pressure butt welding and shall withstand a stress of not less than the breaking strength of individual strand guaranteed.

1.3.2 Steel wires

There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no strand joints or strand splices in any length of the completed stranded steel core of the conductor.

1.4 Tolerances

The manufacturing tolerances to the extent of the following limits only shall be permitted in the diameter of individual aluminium and steel strands and lay-ratio of the conductor:

(a) Diameter of aluminium and steel strands :

Sl. No.	Particulars	Standard	Maximum	Minimum
1	Aluminium	3.00 mm	3.03 mm	3.97 mm
2	Steel	3.00 mm	3.06 mm	3.94 mm

(b) Lay ratio of conductor:

Sl. No.	Particulars		Maximum	Minimum
1	Steel	6 wire layer	28	16
2	Aluminium	12 wire layer	16	10
		18 wire layer	14	10

1.5 Materials

1.5.1 Aluminium

The aluminium strands shall be hard drawn from electrolytic aluminium rods having purity not less than 99.5% and a copper content not exceeding 0.04%. They shall have the same properties and characteristics as prescribed in IEC: 889.

1.5.2 Steel

The steel wire strands shall be drawn from high carbon steel wire rods produced by either the acid or the basic open-hearth process, the electric furnace process, or the basic oxygen process and shall conform to the following requirements as to the chemical composition:

Sl. No.	Element	% Composition
1	Carbon	0.50 to 0.85
2	Manganese	0.50 to 1.10
3	Phosphorous	Not more than 0.035
4	Sulphur	Not more than 0.045
5	Silicon	0.10 to 0.35

The steel wire strands shall have the same properties and characteristics as prescribed for regular strength steel wire in IEC : 888-1987.

1.5.3 Zinc

The zinc used for galvanising shall be electrolytic high grade zinc of 99.95% purity. It shall conform to and satisfy all the requirements of IS:209.

1.6 Standard length

1.6.1 The standard length of the conductor shall be 1800 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.

1.6.2 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. When one number random length has been manufactured at any time, 5(five) more individual lengths each equivalent to the above random length with a tolerance of +/- 5% shall also be manufactured and all the above six random lengths shall be dispatched in the same shipment. At no point, the cumulative quantity supplied of such random lengths shall not be more than 12.5% of the total cumulative quantity supplied including such random lengths. However, the last 20% of the quantity ordered shall be supplied only in standard lengths as specified.

1.6.3 Bidder shall also indicate the maximum single length, above the standard length, he can manufacture in the guaranteed technical particulars of offer. This is required for special stretches like river crossing etc. 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 pendency of the contract.

2.0 Tests and standards

The above line materials shall be of proven design/type tested. Type tested material shall mean that all such type tests which are specified herein below and have been successfully carried out during last five years to prove the process of manufacture and general conformity of the material to this specification. The bidder shall be required to submit the copies of type test reports of these materials. The test reports submitted shall be for the tests conducted within last 5 (five) years prior to the date of bid opening. The type tests conducted earlier should have been conducted in accredited laboratory (accredited based on ISO/IEC guide 25/17025 & EN 45001 by the national accreditation body of the country where the laboratory is located) or witnessed by the representative(s) of the owner or any other utility.

In case the tests have been conducted earlier than the above stipulated period or in the event of any discrepancy in the test report (i.e. any test report not applicable due to any design/manufacturing charge including substitution of components or due to non-compliance with the requirement stipulated in the technical specifications) the tests shall be conducted by the contractor at no extra cost to the owner.

2.1 Type tests

The following tests shall be conducted once on a sample/samples of conductor for every 1000 kms. of production from each manufacturing facility:

- (a) DC resistance test on stranded conductor : as per annexure-A
- (b) UTS test on stranded conductor : as per annexure-A

2.2 Acceptance tests

- (a) Visual and dimensional check on drum : as per annexure-A

- (b) Visual check for joints scratches etc. and length measurement of conductor by rewinding : as per annexure-A
- (c) Dimensional check on steel and aluminium strands : as per annexure-A
- (d) Check for lay-ratios of various layers : as per annexure-A
- (e) Galvanising test on steel strands : as per annexure-A
- (f) Check for lay-ratios of various layers : as per annexure-A
- (g) Torsion and elongation tests on steel strands : as per annexure-A
- (h) Breaking load test on steel and aluminium strands : as per annexure-A
- (i) Wrap test on steel & aluminium strands : as per IEC:888 & IES:889
- (j) DC resistance test on aluminium strands : as per IEC : 889
- (k) Procedure qualification test on welded joint of aluminium strands : as per annexure-A

Note : All the above tests except (j) shall be carried out on aluminium and steel strands after stranding only.

2.3 Routine test

- (a) Check to ensure that the joints are as per specification
- (b) Check that there are no cuts, fins etc., on the strands.
- (c) Check that drums are as per specification
- (d) All acceptance test as mentioned above to be carried out on each coil

2.4 Tests during manufacture

- (a) Chemical analysis of zinc used for galvanizing : as per annexure-A
- (b) Chemical analysis of aluminium used for making aluminium strands : as per annexure-A
- (c) Chemical analysis of steel used for making steel strands : as per annexure-A

2.5 Testing expenses

2.5.1 Bidder 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.

2.5.2 In case of failure in any type test the supplier is either required to manufacture fresh sample lot and repeat all the test 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.

2.5.3 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.

2.5.5 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 supplier's notice of testing, the owner's representative does not find 'plant' to be ready for testing the expenses incurred by the owner for re-deputation shall be deducted from contract price.

2.6 Additional tests

2.6.1 The owner reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at supplier'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.

2.6.2 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 supplier's premises or at any other test centre. In case of evidence of non compliance, it shall be binding on the part of supplier 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.

2.7 Sample batch for type testing

2.7.1 The supplier shall offer material for selection of samples for type testing only after getting quality assurance plan approved from owner's quality assurance department. The sample shall be manufactured strictly in accordance with the quality assurance plan approved by owner.

2.7.2 The supplier shall offer at least three drums for selection of sample required for conducting all the type test.

2.7.3 The supplier is required to carry out all the acceptance tests successfully in presence of owner's representative before sample selection.

2.8 Test reports

2.8.1 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.

2.8.2 Record of routine test reports shall be maintained by the supplier at his works for periodic inspection by the owner's representative.

2.8.3 Test certificates of tests during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by the owner.

2.9 Inspection

- 2.9.1 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 supplier's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.
- 2.9.2 The supplier 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.
- 2.9.3 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.
- 2.9.4 The acceptance of any quantity of material shall in no way relieve the supplier 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.

2.10 Test facilities

- 2.10.1 The following additional test facilities shall be available at the supplier's works:
- (a) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.
 - (b) Standard resistance for calibration of resistance bridges.
 - (c) 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.

2.11 Packing

- 2.11.1 The conductor shall be supplied in non-returnable, strong, wooden drums provided with lagging of adequate strength, constructed to protect the conductor against all damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The supplier 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, except as otherwise specified hereinafter.
- 2.11.2 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.

- 2.11.3 The general outline of the drum for conductor shall be as in the annexed drawings. The bidder should submit their proposed drum drawings along with the bid.
- 2.11.4 For conductor, one standard length shall be wound on each drum.
- 2.11.5 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.
- 2.11.6 The flanges shall be of two ply construction 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. The thickness of each ply shall not vary by more than 3mm from that indicated in the figure. There shall be at least 3 nails per plank of ply with maximum nail spacing of 75mm. 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.
- 2.11.7 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.
- 2.11.8 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.
- 2.11.9 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.
- 2.11.10 The inner cheek of the flanges and drum barrel surface shall be painted with a bitumen based paint.
- 2.11.11 Before reeling, card board or double corrugated or thick bituminised water-proof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. After reeling the conductor, the exposed surface of the outer layer of conductor shall be wrapped with water proof thick bituminised bamboo paper to preserve the conductor from dirt, grit and damage during transport and handling.
- 2.11.12 A minimum space of 75 mm for conductor shall be provided between the inner surface of the external protective tagging and outer layer of the conductor.
- 2.11.13 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.

- 2.11.14 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.
- 2.11.15 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.
- 2.11.16 Outside the protective lagging, there shall be minimum of two binder consisting of hoop iron/galvanised steel wire. Each protective lagging shall have two recesses to accommodate the binders.
- 2.11.17 The conductor ends shall be properly sealed and secured on the side of one of the flanges to avoid loosening of the conductor layers during transit and handling.
- 2.11.18 As an alternative to wooden drum bidder 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 bidder should quote in the package.

2.12 Marking

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

- (a) Contract/award letter number.
- (b) Name and address of consignee.
- (c) Manufacturer's name and address.
- (d) Drum number
- (e) Size of conductor
- (f) Length of conductor in meters
- (g) Arrow marking for unwinding
- (h) Position of the conductor ends
- (i) Distance between outer-most layer of conductor and the inner surface of lagging.
- (k) Barrel diameter at three locations & an arrow marking at the location of the measurement.
- (l) Number of turns in the outer most layer.
- (m) Gross weight of drum after putting lagging.
- (n) Tear weight of the drum without lagging.
- (o) Net weight of the conductor in the drum.
- (p) MICC No.

The above should be indicated in the packing list also.

2.13 Verification of conductor length

The owner reserves the right to verify the length of conductor after unreeling at least 10%(ten percent) of the drums in a lot offered for inspection.

2.14 Standards

2.14.1 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.

2.14.2 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 supplier and those specified in this document will be provided by the supplier to establish their equivalence.

Sl. No.	Indian standard	Title	International standard
1.	IS: 209-1992	Specification for zinc	BS:3436-1986
2.	IS: 398-1982	Specification for aluminium conductors for overhead transmission purposes	IEC:1089-1991 BS:215-1970
3.	IS:398-1990 part-II	Aluminum conductor galvanised steel reinforced	BS;215-1970 IEC:1089-1991
4.	IS:398-1992 part-V	Aluminum conductor galvanised steel-reinforced for extra high voltage (400 kV) and above	IEC:1089-1991 BS:215-1970
5.	IS : 1778-1980	Reels and drums for bare conductors	BS:1559-1949
6.	IS : 1521-1991	Method of tensile testing of steel wire	ISO 6892-1984
7.	IS : 2629-1990	Recommended practice for hot dip galvanising of iron and steel	
8.	IS : 2633-1992	Method of testing uniformity of coating on zinc coated articles	
9.	IS : 4826-1992	Galvanised coating on round steel wires	IEC : 888-1987 BS:443-1969
10.	IS : 6745-1990	Methods of determination of weight of zinc coating of zinc coated iron and steel articles	BS:433-1969 ISO 1460 - 1973
11.	IS : 8263-1990	Method of radio interference tests on high voltage insulators	IEC:437-1973 NEMA:107-1964 CISPR

12.	IS : 9997-1988	Aluminium alloy redraw rods	IEC 104 - 1987
13.		Zinc coated steel wires for stranded conductors	IEC : 888-1987
14.		Hard drawn aluminium wire for overhead line conductors	IEC : 889-1987
15.	IS:398 (part-IV)	Aluminium alloy stranded conductor	IEC : 208-1966 BS-3242-1970

The standards mentioned above are available from:

Reference abbreviation	Name and address
BS	British standards, British standards institution 101, Pentonville road, N - 19-ND, UK
IEC/CISPR	International electro technical commission, Bureau central de la commission, electro technique international, 1 Rue de verembe, Geneva, Switzerland
BIS/IS	Beureau of Indian standards. Manak bhavan, 9, Bahadur shah zafar marg, New Delhi – 110001, India
ISO	International organisation for standardization. Danish board of standardization Danish standardizing sraat, Aurehoegvej-12 DK-2900, Heeleprup, Denmark.
NEMA	National electric manufacture association, 155, east 44th street. New York, NY 10017 U.S.A.

1.0 Tests on conductor**1.1 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.

1.2 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 metre and subsequently one metre 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 20⁰C as per IS: 398-(Part-II)-1990. The resistance corrected at 20⁰C shall conform to the requirements of this specification.

1.3 Chemical analysis of aluminium and steel

Samples taken from the aluminium and steel ingots/coils/strands shall be chemically/spectrographically analysed. The same shall be in conformity to the requirements stated in this Specification.

1.4 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.

1.5 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 conform to the requirements of this specification. 10%(ten percent) drums from each lot shall be rewound in the presence of the owner's representative.

1.6 Dimensional check on steel and aluminium strands

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

1.7 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.

1.8 Procedure qualification test on welded aluminium strands.

Two aluminium wire shall be welded as per the approved quality plan and shall be subjected to tensile load. The breaking strength of the welded joint of the wire shall not be less than the guaranteed breaking strength of individual strands.

1.9 Chemical analysis of zinc

Samples taken from the zinc ingots shall be chemically/ spectrographically analysed. The same shall be in conformity to the requirements stated in the specification.

1.10 Galvanising test

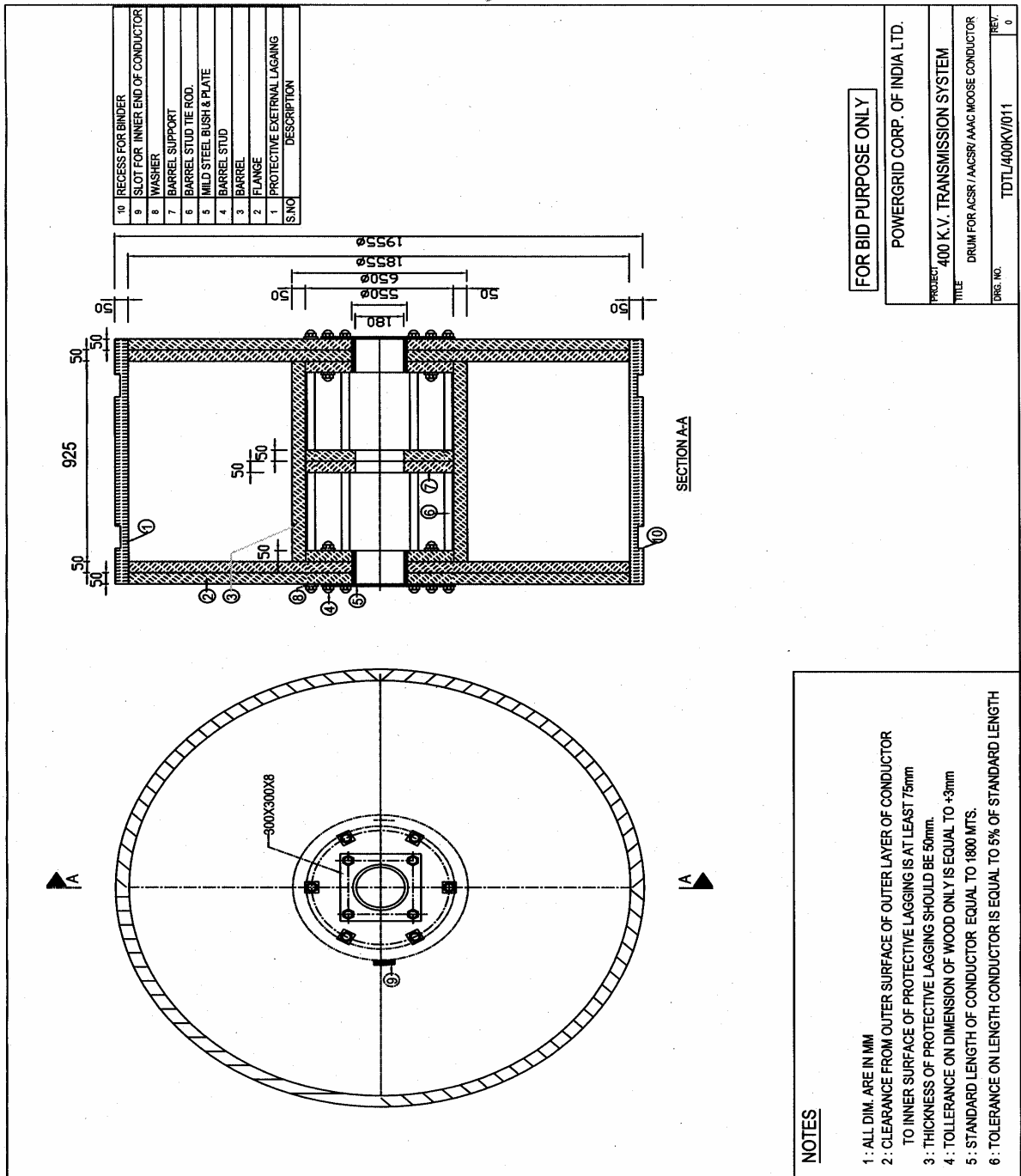
The test procedure shall be as specified in IEC: 888. The material shall conform to the requirements of this specification. The adherence of zinc shall be checked by wrapping around a mandrel four times the diameter of steel wire.

1.13 Torsion and elongation tests on steel 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 16 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.

1.14 Check on barrel batten strength of drums

The details regarding barrel batten strength test will be discussed and mutually agreed to by the supplier & owner in the quality assurance programme.



FOR BID PURPOSE ONLY

PROJECT	POWERGRID CORP. OF INDIA LTD.
TITLE	400 K.V. TRANSMISSION SYSTEM
DRUM FOR ACSR / AACSR / AAC MOOSE CONDUCTOR	
DRG. NO.	TDTL/400KV/011
REV.	0

NOTES

- 1: ALL DIM. ARE IN MM
- 2: CLEARANCE FROM OUTER SURFACE OF OUTER LAYER OF CONDUCTOR TO INNER SURFACE OF PROTECTIVE LAGGING IS AT LEAST 75mm
- 3: THICKNESS OF PROTECTIVE LAGGING SHOULD BE 50mm.
- 4: TOLERANCE ON DIMENSION OF WOOD ONLY IS EQUAL TO +3mm
- 5: STANDARD LENGTH OF CONDUCTOR EQUAL TO 1800 MTS.
- 6: TOLERANCE ON LENGTH CONDUCTOR IS EQUAL TO 5% OF STANDARD LENGTH

END OF SECTION - V