



GUJARAT ENERGY TRANSMISSION
CORPORATION LTD.
Sardar Patel Vidyut Bhavan, Race Course,
Vadodara: 390 007

TECHNICAL SPECIFICATION
OF
ACSR CONDUCTOR
FOR
TRANSMISSION LINE

GETCO/E/TS –CON052/R5 July 2022

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TECHNICAL SPECIFICATION FOR ACSR CONDUCTORS

1.0 SCOPE

- 1.1 This specification provides for design, manufacture, testing, inspection, packing and dispatch, to destination of Steel Cored Aluminum Conductors, specified herein for their satisfactory operation in various lines and substations of the State.
- 1.2 These conductors are to be used as power conductors on single circuit and / or double circuit 220KV, 132KV, & 66KV transmission lines and / or substations of the purchaser.

2.0 STANDARDS

- 3.1 The power conductor shall conform to the following Indian / International Standards, which shall mean latest revisions, amendments / changes adopted and / or published as on the date of opening of the Tender.

Sr. No.	Indian Standards	Title	International Standards
1	IS : 209	Specification BS : 3436 for zinc	
2	IS : 398 Part I to V (As relevant)	Specification IEC : 209 for aluminium BS : 215 conductor for (Part-II) overhead Transmission purpose.	
3	IS : 1778	Reels and BS : 1559 Drums for Bare Conductors	

Sr. No.	Indian Standards	Title	International Standards
4	IS : 1521	Method of Ten-ISO / R 89 site testing of steel wire.	
5	IS : 2629	Recommended practice for Hot dip galvanising of Iron and Steel.	
6	IS : 2633	Method of Testing uniformity of coating of zinc coated articles.	
7	IS : 4826	Galvanised coating quoting on round steel wire.	ASTM A – 472 729 BS : 443
8	IS : 6745	Methods of determination of weight of zinc coating of zinc coated iron and steel articles.	BS : 443

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9	IS : 8263	Method of radio Interference tests on high voltage Insulators	IEC:437 NEMA : 107 CISPR
10	IS : 1841	EC grade aluminium rod produced by rolling (Second Revision)	
11	IS : 5484	EC grade aluminium rod produced by continuous casting and rolling (first revision)	

However, in an event where the supplier offers ACSR conductor conforming to standards other than the above, then the salient points of comparison between the standards adopted and the standards quoted herein shall be detailed in relevant schedule with an authenticated English version of such standards referred to.

3.0 CLIMATIC CONDITIONS

- i) Location : In the State of Gujarat As per Annexure-I.
- ii) Maximum Ambient Air Temperature. ° C. : 50
- iii) Minimum Ambient Air Temperature. ° C. : 0
- iv) Average daily ambient Air Temperature ° C. : 35
- v) Maximum relative humidity. - % : 95
- vi) Average rainfall per annum.(mm) : 1150
- vii) Maximum altitude above mean sea level – Mtrs : 1000
- viii) isokeraunic level i.e. Average number of Thunder storm - Days/annum : 15
- ix) Maximum wind pressure.(kg/Sq. meters) : 200
- ix) Seismic level i.e. Earthquake Acceleration
 - a) Horizontal Seismic Co-efficient (acceleration) – g (Zone – 5) : 0.08
 - b) Vertical Seismic Co-efficient (acceleration) – g (Zone – 5) : 0.84

4.0 PRINCIPAL PARAMETERS

4.1 The details of conductor are tabulated here under :-

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Sr. No	Description	Alumunium				Steel			
		Moose	Zebra	Panther	Dog	Moose	Zebra	Panther	Dog
1)	Number Of Strands – Nos.	54	54	30	6	7	7	7	7
2)	Diameter – mm. I) Strands a) Nominal b) Maximum c) Minimum II) Overall Conductor	3.53 3.55 3.51 31.77	3.18 3.21 3.15 28.6	3.00 3.03 2.97 21.0	4.72 4.77 4.67 14.15	3.53 3.60 3.46	3.18 3.24 3.12	3.00 3.06 2.94	1.57 1.60 1.54
3)	Cross Sectional Area– Sq. mm. a) Whole Conductor b) Each Strand	597.0 9.787	484.5 7.94	261.5 7.06	118.5 17.5	9.787	7.94	7.06	1.94
4)	Laying Of Strands – Nos. a) Center b) First Layer c) Second Layer d) Third Layer	N.A 12 18 24	N.A 12 18 24	N.A 12 18 -	N.A 6 - -	1 6 - -	1 6 - -	1 6 - -	1 6 - -
5)	Weight (Excl. Wt. Of Grease) – Kg / Km. a) Whole Conductor b) Strand (At Nominal Dia.)	2004 26.45	1621 21.47	974 19.11	394 47.8	76.34	61.95	55.13	15.10
6)	Calculated D.C. resistance at 20 °C - Ohms / Km a) Whole Conductor b) Strand	0.5552 2.921	0.06869 3.626	0.139 4.079	0.2792 1.650	N.A	N.A	N.A	N.A.
7)	Ultimate Tensile Stress – KN a) Whole Conductor b) Strand i) Before ii) After Stranding	161.20 1.57 1.49	130.32 1.29 1.23	89.67 1.17 1.11	32.41 2.78 2.64	N.A. 12.86 12.22	N.A 10.43 9.91	N.A 9.29 8.83	N.A 2.70 2.57

**SIGNATURE AND
SEAL OF THE BIDDER**

8)	Modulus of Elasticity – a) Kg / Sq. Cm.	0.7036 $\times 10^6$	0.7036 $\times 10^6$	0.8158 $\times 10^6$	0.76478x 106	N.A.	N.A.	N.A.	N.A.
9)	Coefficient of linear expansion - per deg. C.	19.3x1 0 ⁻⁶	19.3x10 ⁻⁶	17.8x10 ⁻⁶	19.8x10 ⁻⁶	11.5x10 ⁻⁶			
10)	Chemical Composition - % a) EC Grade Al. b) Copper (Max.) c) Carbon d) Manganese e) Phosphorous f) Sulphur g) Silicon	99.95 0.04 N.A N.A N.A N.A N.A				N.A N.A. 0.50 – 0.85 0.50 – 1.10 Max. 0.035 Max. 0.045 0.10 – 0.35			
11)	Grease Make Protetilo – 56 – 57 OR Rustilo – 442					As per IS 398 (Part-2) – 1996 neutral Grease between the layers of steel only wires			
12)	Zinc a) Purity - %	N . A .				99.95			
13)	Resistivity – Ohms Sq.mm / Mtr. (At 20°C Max)	0.028264				N . A .			
14)	Density (At 20°C) – Gm / cm ³	2.703				7 . 80			
15)	Constant Mass Temp. Co-efficient Of resistance – Per°C	0.004				N . A .			
16) *	Lay Ratios a) First Layer i i) Maximum ii)Minimum b) Second Layer j i) Maximum ii)Minimum c) Third Layer k i) Maximum ii)Minimum	14 12	17 10	16 10	14 10	28 13	28 13	28 13	28 13
		13 11	16 10	14 10	- -	- -	- -	- -	- -
		12 10	14 10	- -	- -	- -	- -	- -	- -
17)	Elongation (Minimum) - % before stranding	N. A.				4			

* - The lay ratios of the aluminium shall not be greater than lay ratio of aluminium layer immediately beneath it.

**SIGNATURE AND
SEAL OF THE BIDDER**

5.0 GENERAL TECHNICAL REQUIREMENT

- 5.1 The ACSR conductor shall be suitable for being installed directly in air supported on suspension insulator strings or anchored through tension insulator strings at the power cross arms of single circuit, double circuit or multi circuit transmission line towers.
- 5.2 The conductor shall therefore be suitable for satisfactory operation under the tropical climatic conditions listed in the relevant clause. The applicable design particulars of the conductor to be used on these lines is furnished in Annexure - I. "System Particulars".

5.3 Physical Constants Of Materials

5.3.1 Physical constants for Hard-drawn Aluminium.

5.3.1.1 Resistivity :

The resistivity of aluminium depends upon its purity and its physical condition. However as per the specified value of purity in this specification the maximum value permitted is 0.028264 ohm. sq. mm / mtr at 20 Deg. C, and this value shall be used for calculation of the maximum permissible value of resistance. This value may be checked from the measured value of the resistance.

5.3.1.2 Density :

At a temperature of 20°C the density of hard drawn aluminium shall be 2.703 g/cm³.

5.3.2 Constant-Mass Temperature Co-efficient of Resistance

- 5.3.2.1 At a temperature of 20°C the constant-mass temperature co-efficient of resistance of hard drawn aluminium measured between two potential points rigidly fixed to the wire, the metal being allowed to expand freely, has been taken as 0.004 per degree Celsius.

5.3.3 Co-efficient of Linear Expansion:

- 5.3.3.1 The co-efficient of linear expansion of hard-drawn aluminium at 0°C has been taken as 19.3×10^{-6} per °C. This value holds good for all practical purposes over the range of temperature from 0°C to highest safe operating temperature.

5.4 Physical constants for Galvanised steel wires

5.4.1 Density

5.4.1.1 At a temperature of 20°C, the density of galvanized steel wire is to be taken as 7.80 g/cm³.

5.4.2 Co-efficient of Linear Expansion

In order to obtain uniformity in calculations a value of 11.5×10^{-6} Per °C may be taken as the value for the co-efficient of Linear Expansion of galvanized steel wires used for the cores of steel-reinforced aluminum conductors.

5.5 Materials

5.5.1 The conductors shall be manufactured from EC grade aluminum rods suitably hard-drawn on wire drawing machines. The aluminum rods used shall comply with all the relevant ISS, BSS, or other standards to be specified along with the due justifications.

5.5.2 Galvanised steel wire shall be drawn from high carbon steel rods produced by either acidic or basic open hearth process, electric furnace process or basic oxygen process. All the properties of the steel strands and wires shall confirm to the relevant standards.

5.5.3 The zinc used for galvanising shall be electrolytic high grade Zinc not less than 99.95 percent purity. It shall conform to and satisfy all the requirements of relevant ISS, BSS or other Standards to be specified with the due justification. Galvanising has to be done by hot dip galvanising process. Neutral grease may be applied between the layers of wires, however the weight of the same shall be specified and added to the total weight of the conductor.

NOTE: Lithium soap grease corresponding to Grade II of IS:7623-1974 (Specification for lithium soap greases) is suitable for such application.

5.5.4 The bidder should specify the source of raw materials along with the proof of last purchases made. The GETCO may reject the tender of the Bidders whose raw material suppliers are found to be supplying any poor quality or non standard materials, to the GETCO or any other purchaser.

5.6 Freedom From Defects

- 5.6.1 The wires shall be smooth and free from all imperfections such as spills, splits, slag inclusion, die marks, scratches, fittings, blow-holes, projections, looseness, overlapping of strands, chipping of aluminium layers etc. and all such other defects which may hamper the mechanical & electrical properties of the conductor as also the installation of the conductor at the site etc. Special care should be taken to keep away dirt, grit etc. during stranding.

5.7 Wire Sizes

5.7.1 Nominal Size and Tolerances

The aluminium and galvanized steel wires for the stranded conductor covered by this standard shall have diameters specified in clause 4.1 and shall be within the tolerances indicated therein. The diameter of the steel wires shall be measured over the zinc coating.

5.8 Joints In Wires

5.8.1 Aluminum Wires

- 5.8.1.1 No joints shall be permitted in the aluminium wires in the outermost layer of the ACSR conductor. Joints in the inner layers are permitted, in addition to those made in the base rod or wire before final drawing, but no two such joints shall be less than 15 mtr. apart in the complete stranded conductor. Such joints shall be made by cold pressure butt-welding.

NOTE : Joints are not permitted in the outermost layer of the conductor in order to ensure a smooth conductor finish and reduce radio interference levels and corona losses on the extra high voltage lines.

5.8.2 Galvanised steel wires

- 5.8.2.1 There shall be no joints except those in the base rod or wire before final drawing, in steel wires forming the core of the steel-reinforced aluminium conductor.

5.9 Stranding

5.9.1 The wires used in the construction of galvanized steel reinforced aluminium conductor shall before stranding and after stranding shall satisfy all the relevant requirements as per the standards indicated or any other standards with due justification.

5.9.2 The zinc used for galvanizing shall be electrolytic high grade Zinc. It shall conform to and satisfy all the requirements of relevant standards indicated or any other standards with due justification. Galvanising shall be done by hot dip galvanising process. Neutral grease may be applied between the layers of wires.

NOTE: Lithium soap grease corresponding to Grade II of IS:7623-1974 (Specification for lithium soap greases) is suitable for such application.

5.9.3 The lay ratio of the different layers shall be within the limits given in Table above.

5.9.4 In all constructions, the successive layers shall have opposite directions of lay, the outermost layer being right-handed. The wires in each layer shall be evenly and closely stranded.

5.9.5 In conductors having multiple layers of aluminium wires, the lay ratio of any aluminium layer shall not be greater than the lay ratio of the aluminium layer immediately beneath it.

5.10 Standard Length

5.10.1 The standard length of the conductor shall be 2000 meter. A tolerance of +/-5% on the standard length shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.

5.10.2 Random lengths will be accepted provided no length is less than 95% of the standard length specified and the total quantity of such random lengths shall not be more than 5% of the total quantity ordered.

5.10.3 Bidder shall also indicate the maximum single length, above the standard length, he can manufacture in the guaranteed technical particulars. This is required for special stretches like river crossing etc. The purchaser reserves the right to place orders for the above length to the extent of 50% of the total ordered quantity on the same terms and conditions applicable for the standard lengths during the tendency of the contract.

5.10.4 For specification of standard length mentioned at 5.10.1 may be specified as under for ACSR Zebra, Panther and Dog Conductor :

Sr. No.	Type of Conductor	Standard length in Meter	Tolerance.
1	ACSR Moose, Zebra, Panther, And Dog.	2000 2500*	$\pm 5\%$ $\pm 5\%$

(*) for river crossings, if any.

6.0 **TESTS :**

6.1 The type, acceptance, routine tests & tests any specifically demanded by the GETCO and tests during manufacture shall be carried out on the conductor free of cost.

6.1.1 Type tests shall mean those tests, which are to be carried out to prove the process of manufacture and general conformity of the material to this specification. These tests shall be carried out on samples prior to commencement of commercial production against the order. The Supplier shall indicate his schedule for carrying out these tests in the activity schedule. These tests shall have to be carried out at the Government Approved Testing Laboratory only in presence of the GETCO's representative. GETCO reserves the right to specify the name of the laboratory also, if so felt.

6.1.2 Acceptance Tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of that lot. These tests shall be carried out at the manufacturers works in presence of GETCO's representative before the dispatch of the materials to the site.

6.1.3 Routine Tests shall mean those tests which are to be carried out on each strand/spool/length of the conductor to check requirements which are likely to vary during production. These tests shall be carried out by the manufacturer on each drum and shall have to furnish the reports to the GETCO's representative during his visit for acceptance tests.

6.1.4 Tests during manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the supplier to ensure the desired quality of the end product to be supplied by him, including all quality control checks & raw material testing.

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- 6.1.5 Samples for individual wires for tests shall be taken before stranding from not less than ten percent of the spools in the case of aluminum wires and ten percent of the coils in the case of steel wires. If samples are taken after stranding, they shall be obtained by cutting 1.2-2.0 meters from the outer end or inner end of the finished conductor from not more than ten percent of the finished reels.
- 6.1.6 The standards to which these tests will be carried out are listed against them. Where a particular test is a specific requirement of this specification, the norms and procedures of the test shall be as specified in Annexure-II or as mutually agreed between the supplier and the purchaser in the Quality Assurance Programme.
- 6.1.7 For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Bidder in the "Guaranteed Technical Particulars", of his proposal or the acceptance value specified in this specification, whichever is more stringent for that particular test.

6.2 Type Tests

Bidder shall submit following tests from NABL accredited/Government Laboratory. The test shall be carried out in accordance with latest /amended / up to date IS. The bidder has to submit the all type test reports as stated hereunder for the offered item along with the technical bid. The type test reports from NABL accredited/Government Laboratory shall not be older than Ten years. Type test reports shall be valid as on the last date of submission of bid.

6.2.1 Bidder shall submit the following Type test reports along with Technical bid

1. Measurement of Diameter (Cl. 13.2)
 - a) Aluminium Wire
 - b) Steel Wire
2. Breaking Load Test (Cl. 13.3)
 - a) Aluminium Wire (before/after)
 - b) Steel Wire (before/after)
3. Ductility Test (Cl. 13.4)
 - a) % Elongation (Steel wire) (before/after)
 - b) Torsional test (before/after)
4. Wrapping Test (Cl. 13.5)
 - a) Aluminium Wire
 - b) Steel Wire
5. Resistance Test (Cl. 13.6)
 - a) Aluminium Wire
 - b) Conductor
6. Measurement of Lay Ratio (Cl. 13.8)
 - a) First Layer (Steel)
 - b) Outermost Layer (Alu.)
 - c) Beneath Outermost Layer (Alu.)

**SIGNATURE AND
SEAL OF THE BIDDER**

7. Stress Strain Test (Cl. 13.11)
 - a) On composite conductor
 - b) On steel core
8. Surface Condition Test (Cl. 13.9)
9. Ultimate Breaking Load of stranded conductor (Cl. 13.10)
10. Galvanising Test of steel wire (Cl. 13.7)
 - a) Weight of Zinc coating
 - b) Uniformity of Zinc coating
11. Dry RIV and Corona-Applicable to ACSR Moose Conductor only.

Important Note:

In case of non-submission / partial submission or type test reports of which validity is over, the bidder shall submit pending type test report/s from NABL accredited/Government Laboratory, in the event of an order, before commencement of supply without affecting delivery schedule, free of cost to GETCO. Confirmation for above shall be invariably submitted along with technical bid. Furthermore, purchaser reserve right to select the sample from Manuf. Works & recommend the NABL lab to carry out type tests in case of non-submission/ partial submission or type test reports of which validity is over.

6.3 Acceptance Tests

a)	Visual and dimensional check	IS:398(Part II) 1996/Relevant with latest Amendment.
b)	Visual check for joints, scratches etc. and lengths of conductor	- D O -
c)	Dimensional check on steel and aluminium strands	IS:398(Part – 2) 1996 or as per this specifications
d)	Check for lay ratio of various layers.	IS : 398 (Part II) 1996 / Relevant with latest Amendment.
e)	Galvanising test on steel strands	- D O -
f)	Torsion and elongation test on steel strands	- D O -
g)	Breaking load test on steel and aluminum strands.	- D O -
h)	Wrap test on steel and aluminum strands.	- D O -
i)	DC resistance test on aluminum strands	- D O -
j)	UTS test on welded joint of aluminum strand	As per this specification

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

6.4 Routine tests

- a) Check ensure that the joints are as per specifications.

**SIGNATURE AND
SEAL OF THE BIDDER**

- b) Check that there are no cuts, fins etc. on the strands.
- c) Check that drums are as per specification.
- d) All acceptance tests as mentioned in Clause 6.3 above shall be carried out on each coil.

6.5 Test During Manufacture

a)	Chemical analysis of zinc used for galvanising	IS : 398 (Part II) 1996 / Relevant with latest Amendment.
b)	Chemical analysis of aluminium used for making aluminium strands	IS : 398 (Part II) 1996 / Relevant with latest Amendment.
c)	Chemical analysis of steel used making steel strands.	IS : 398 (Part II) 1996 / Relevant with latest Amendment.

6.6 Testing Charges

- 6.6.1 The testing charges for the type tests specified and as per relevant IS shall be borne by the bidder. All the suppliers irrespective of quantity allotted to them, and time when they have earlier carried out the Type Test, will have to carry out the Type Tests at their own cost and GETCO will not have any bearing on this account.
- 6.6.2 In case of failure in any of the type test/s, the supplier is either required to modify the design of the material or repeat the particular type test three times successfully at his own expense. The decision of the GETCO in this regard shall be final and binding. The GETCO at its own desecration may also cancel the order at the risk and cost of the supplier. If the material fails twice successfully in the type test.
- 6.6.3 Bidder shall indicate the laboratories in which they proposed to conduct the type tests. They shall ensure that the tests can be completed in these laboratories within the time schedule guaranteed by them in the appropriate schedule. GETCO reserves the right to specify the name of the laboratory also, if so felt.
- 6.6.4 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.

6.7 Additional Tests

The GETCO reserves the right of getting done 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 material comply with the specifications. In such case all the expenses will be to Suppliers account.

6.8 Sample Batch For Type Testing

- 6.8.1 The Supplier shall offer at least three (3) drums for selection of samples required for conducting all the type tests.
- 6.8.2 The Supplier is required to carry out all the acceptance tests successfully in the presence of Purchaser's representative before dispatch of the selected sample to the testing laboratory for type test..

6.9 Test Reports

- 6.9.1 Copies of type test reports shall be furnished in at least two(2) copies along with one original. One copy shall be returned duly certified by the Purchaser only after which the material already inspected i.e. the materials manufactured for selection of sample for type test, shall be dispatched on receipt of Dispatch Instructions from the Chief Engineer (Projects).
- 6.9.2 Record of routine test reports shall be maintained by the Supplier at his works for periodic inspection by the purchasers representative.
- 6.9.3 Test Certificates of test during manufacture shall be maintained by the Bidder. These shall be produced for verification as and when desired by the Purchaser.

6.10 Test Facilities

- 6.10.1 The following additional facilities shall be available at Supplier's works:-
- a) Calibration Reports from Government approved testing laboratory 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 transverse layering facilities.

- d) The bidder should have all the routine and acceptance testing facilities, in house.

7.0 INSPECTION

- 7.1 The Purchaser'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 the representative shall have full facilities for unrestricted inspection of the Suppliers works raw materials and process of manufacture and conducting necessary tests as may be deemed fit, for certifying the quality of product.
- 7.2 The Supplier shall keep the Purchaser 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.
- 7.3 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected, tested, and necessary dispatch instructions are issued in writing, except for the cases where waiver of inspection is granted by competent authority of the GETCO, and even in this case also written dispatch instructions will be issued. Any dispatches before the issue of Dispatch Instructions in writing will be liable for rejection and non acceptance by the consignee.
- 7.4 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.
- 7.5 At least 5% of the total number of drums subject to minimum of two in any lot put up for inspection, shall be selected at random to ascertain the length of conductor by following method:
"At the works of the manufacturer of the conductor, the conductor shall be transferred from one drum to another at the same time measuring its length with the help of a graduated pulley & Cyclometer. The difference in the average length thus obtained and as declared by the Supplier in the packing list shall be applied to all the drums if the conductor is found short during checking."
- 7.6 The sample cut of from any numbers of drums for carrying out any type of tests will be to the suppliers account.

8.0 QUALITY ASSURANCE PLAN

8.1 The bidder shall invariably furnish following information along with his offer, failing which his offer shall be rejected.

- i) Statement giving list of important raw materials names of sub suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials in presence of supplier's representative and as routine and / or acceptance during production and on finished goods, copies of test certificates.
- ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.
- iii) List of manufacturing facilities available.
- iv) Level of automation achieved and list of areas where manual processing exists.
- v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- vi) List of testing equipment available with the Supplier for final testing of Conductor specified. In the case if the suppliers does not possess all the Routine and Acceptance testing facilities the tender will be rejected.
- vii) The GETCO reserves the right for factory inspection to verify the facts quoted in the offer. If any of the facts are found to be misleading or incorrect the offer of that Bidder will be out rightly rejected and he may be black listed.
- viii) Special features provided to make it maintenance free.

8.2 The bidder shall also submit following information to the purchaser along with the technical Bid. .

- i) List of raw materials as well as bought out accessories, and the name of suppliers of raw materials as well as bought out accessories.
- ii) Type test certificates of the raw material and bought out accessories.

- iii) Quality assurance plan (QAP) with hold points for purchaser's inspection.

8.3 The Supplier shall submit the routine test certificates of all the bought out items, accessories etc.

9.0 DOCUMENTATION

9.1 Two sets of type test reports, duly approved by the Purchaser shall be submitted by the Supplier, before commencement of supply. A copy of acceptance and routine test certificates, duly approved by the purchaser shall accompany the dispatch consignment.

9.2 The manufacturing of the conductor shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the conductor prior to the approval of the drawing shall be at supplier's risk.

9.3 Approval of drawing etc. by the purchaser shall not relieve the Supplier of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The conductor shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and purchaser shall have the power to reject any work or material which in his judgement is not in full accordance therewith.

9.4 All the drawings, i.e. elevation, side view, plan, cross sectional view etc., in AutoCAD format and manuals in PDF format, for offered item shall be submitted. Also the hard copies as per specification shall be submitted.

9.5 The bidder shall submit Quality Assurance Plan for manufacturing process and Field Quality Plan with the technical bid.

9.6 All the points other than GTP, which are asked to confirm in technical specifications must be submitted separately with the bid.

10.0 PACKING & FORWARDING

10.1 The conductor shall be supplied in returnable steel drums or non-returnable strong wooden drums as per the tender schedule A, provided with lagging of adequate strength, and displacement during transit, storage and

subsequent handling and stringing operations in the field. The drums shall confirm to IS:1778-1980 except otherwise specified hereinafter. For returnable steel drum, additional GETCO technical specification for the same shall be referred.

- 10.2 The drums shall be suitable for wheel mounting and for jetting off the conductor under a minimum controlled tension of the order of 5 kN.
- 10.3 The bidder should submit the proposed drum drawings & GTP along with the bid. However, the same shall be in line with the requirements as stated herein. After placement of the Letter of Award, the Supplier shall submit four copies of fully dimensioned drawing of the drum, for Purchaser's approval before taking up manufacturing of Conductor and or drums. After getting approval from the Purchaser, Supplier shall submit 6 more copies of the approved drawing to Purchaser for further distribution and field use at Purchaser's end.
- 10.4 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 for anti-termite/anti-fungus (Aldrime / Aldruse) etc. shall be applied to the entire drum with preservatives of a quality which is not harmful to the conductor nor to the persons using or storing the same.
- 10.5 For wooden drum, the flanges shall be of three ply construction with each ply at right angles to the other and nailed together. The nails shall be driven from the inside face flange, punched and then clenched on the outer face. The tolerance in thickness of each ply shall be +3 mm only. There shall be at least 3 nails per plank of ply with maximum nail spacing of 75 mm. Where a slot is cut in the flange to receive the inner end of the conductor, the entrance shall be in the line with the periphery of the barrel.
- 10.6 For wooden drum, 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.
- 10.7 Barrel studs shall be used for construction of wooden 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. Barrel studs should be tack welded with the nuts after tightening.

- 10.8 Normally, the nuts on the studs shall stand proud of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of barrel shall generally be flushed with the top of the nuts.
- 10.9 The complete drum including inner cheek of the flanges and drum barrel surface shall be painted with a bitumen based paint.
- 10.10 For any type of drum, before reeling, card board or double corrugated or thick bituminized waterproof bamboo paper shall be secured to the drum barrel and inside of flanges or the drum by means of a suitable commercial adhesive material. The paper should be dried before use. Medium grade Kraft paper shall be used in between the layers of the conductor. After reeling the conductor, the exposed surface 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.
- 10.11 A minimum space of 125 mm shall be provided between the inner surface of the external protective layer and outer layer of the conductor for 'Moose' conductor, however 75 mm shall be acceptable for all other conductors.
- 10.12 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 nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.
- 10.13 Outside the protective layer, there shall be minimum of two binder consisting of hoop iron/galvanized steel wire. Each protective layer shall have two recess to accommodate the binders.
- 10.14 The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges. The end securing shall be done by taking out at least 500 mm. of steel core on either ends and sealing it with U-nails. The composite conductor shall be banded by use of galvanized steel wire/aluminium.
- 10.15 Wire at three locations at the most 75 mm apart or less covered with PVC adhesive tape so as to avoid loosening of conductor layers in transit and handling.
- 10.16 Only one length of conductor shall be wound on each drum.

	Name of conductor	Length	Drum Size	Flange Dia (A)	Barrel Dia (B)	Travers (W)	No. of TIE ROD	Thickness (T)
1	Moose/Zebra Conductor	2000 $\pm$ 5% 2500 $\pm$ 5%	Drawing to be submitted as per requirement (IS 1778,1980)					37 +37+37= 111 37 +37+37= 111
2	Panther Conductor	2000 $\pm$ 5% 2500 $\pm$ 5%	Drawing to be submitted as per requirement (IS 1778,1980)					32 + 32+32=96 32 + 32+32=96
3	Dog Conductor	2000 $\pm$ 5% 2500 $\pm$ 5%	Drawing to be submitted as per requirement (IS 1778,1980)					32 + 32+32=96 32 + 32+32=96

10.17 If any bidder wishes to supply the conductor in the steel drums the same will be acceptable, however free of cost.

11.0 Marking

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

- Contract/Award letter / order number
- Name and address of consignee
- Manufacturer's name and address
- Drum Number
- Size of conductor
- Length of conductor in meters
- Gross weight of drum with conductor
- Weight of empty drum with lagging
- Arrow marking for unwinding.

12.0 QUANTITY AND DELIVERY REQUIREMENT

Schedule of requirement and desired delivery is as per indent annexure.

13.0 DRAWINGS

13.1 All the bidders have to submit the drawings for the drums to be utilized for packing of the conductor, for the lengths specified in this Specification.

14.0 DEVIATIONS

14.1 Any deviation to this Technical Specification will be out rightly rejected. All the Bidders have to submit this specification duly authenticated without any alterations, additions etc. on each page along with the Technical Bid. Any offer without this will be out rightly rejected.

ANNEXURE-I

SYSTEM PARTICULARS

A) Electrical System Data :

a)	System Voltage (KV rms)	400	220	132	66
b)	Max. Voltage KV rms)	420	245	145	72
c)	Lightning impulse withstand voltage (dry & wet) (KVP)	1425	1050	650	350
d)	Power Frequency withstand voltage (wet) (KV rms)	650	460	275	140
e)	Short circuit level (KA) for 3 Sec.	40	40	40	25
f)	Switching Surge withstand voltage (wet) KVP	1050	NA	NA	NA
g)	Normal Span – M	400	350	350	260
h)	Wind Span – M	440	385	385	300
i)	Factor of safety at everyday temp and no wind	4	4	4	4

ANNEXURE - II

TEST PROCEDURES

1.0 UTS TEST ON STRANDED CONDUCTOR

- 1.1 Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5 m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate up to (50%) of 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 a steady rate to (100%) of UTS and held for one minute. The applied load shall then be increased until the failing load is reached and the value recorded.

2.0 SURFACE CONDITION TEST

- 2.1 A sample of the finished conductor for use in 400/220 / 132/66 KV system having a minimum recommended length of 5 meters with compression type dead end clamps compressed on both ends in such a manner as to permit the conductor to take its normal straight line shape, shall be subjected to a tension of 50 percent of the UTS of the conductor. The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of conductor. The measured diameter at any place shall be not be less than the sum of the minimum specified diameters of the individual aluminium and steel strands as given in this specification.

3.0 D.C. RESISTANCE TEST ON STRANDED CONDUCTOR

- 4.1 On a conductor sample of minimum 5m length two contact clamps shall be fixed with a pre-determined 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 shall be recorded. The value obtained shall be corrected to the value at 20 deg. C as per Clause No. 12.8 of IS : 398 (Part V) / 1996. The resistance corrected at 20 deg. C shall conform to the requirements of this specification.

4.0 RADIO INTERFERENCE VOLTAGE TEST (ONLY FOR MOOSE)

Under the conditions as specified under (2) above, the conductor samples shall have a radio interference voltage level below 1000 micro volts at one

MHz when subjected to 50 Hz AC voltage specified in this specification under dry and wet conditions.

5.0 STRESS-STRAIN TEST SURFACE CONDITION TEST

5.1 This test is contemplated to collect the creep data of the conductor from the Bidder. A sample of conductor of minimum 10 meters length shall be suitably compressed with dead end clamps.

5.2 Test Set - Up

5.2.1 The test sample shall be supported in a through over its full length and the through shall be adjusted such that the conductor does not get lifted by more than 10mm under tension. This shall be ascertained by actual measurement.

5.2.2 The distance between the clamp and the sleeve mouth shall be monitored with calipers during the test to ensure that after the test, it does change by more than ± 0.1 mm from the value before the test.

5.2.3 The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which lock the steel and aluminium wires together. Target plates may be used with dial gauges on displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting the conductor, lifting it and moving it from side-to-side by the maximum amounts expected during the test should introduce no more than 0.3 mm error in the reading.

5.3 Test Loads for Complete Conductor

5.3.1 The loading conditions for repeated stress-strain tests for complete conductor shall be as follows :

5.3.1.1 1 KN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then strain gauges are to be set at zero at the zero tension.

5.3.2 For non-continuous stress-strain data, the strain readings at 1 KN intervals at lower tension and 5 KN intervals above 30% of UTS shall be recorded.

- 5.3.3 The sample shall be reloaded to 50% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 Minutes. The load shall then be released.
- 5.3.4 Reloading up to 70% of UTS shall be done and held for 1 hour. Readings are to be noted after 5,10,15,30,45 and 60 minutes and then load shall be released.
- 5.3.5 Reloading up to 85% of UTS shall be done and held for 1 hour. Readings are to be noted after 5,10,15,30,45 and 60 minutes and then load shall be released.
- 5.3.6 Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongation shall be recorded up to 90% of UTS at the intervals described under Clause 6.3.5.

5.4 Test Loads For Steel Core Only

The loading conditions for repeated stress-strain tests for the steel core of ACSR shall be as follows :

- 5.4.2 The test shall consist of successive application of load applied in a manner similar to that for one complete conductor at 30%, 50%, 70% and 85% of UTS.
- 5.4.3 The steel core shall be loaded until the elongation at the beginning of each hold period corresponds to that obtained on the complete conductor at 30%, 50%, 70% and 85% of UTS respectively.

5.5 Stress Strain Curves

The design stress-strain curve shall be obtained by drawing a smooth curve through the 0.5 and 1 hour points at 30%, 50% and 70% of UTS loading. The presence of any aluminium slack that can be related to any observed extrusion entering the span from the compression dead ends shall be removed from the lower ends of the design curves. Both the laboratory and design stress-strain curves shall be submitted to the purchaser along with test results. The stress-strain data obtained during the test shall be corrected to the standard temperature i.e. 20 deg. C.

6.0 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 this specification.

7.0 CHEMICAL ANALYSIS OF ALUMINIUM AND STEEL

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

8.0 VISUAL AND DIMENSIONAL CHECK ON DRUMS

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

9.0 VISUAL CHECK FOR JOINTS, SCRATCHES ETC.

Conductor drums shall be rewound in the presence of the inspecting officer. The inspector shall visually check the scratches, joints, etc. and that the conductor generally conform to the requirements of the specification.

10.0 DIMENSIONAL CHECK OF STEEL AND ALUMINIUM STRANDS

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

11.0 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.

12.0 GALVANISING TEST

The test Procedure shall be as specified in relevant IS. The material shall conform to the requirements of this specification.

13.0 TORSION AND ELONGATION TESTS ON STEEL STRANDS

The test procedures shall be as per the relevant IS 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 standard diameter of

the strand, the minimum number of twist will be proportionate 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 200 mm.

14.0 BREAKING LOAD TEST ON WELDED ALUMINIUM STRAND

Two Aluminum wire shall be welded as per the approved quality plan and shall be subjected to tensile load. The welded point of the wire shall be able to withstand the minimum breaking load of the individual strand specified in this specification.

**GUJARAT ENERGY TRANSMISSION
CORPORATION LTD.**

**Sardar Patel Vidyut Bhavan, Race Course,
Vadodara : 390 007**

GUARANTEED TECHNICAL PARTICULARS

FOR

ACSR CONDUCTOR

GUARANTEED TECHNICAL PARTICULARS FOR ACSR 'DOG'
CONDUCTOR

The Guaranteed Technical particulars furnished below shall be duly attested by the Bidder. Any correction / alterations in this GTP will lead to out right rejection of the Bid.

Sr. No	Description	Aluminum	Steel
1)	Number of Strands – Nos.	6	7
2)	Diameter of Strand – mm. I) Strands i) Nominal j) Maximum k) Minimum II) Overall Of Conductor	4.72 4.77 4.67 14.15	1.57 1.60 1.54 ---
3)	Cross Sectional Area of – Sq. mm. a) Whole Conductor (Appro.) b) Each Strand	118.5 17.5	--- 1.94
4)	Laying of Strands – Nos. e) Center First Layer	N.A. 6	1 6
5)	Weight (Excl. Wt. Of Grease) – Kg / Km. c) Whole Conductor d) Strand (At Nominal Dia.)	394 47.8	--- 15.10
6)	Calculated D.C. resistance at 20 °C - Ohms / Km c) Whole Conductor d) Strand	0.2792 1.650	N.A. N.A.
7)	Ultimate Tensile Stress – KN c) Whole Conductor d) Strand iii) Before Stranding iv) After Stranding	32.41 2.78 2.64	N.A. 2.70 2.57
8)	Modulus of Elasticity – • Kg / Sq. Cm. • GN / Sq. M	0.76478x10 ⁶ 75	
9)	Coefficient of linear expansion - per deg. C.	19.8x10 ⁻⁶	11.5x10 ⁻⁶
10)	Chemical Composition - % h) EC Grade Al. i) Copper (Max.)	99.5 0.04	N.A N.A.

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	j) Carbon	N.A	0.50 – 0.85
	k) Manganese	N.A	0.50 – 1.10
	l) Phosphorous	N.A	Max. 0.035
	m) Sulphur	N.A	Max. 0.045
	n) Silicon	N.A	0.10 – 0.35
11)	Grease Make Protectilo – 56 57 or Rustilo - 442	As per IS 389 (Part-2) – 1996 Neutral Grease between the layers of steel wires only	
12)	Zinc Purity - %	99.95	
13)	Resistivity – Ohms Sq. mm / Mtr. (At 20°C Max)	0.028264	N . A .
14)	Density (At 20°C) – Gm /cm ³	2.703	7 . 8 0
15)	Constant Mass Temp. Co- efficient Of resistance – Per°C	0.004	N . A .
16)*	Lay Ratios d) First Layer 1 i) Maximum ii) Minimum	14 10	28 13
17)	Elongation (Minimum) - % Before stranding	N. A.	4

* - The lay ratios of the outer aluminium shall not be greater than lay ratio of Aluminium layer immediately beneath it.

Signature of the Bidder : _____

Name : _____

Designation : _____

Date : _____

Authorized common rubber

Stamp / seal of the bidder : _____

GUARANTEED TECHNICAL PARTICULARS FOR ACSR 'PANTHER'
CONDUCTOR

The Guaranteed Technical particulars furnished below shall be duly attested by the Bidder. Any correction / alterations in this GTP will lead to out right rejection of the Bid.

Sr. No	Description	Aluminum	Steel
1)	Number of Strands – Nos.	30	7
2)	Diameter of Strand – mm. I) Strands l) Nominal m) Maximum n) Minimum II) Overall Of Conductor	3.00 3.03 2.97 21.00	3.00 3.06 2.94 ---
3)	Cross Sectional Area of – Sq. mm. c) Whole Conductor (Approx.) d) Each Strand	261.5 7.06	--- 7.06
4)	Laying of Strands – Nos. f) Center g) First Layer Second Layer	N.A. 12 18	1 6 N.A.
5)	Weight (Excl. Wt. Of Grease) – Kg / Km. e) Whole Conductor f) Strand (At Nominal Dia.)	974 19.11	--- 55.13
6)	Calculated D.C. resistance at 20 °C - Ohms / Km e) Whole Conductor f) Strand	0.1390 4.079	N.A. N.A.
7)	Ultimate Tensile Stress – KN e) Whole Conductor f) Strand v) Before Stranding vi) After Stranding	89.67 1.17 1.11	N.A. 9.29 8.83
8)	Modulus of Elasticity – b) Kg / Sq. Cm. c) GN / Sq. M	0.8158x10 ⁶ 80	
9)	Coefficient of linear expansion - per deg. C.	17.8x10 ⁻⁶	11.5x10 ⁻⁶

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SEAL OF THE BIDDER**

10)	Chemical Composition - % o) EC Grade Al. p) Copper (Max.) q) Carbon r) Manganese s) Phosphorous t) Sulphur u) Silicon	99.5 0.04 N.A N.A N.A N.A N.A	N.A N.A. 0.50 – 0.85 0.50 – 1.10 Max. 0.035 Max. 0.045 0.10 – 0.35
11)	Grease Make Protectilo – 56 57 OR Rustilo – 442	As per IS 389 (Part-2) – 1996 Neutral Grease between the layers of steel wires only	
12)	Zinc Purity - %	99.95	
13)	Resistivity – Ohms Sq. mm / Mtr. (At 20°C Max)	0.028264	N . A .
14)	Density (At 20°C) – Gm /cm ³	2.703	7 . 8 0
15)	Constant Mass Temp. Co-efficient Of resistance – Per°C	0.004	N . A .
16)*	Lay Ratios e) First Layer m i) Maximum ii)Minimum f) Second Layer n i) Maximum ii)Minimum	16 10 14 10	28 13 N . A . N . A .
17)	Elongation (Minimum) - % Before Stranding	N. A.	4

* - The lay ratios of the outer aluminium shall not be greater than lay ratio of Aluminium layer immediately beneath it.

Signature of the Bidder : _____

Name : _____

Designation : _____

Date : _____

Authorized common rubber

Stamp / seal of the bidder : _____

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SEAL OF THE BIDDER**

GUARANTEED TECHNICAL PARTICULARS FOR ACSR 'ZEBRA'
CONDUCTOR

The Guaranteed Technical particulars furnished below shall be duly attested by the Bidder. Any correction / alterations in this GTP will lead to out right rejection of the Bid.

Sr. No	Description	Aluminum	Steel
1)	Number of Strands – Nos.	54	7
2)	Diameter of Strand – mm. I) Strands o) Nominal p) Maximum q) Minimum II) Overall Of Conductor	3.18 3.21 3.15 28.62	3.18 3.24 3.12 ---
3)	Cross Sectional Area of – Sq. mm. e) Whole Conductor f) Each Strand	484.5 7.94	--- 7.94
4)	Laying of Strands – Nos. h) Center i) First Layer j) Second Layer k) Third Layer	N.A. 12 18 24	1 6 N.A. N.A.
5)	Weight (Excl. Wt. Of Grease) – Kg / Km. g) Whole Conductor h) Strand (At Nominal Dia.)	1621 21.47	--- 61.95
6)	Calculated D.C. resistance at 20 °C - Ohms / Km g) Whole Conductor h) Strand	0.06868 3.626	N.A. N.A.
7)	Ultimate Tensile Stress – KN g) Whole Conductor h) Strand vii) Before Stranding viii) After Stranding	130.32 1.29 1.23	N.A. 10.43 9.91
8)	Modulus of Elasticity – • Kg / Sq. Cm. • GN / Sq. M	0.7036x10 ⁶ 69	
9)	Coefficient of linear expansion - per deg. C.	19.3x10 ⁻⁶	11.5x10 ⁻⁶

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10)	Chemical Composition - % v) EC Grade Al. w) Copper (Max.) x) Carbon y) Manganese z) Phosphorous aa) Sulphur bb) Silicon	99.5 0.04 N.A N.A N.A N.A N.A	N.A N.A. 0.50 – 0.85 0.50 – 1.10 Max. 0.035 Max. 0.045 0.10 – 0.35
11)	Grease Make Protectilo – 56 -57 or Rustilo – 442	As per IS 398 (Part – 2) 1996 Neutral Grease between the layers of steel wires only	
12)	Zinc Purity - %	99.95	
13)	Resistivity – Ohms Sq. mm / Mtr. (At 20°C Max)	0.028264	N . A .
14)	Density (At 20°C) – Gm /cm ³	2.703	7 . 8 0
15)	Constant Mass Temp. Co-efficient Of resistance – Per °C	0.004	N . A .
16)*	Lay Ratios g) First Layer o i) Maximum ii)Minimum h) Second Layer p i) Maximum ii)Minimum i) Third Layer q i) Maximum ii)Minimum	17 10 16 10 14 10	28 13 N. A. N. A.
17)	Elongation (Minimum) - % Before stranding	N. A.	4

* - The lay ratios of the outer aluminium shall not be greater than lay ratio of Aluminium layer immediately beneath it.

Signature of the Bidder : _____

Name : _____

Designation : _____

Date : _____

Authorized common rubber

Stamp / seal of the bidder : _____

GUARANTEED TECHNICAL PARTICULARS FOR ACSR 'MOOSE'
CONDUCTOR

The Bidder shall duly attest the Guaranteed Technical particulars furnished below. Any correction / alterations in this GTP will lead to out right rejection of the Bid.

Sr. No	Description	Aluminium	Steel
1)	Number of Strands – Nos.	54	07
2)	Diameter of Strand – mm. I) Strands a) Nominal b) Maximum c) Minimum II) Overall Of Conductor	3.53 3.55 3.51 31.77	3.53 3.60 3.46 ---
3)	Cross Sectional Area of – Sq. mm. a) Whole Conductor b) Each Strand	597.0 9.787	68.6 9.787
4)	Laying of Strands – Nos. a) Center b) First Layer c) Second Layer d) Third Layer	N.A. 12 18 24	01 06 N.A. N.A.
5)	Weight (Excl. Wt. Of Grease) – Kg / Km. a) Whole Conductor b) Strand (At Nominal Dia.)	2004 26.45	--- 76.34
6)	Calculated D.C. resistance at 20 °C - Ohms / Km a) Whole Conductor b) Strand	0.05552 2.921	N.A. N.A.
7)	Ultimate Tensile Stress – KN a) Whole Conductor b) Strand i) Before Stranding ii) After Stranding	161.20 1.57 1.49	N.A. 12.86 12.22
8)	Modulus of Elasticity – • Kg / Sq. Cm. • GN / Sq. M	0.7036x10 ⁶ 69	

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9)	Coefficient of linear expansion - per deg. C.	19.3x10 ⁻⁶	11.5x10 ⁻⁶
10)	Chemical Composition - % i) EC Grade Al. ii) Copper (Max.) iii) Carbon iv) Manganese v) Phosphorous vi) Sulphur vii) Silicon	99.5 0.04 N.A. N.A. N.A. N.A. N.A.	N.A. N.A. 0.50 – 0.85 0.50 – 1.10 Max. 0.035 Max. 0.045 0.10 – 0.35
11)	Grease Make Protectilo – 56 57 OR Rustilo – 442	Protectilo – 56/57 or Rustilo – 442 40	
12)	Zinc Purity - %	99.95	
13)	Resistivity – Ohms Sq. mm / Mtr. (At 20°C Max)	0.028264	N. A.
14)	Density (At 20°C) – Gm /cm ³	2.703	7.80
15)	Constant Mass Temp. Co- efficient Of resistance – Per °C	0.004	N.A.
16)*	Lay Ratios a) First Layer i) Maximum ii) Minimum b) Second Layer i) Maximum ii) Minimum	14 12 13 11 12 10	28 13 N.A. N.A.
17)	Elongation (Minimum) - % Before Stranding	N. A.	04

* - The lay ratios of the outer aluminium shall not be greater than lay ratio of Aluminium layer immediately beneath it.

Signature of the Bidder: _____
Name: _____
Designation: _____
Date: _____

Authorized common rubber
Stamp / seal of the bidder: _____

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