



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

**TECHNICAL SPECIFICATION**  
**OF**  
**HIGH AMPACITY ALLOY**  
**CONDUCTOR**  
**ZEBRA/MOOSE CONDUCTOR**  
**FOR**  
**TRANSMISSION LINE**

GETCO/E/TS –CON052/ R4 July 2022

**BLANK**

**BLANK**

## **TECHNICAL SPECIFICATION FOR AL59 CONDUCTORS**

### **1.0 SCOPE**

- 1.1 This specification provides for design, manufacture, testing, inspection, packing and dispatch, to destination of AL59 conductor, 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 & 400 kV transmission lines and / or sub-stations of the purchaser.

### **2.0 STANDARDS**

The conductor shall conform to the following International/Indian 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 Supplier and those specified in this document will be provided by the Supplier to establish their equivalence.

<b>Sl. No.</b>	<b>International /Indian Standard</b>	<b>Title</b>
1.	SS 4240814	Aluminium alloy stranded Conductors for overhead lines Al59 specifications
2.	SS 4240813	Aluminium alloy wire for stranded Conductors for overhead lines- Al 59 wires
3.	IS 398 – Part 2	Aluminium conductors for overhead transmission purposes specification (Aluminium conductors, Galvanized steel reinforced) – To be referred for testing procedure.
4.	IS 398 – Part 4	Aluminium conductors for overhead transmission purposes (Aluminium alloy stranded conductors (Al-Mg-Si type) – specification) – To be referred for testing procedure.
5.	IS 398 – Part 5	Aluminium conductors – Galvanized Steel – Reinforced for Extra High Voltage (400 kV & Above)

### **3.0 CLIMATIC CONDITIONS**

- i) Location : In the State of Gujarat.
- ii) Maximum Ambient Air Temperature. Degree Celsius. : 50
- iii) Minimum Ambient Air Temperature. Degree Celsius. : 0

- iv) Average daily ambient Air Temperature Degree Celsius. : 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 FOR Same Diameter

Sr. No	Description	Details	
		AL59 Equivalent to ACSR	
		ZEBRA	MOOSE
		Same Diameter	Same Weight
		AL59-ZEBRA	AL59- MOOSE
1)	Standard according to which the conductor will be manufactured and tested	SS 4240814 SS 4240813 IS 398 (P2) IS 398 (P4)	SS 4240814 SS 4240813 IS 398 (P2) IS 398 (P4)
2)	Quality of material & standard to which conform	SS 4240813, SS 4240814 & IS-9997	SS 4240813, SS 4240814 & IS-9997
3)	Number of strands and wire diameter in mm	61/3.18	61/3.50
5)	Number Of Strands – Nos.	61	61
6)	Diameter of Strand – mm.		
	I) Strands		
	a) Nominal	3.18	3.50
	b) Maximum	3.21	3.53
	c) Minimum	3.15	3.47
	II) Overall Of Conductor	28.62	31.50
7)	Cross Sectional Area of – Sq. mm.		
	a) Whole Conductor	484	587
	b) Each Strand	7.94	9.62
8)	Laying of Strands – Nos.		

	a) Centre wire b) First Layer c) Second Layer d) Third Layer e) Fourth Layer	1 6 12 18 24	1 6 12 18 24
9)	Weight (Excl. Wt. Of Grease) – Kg / Km. a) Whole Conductor b) Strand (At Nominal Dia.)	1336 21.43	1618 25.96
10)	Calculated D.C. resistance at 20 °C - Ohms / Km a) Whole Conductor b) Strand	0.06250 3.762	0.05070 3.100
11)	Ultimate Tensile Stress – KN a) Whole Conductor b) Strand i) Before Stranding ii) After Stranding	121.02  1.98 1.88	141.12  2.31 2.19
12)	Modulus of Elasticity – MPA	68000	68000
13)	Coefficient of linear expansion - per deg. C.	23.0x10 <sup>-6</sup>	23.0x10 <sup>-6</sup>
14)	Chemical Composition	The wire material shall be an aluminium alloy meeting the requirements on Resistivity, tensile strength etc.	The wire material shall be an aluminium alloy meeting the requirements on Resistivity, tensile strength etc.
15)	Resistivity – Ohms Sq.mm / Mtr.	Max.0.02930	Max.0.02930
16)	a) Continuous maximum operating temperature	95 °C	95 °C
17)	Minimum continuous current rating of conductor at 95 degree C corresponding of ambient temperature of 40 degree C & wind speed 0.56 mtr/sec.	910	1040

18)	Lay Ratios a) First Layer i) Maximum ii) Minimum b) Second Layer i) Maximum ii) Minimum c) Third Layer i) Maximum ii) Minimum d) Fourth Layer i) Maximum ii) Minimum	17 10 16 10 15 10 14 10	17 10 16 10 15 10 14 10
19)	Minimum tensile strength of the finished strand with joint if any made in base rod or semi finished wire a) Aluminium Alloy	Joints not allowed in outermost layer but Joints allowed in inner layers and tensile strength of joint wire is at least 90% of the value required for a un joint wire.	Joints not allowed in outermost layer but Joints allowed in inner layers and tensile strength of joint wire is at least 90% of the value required for a un joint wire.

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

## **5.0 GENERAL TECHNICAL REQUIREMENT**

**5.1** The AL59 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 are furnished in Annexure - I. "System Particulars".

### **5.3 Physical Constants of Materials**

**5.3.1** The AL59 should be as per SS 4240814 and its latest amendments. The material offered shall be of the best quality and workmanship. The AL59 shall have accurate chemical composition of Alloy so as to offer excellent corrosion resistance, better strength to weight ratio and improved conductivity. The solution treatment shall be done in a very sophisticated and advanced technology furnace with automatic quenching system.

#### **5.3.1.1 Resistivity:**

The resistivity of AL59 depends upon its purity and its physical condition. However as per the specified value of purity in this specification the maximum value permitted is 0.02930 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 20Degree Celsius the density of AL59 shall be 2.70 g/cm<sup>3</sup>.

**5.3.2 Constant-Mass Temperature Co-efficient of Resistance**

5.3.2.1At a temperature of 20Degree Celsius the constant-mass temperature co-efficient of resistance of AL59 measured between two potential points rigidly fixed to the wire, the metal being allowed to expand freely, has been taken as 0.0039 per degree Celsius.

**5.3.3 Co-efficient of Linear Expansion:**

5.3.3.1The co-efficient of linear expansion of AL59 at 0 Degree Celsius has been taken as  $23.0 \times 10^{-6}$  per Degree Celsius. This value holds good for all practical purposes over the range of temperature from 0 Degree Celsius to highest safe operating temperature.

**5.4 Materials**

5.4.1 Aluminium alloy

The aluminium alloy wire shall be an aluminium alloy meeting the mechanical strength and resistance of the wire properties as mentioned in the GTP

5.4.2 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 Nonstandard materials, to the GETCO or any other purchaser.

**5.5 Freedom from Defects**

5.5.1 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.

**5.6 Wire Sizes**

**5.6.1 Nominal Size and Tolerances**

The aluminium 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.



**5.7 Joints in Wires****5.7.1 Aluminium Wires**

- 5.7.1.1 No joints shall be permitted in the aluminium wires in the outermost layer. However, joints in the inner layer of the AL59 conductor are permitted but tensile strength of joint wire should be at least 90% of the value required for an un joint wire., 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.

**5.8 Stranding**

- 5.8.1 The wires used in the construction of AL59 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.
- 5.8.2 The lay ratio of the different layers shall be within the limits given in Table above.
- 5.8.3 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.
- 5.8.4 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.

**5.9 Standard Length**

- 5.9.1 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.
- 5.9.2 Random lengths will be accepted provided no length is less than 70% of the standard length specified and the total quantity of such random lengths shall not be more than 5% of the total quantity ordered.
- 5.9.3 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.
- 5.9.4 For specification of standard length mentioned at 5.10.1 may be specified as under for AL59 Moose, Zebra, conductor:

Sr. No.	Type of Conductor	Standard length in Meter	Tolerance.
1	AL59 Zebra (61/3.18 mm)	2000 2500*	$\pm 5\% \times 1$ $\pm 5\% \times 1$
2	AL59 Moose (61/3.50 mm)	2000 2500*	$\pm 5\% \times 1$ $\pm 5\% \times 1$

(\*) 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. 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 NABL or Government Approved Testing Laboratory only. 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 manufacturer's 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.
  - 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 relevant clause of standard IS:398 part-2/4/5 with latest amendment 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 to 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

6.2.1 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.

1. Measurement of Diameter (IS:398 P2 - Cl. 13.2)
  - a) Aluminium Wire
2. Breaking Load Test (IS:398 P2 - Cl. 13.3)
  - a) Aluminium Wire (before/after)
3. Elongation Test (IS:398 P4 - Cl. 12.3 but on gauge length 250 mm.)
  - a) Aluminium Wire
4. Resistance Test (IS:398 P2 - Cl. 13.6 & Annexure-II)
  - a) Aluminium Wire
  - b) Conductor
5. Measurement of Lay Ratio (IS:398 P2 - Cl. 13.8)
  - a) First Layer (Alu. Alloy)
  - b) Second Layer (Alu. Alloy)
  - c) Third Layer (Alu. Alloy)
  - d) Fourth Layer (Alu. Alloy)
6. Stress Strain Test (IS:398 P2 - Cl. 13.11)
  - a) On composite conductor
7. Surface Condition Test (IS:398 P2 - Cl. 13.9)
8. Ultimate Breaking Load of stranded conductor (IS:398P2-Cl.13.10 & Annexure-II)
9. Dry RIV and Corona-Applicable to AL59 Moose Conductor for 400 KV 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 on drum	SS 4240813, SS 4240814 and IS: 398(Part 2 & 4) 1994/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	- D O -

d)	Check for lay ratio of various layers.	- D O -
e)	Breaking load test on aluminum strands.	- D O -
f)	Wrap test on steel and aluminum strands.	- D O -
g)	DC resistance test on aluminum strands	- D O -
h)	UTS test on welded joint of aluminum strand	As per this specification

#### 6.4 **Routine tests**

- a) Check ensures that the joints are as per specifications.
- 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 **Tests during Manufacture**

a)	Chemical analysis of aluminium used for making aluminium strands	As per relevant standard
----	--	--------------------------

#### 6.6 **Testing Charges**

- 6.6.1 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 expenses. 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.
- 6.6.2 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, by bidder. No charges will be borne by GETCO.

#### 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) Hard copies/Color Scan 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 purchaser's 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/NABL accredited Lab 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.
- a. 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.
  - b. Information and copies of test certificates as in (i) above in respect of bought out accessories.
  - c. List of manufacturing facilities available.
  - d. Level of automation achieved and list of areas where manual processing exists.

- e. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
  - f. List of testing equipment available with the Supplier for final
  - g. 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.
  - h. 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.
  - i. 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.
- a. List of raw materials as well as bought out accessories, and the name of suppliers of raw materials as well as bought out accessories.
  - b. Type test certificates of the raw material and bought out accessories.
  - c. 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/Laminated wood fiber/Nalco flex/Poly Propylene Sheet with 12% wooden lagging of adequate strength, and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally confirm to IS: 1778-1980 except otherwise specified hereinafter. For returnable steel drum, attached 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 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 or to the persons using or storing the same.
- 10.5 The flanges shall be of two 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 and on MS hardware is +/- 1 mm. 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 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 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 bitumen based paint.
- 10.10 Before reeling, card board/HDPE sheet/ 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 for above 37 strands 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 75 mm shall be provided between the inner surface of the external protective layer and outer layer of the conductor for 'Moose' conductor; however 50 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 binders consisting of hoop iron/galvanized steel wire.
- 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 400 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	AL59 Zebra Conductor (61/3.18mm)	2000 $\pm$ 5% 2500 $\pm$ 5%	Drawing to be submitted as per requirement					37+37+37 = 111
2	AL59 Moose Conductor (61/3.50mm)	2000 $\pm$ 5% 2500 $\pm$ 5%	Drawing to be submitted as per requirement					37+37+37 = 111

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:

- a) Contract/Award letter / order 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) Gross weight of drum with conductor
- h) Weight of empty drum with lagging
- i) 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 Tender Specification.

### 14.0 **DEVIATIONS**

14.1 Any deviation to this tender 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%) 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%) 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 220 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**

- 3.1 On a conductor sample of minimum 5m lengths 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 plate's 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 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        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 ALUMINIUM**

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

#### **7.0        VISUAL AND DIMENSIONAL CHECK ON DRUMS**

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

#### **8.0        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 conforms to the requirements of the specification.

#### **9.0        DIMENSIONAL CHECK OF ALUMINIUM STRANDS**

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

#### **10.0       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.

#### **11 .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**

**HIGH AMPACITY CONDUCTOR**

**GUARANTEED TECHNICAL PARTICULARS FOR AL59 (61/3.18)**  
**CONDUCTOR**

Sr. No	Description	Conductor Details
		Same Diameter
	Make	
1)	Standard according to which the conductor will be manufactured and tested	SS 4240814 SS 4240813 IS 398 (P2) IS 398 (P4)
2)	Quality of material & standard to which conform	SS 42 40813, SS 42 40814 & IS-9997
3)	Number of strands and wire diameter in mm	61/3.18
5)	Number of Strands – Nos.	61
6)	Diameter of Strand – mm. Strands Nominal Maximum Minimum Overall Of Conductor	 3.18 3.21 3.15 28.62
7)	Cross Sectional Area of – Sq. mm.  Whole Conductor Each Strand	 484 7.94
8)	Laying of Strands – Nos. a) Centre wire b) First Layer c) Second Layer d) Third Layer e) Fourth Layer	 1 6 12 18 24
9)	Weight (Excl. Wt. Of Grease) – Kg / Km.  Whole Conductor Strand (At Nominal Dia.)	 1336 21.43
10)	Calculated D.C. resistance at 20 °C - Ohms / Km  Whole Conductor Strand	 0.06250 3.762
11)	Ultimate Tensile Stress – KN Whole Conductor Stand i)Before Stranding ii)After Stranding	 121.02  1.98 1.88
12)	Modulus of Elasticity - MPA	68000
13)	Coefficient of linear expansion - per deg. C.	23.0x10 <sup>-6</sup>



14)	Chemical Composition	The wire material shall be an aluminium alloy meeting the requirements on Resistivity, tensile strength etc as per relevant standard.
15)	Resistivity – Ohms Sq.mm / Mtr.	Max.0.02930
16)	a) Continuous maximum operating temperature	95 °C
17)	Minimum continuous current rating of conductor at 95 degree C corresponding of ambient temperature of 40 degree C & wind speed 0.56 mtr/sec.	910
18)	Lay Ratios First Layer i) Maximum ii) Minimum Second Layer i) Maximum ii) Minimum Third Layer i) Maximum ii) Minimum Fourth Layer i) Maximum ii) Minimum	  17 10  16 10  15 10  14 10
19)	Minimum tensile strength of the finished strand with joint if any made in base rod or semi finished wire a) Aluminium Alloy	No joints are allowed in outermost layer but joints are allowed in inner layer and tensile strength of joint wire is at least 90% of the value required for a un joint wire.

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

**GUARANTEED TECHNICAL PARTICULARS FOR AL59 (61/3.50)**  
**CONDUCTOR**

Sr. No	Description	Conductor Details
		Same Weight
	Make	
1)	Standard according to which the conductor will be manufactured and tested	SS 4240814 SS 4240813 IS 398 (P2) IS 398 (P4)
2)	Quality of material & standard to which conform	SS 42 40813, SS 42 40814 & IS-9997
3)	Number of strands and wire diameter in mm	61/3.50
5)	Number of Strands – Nos.	61
6)	Diameter of Strand – mm. Strands Nominal Maximum Minimum Overall Of Conductor	  3.50 3.53 3.47 31.50
7)	Cross Sectional Area of – Sq. mm.  Whole Conductor Each Strand	  587 9.62
8)	Laying of Strands – Nos. a) Centre wire b) First Layer c) Second Layer d) Third Layer e) Fourth Layer	 1 6 12 18 24
9)	Weight (Excl. Wt. of Grease) – Kg / Km.  Whole Conductor Strand (At Nominal Dia.)	  1618 25.96
10)	Calculated D.C. resistance at 20 °C - Ohms / Km  Whole Conductor Strand	  0.05070 3.100
11)	Ultimate Tensile Stress – KN Whole Conductor Stand i)Before Stranding ii)After Stranding	 141.12  2.31 2.19
12)	Modulus of Elasticity – MPA	68000

13)	Coefficient of linear expansion - per deg. C.	23.0x10 <sup>-6</sup>
14)	Chemical Composition	The wire material shall be an aluminium alloy meeting the requirements on Resistivity, tensile strength etc as per relevant standard.
15)	Resistivity – Ohms Sq.mm / Mtr.	Max.0.02930
16)	a) Continuous maximum operating temperature	95 °C
17)	Minimum continuous current rating of conductor at 95 degree C corresponding of ambient temperature of 40 degree C & wind speed 0.56 mtr/sec.	1040
18)	Lay Ratios First Layer i) Maximum ii) Minimum Second Layer i) Maximum ii) Minimum Third Layer i) Maximum ii) Minimum Fourth Layer i) Maximum ii) Minimum	 17 10  16 10  15 10  14 10
19)	Minimum tensile strength of the finished strand with joint if any made in base rod or semi finished wire Aluminium Alloy	No joints are allowed in outermost layer but joints are allowed in inner layer and tensile strength of joint wire is at least 90% of the value required for a un joint wire.

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