ODISHA POWER TRANSMISSION CORPORATION LIMITED

AMENDED TECHNICAL SPECIFICATION

FOR

LL-ACSR CONDUCTOR

TECHNICAL SPECIFICATIONS FOR LL ACSR CONDUCTOR

1.0 STANDARDS:

This section provides for standard design, manufacture, stage testing, inspection and testing before dispatch, packing and delivery of Low Electrical Power Loss Conductors (LL-ACSR) specified hereunder for their satisfactory operation. The power conductors shall conform to the following Indian Standards, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise specified herein before:

Sr. No.	Indian Standards or any Equivalent International Standard	Title
1	IS:398 Part I to Part V (as relevant)	Specification for Aluminium Conductors for overhead Transmission purpose
2	IS:1778	Reels and drums for Bare wires
3	IS:1521	Method of Tensile Testing of Steel wire
4	IS:2633 -1990	Method of Testing Uniformity of Zinc coating of Zinc coated Articles.
5	IS:8263	Method of Radio Interference Tests
6	IS:1841	EC Grade Aluminium Rod produced by rolling
7	IS:5484	EC grade Aluminium Rod produced by continuous casting and rolling
8	IS: 2141 -1990	Method of Elongation test of steel wire
9	IEC 61089, IEC 61232, IEC 60889	Low Electrical Power Loss Type Conductor LL-ACSR 490mm^2 & LL-ACSR 240mm^2.

2.0 PARAMETERS FOR LOW-ELECTRICAL POWR LOSS CODUCTORS:

Sr. No.	Details of Stranded Conductor	LL-ACSR 490mm2 equivalent Zebra	LL-ACSR 240mm2 equivalent Panther
2.1	**Principal Parameters of Stranded Conductor:**		
a)	Overall diameter(mm)	Equal or less than 28.62	Equal or less than 20.99
b)	Approximate weight (Kg/Km)	1621	974
c)	Calculated D.C. Resistance at 20 Deg.C (Ohm/Km)	Equal or less than 0.0591	Equal or less than 0.120
d)	Minimum UTS (kN)	Approx. 131.9	Approx. 92.25
e)	Modulus of Elasticity GPa	-	-

2.2 The details Core Steel Strand are as follows:

a)	Minimum UTS of Core steel Before stranding (MPa)	Aluminum-clad extra high strength (1770MPa) steel wire or Zinc-coated extra high strength (1960MPa) steel wire	Aluminum-clad extra high strength (1770MPa) steel wire or Zinc-coated extra high strength (1960MPa) steel wire

2.3 Sag and Tension

a)	Max. working tension	50% of UTS	50% of UTS
b)	Everyday stress	Less than 25% of UTS	Less than 25% of UTS
c)	Basic span length (m)	320	320

The design data of the lines on which these conductors will be used are as follows:

a)	Normal Span.		320 Meters
	Wind Span.		320 Meters
	Weight Span.		
	(a)	Max.	500 Meters
	(b)	Min.	50 Meters
b)	Wind Pressure on full project area.		52 Kgf per M^2
c)	Temperature		
	(a) Minimum		5 ° C
	(b) Maximum		67 ° C
	(c) Every day		32°C
d)	Factors of safety : Minimum		
	(i)	Every day temperature and no wind.	4.00
	(ii)	Minimum temperature and 2/3 maximum wind :	2.00
	(iii)	Every day Temperature and full wind	2.00

This is as per Indian Electricity Rules, 1956.

e) Relative Humidity.

	Maximum.	100 Percent
	Minimum.	60 Percent
f)	Isoceramic level.	100/Years
g)	Number of rainy days per year.	100 days
h)	Average rainfall per year	1150 mm. approx.
i)	Altitude.	Less than 350 Metres.

3.0 GENERAL TECHNICAL REQUIREMENTS : MATERIAL AND WORKMANSHIP (FOR Low Electrical Power Loss Conductor Equivalent to ACSR ZEBRA & ACSR PANTHER):

3.1 Requirements for Low Electrical Power Loss Conductor

The Qualified Manufacturer shall be a manufacturer of Low Loss conductor for the last twenty years. The Qualified Manufacturer's experience should include the following:

a) For manufacturers of LL conductors and Accessories, the Companies having ISO 9001 or equivalent qualification and should have supplied minimum 1,000 km of LL conductor to any power utility in the world and should produce the end user certificate for successful performance at least for three years.

3.2 Materials:

The conductors shall be manufactured from EC grade aluminium rods suitably hard-drawn on wire drawing machines. The aluminium rods used shall comply with IS: 1841 and IS: 5484 or any equivalent International Standard. The mechanical and electrical properties of aluminium wire shall comply with the requirements given in relevant standard.

3.2.1 Physical constants for Hard-drawn Aluminium:

3.2.1.1 Resistivity:

The resistivity of aluminium depends upon its purity and its physical condition. For the purpose of this specification the maximum value permitted is 0.28264 Ohm sq.mm/mt. at 20° C and this value has been used for calculation of the maximum permissible value of resistance.

NOTE: It is not intended to check the resistivity from the measured values of resistance.

3.2.1.2 Density:

At a temperature of 20° C the density of hard drawn aluminium has been taken as 2.703 g/cm.^{3}

3.2.1.3 Constant-Mass Temperature Co-efficient of Resistance:

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.

3.2.1.4 Co-efficient of Linear Expansion:

The co-efficient of linear expansion of hard-drawn aluminium at 0° C has been taken as 23.0 x 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.

3.2.2 Aluminum-Clad steel wire shall be drawn after extruding aluminum on high carbon steel rods produced by either acidic or basic open hearth process, electric furnace process or basic oxygen process. The mechanical and electrical properties of wire shall comply with this specification. The chemical composition of high carbon steel wires is given below for guidance only.

Element	Percentage Composition
Carbon	0.5 to 0.85
Maganese	0.50 to 1.10
Phosphorous	Not more than 0.035
Sulphur	Not more than 0.045
Silicon	0.10 to 1.2

3.2.2.1 Physical constants for aluminum-clad steel wires:

3.2.2.1.1 Density :

At a temperature of 20° C, the density of aluminum-clad steel wire is to be taken as 7.14 g/$cm^{3.}$

3.2.2.1.2 The aluminum used for cladding shall be EC-grade aluminum. Minimum thickness of aluminum shall be 2.3% of nominal diameter of aluminum-clad steel.

3.2.2.1.3 Ultimate tensile strength

More than 1770 MPa.

3.2.2.1.4 Freedom From Defects:

The wires shall be smooth and free from all imperfections such as spills, 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 and electrical properties of the conductor. Special care should be taken to keep away dirt, grit etc. during stranding.

3.2.2.2 Physical constants for galvanized steel wires:

3.2.2.2.1 Density :

At a temperature of 20° C, the density of galvanized steel wire is to be taken as 7.80 g/$cm^{3.}$

3.2.2.2.2 Ultimate tensile strength

More than 1960 MPa.

3.2.2.2.3 Freedom From Defects:

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

3.3 Wire Sizes

3.3.1 Nominal Size:

The aluminium, aluminum-clad steel wires and Galvanized steel wires for the stranded conductor covered by this standard shall have diameters specified in clause 2.1 & 2.2. The diameter of the steel wires shall be measured over the aluminum-cladding and all the Aluminum wires to be trapezoidal.

3.3.2 Tolerances on Nominal Size :

Tolerance of +/- 1% is permitted on the nominal diameter of Round Aluminium Wires and Tolerance of +/- 2% is permitted on the trapezoid shape aluminum wires. Tolerance of +/- 2 % is permitted on the nominal diameter of Galvanized Steel Core Wire and Aluminum-clad steel wire which is proposed..

3.4 JOINTS IN WIRES:

3.4.1 Aluminium Wires:

No joints shall be permitted in the aluminium wires in the outermost layer of the LL-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 only by cold pressure butt-welding. It may please be noted that 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 extra high voltage lines.

3.4.2 Aluminum-clad Steel Wires, Galvanized steel wires:

There shall be no joints except those made in the base rods or wires before final drawing, in aluminum-clad steel wires/Galvanaized steel wires forming the core of the steel-reinforced aluminium conductor. Joints are not permitted in the steel wires after final drawing also in order to avoid reduction in the breaking strength of the conductor that may occur as a result of failure of the joints.

3.5 STRANDING :

3.5.1 The wires used in the construction of aluminum-clad steel reinforced aluminium conductor, before stranding, shall satisfy all the relevant requirements of this specification.

3.5.2 The lay ratio of the different layers shall be within the limits given in the Table below:-

Type of conductor	Ratio of Alu. wire diameter to steel wire diameter	Lay Ratios of Steel core 6 wire layer		Lay Ratios for Aluminium wires (2 Alu. Wire Layer Conductors)			
				Outermost layer		Innermost Layer	
		Min.	Max.	Min.	Max.	Min.	Max.
LL-ACSR 240 mm^2 equivalent Panther & 490 mm^2 equivalent Zebra	N/A	13	28	10	14	10	16

NOTE : **For the purpose of calculation, the mean lay ratio shall be taken as the arithmetic mean of the relevant minimum and maximum values given in this table.**

3.5.3 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.

3.5.4 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.

3.5.5 The finished Conductor shall have a smooth surface without any surface cut, abrasion, scuff marks and shall be free from dirt, grit, etc. even if the damage to conductor is acceptable from mechanical considerations. It will not be acceptable from electrical considerations, and full care should be taken not to supply damaged conductor. Projections of more than 2 mils shall not be acceptable. Any such damage shall be properly rectified or new conductor supplied.

3.5.6 Failure of any sample to meet the above requirements shall be sufficient cause for rejection of the lengths of conductor represented by the sample. Particular care shall, therefore, be taken during manufacture, handling, packing and transportation of the conductor, to see that the surface is not dented, cut or damaged in any way.

3.6 STANDARD LENGTH :

3.6.1 The standard length of conductor shall be 2000 metres. A tolerance of +/-5% on the standard length offered by the Contractor shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths. The numbers of random length drums shall not be more than 10% of the lot. Further, no peace shall be shorter than 50% of the standard length.

3.6.2 Contractor shall also indicate the maximum single length, above the standard length, they can manufacture. This is required for special stretches like river crossing etc.

3.7 Aluminum Cladding/ Galvanized steel wires

3.7.1 All the wires of Iron & steel strand shall be aluminum-cladded / Galvanized .

3.8 TESTS :

3.8.1 The conductor offered shall be type tested as per the relevant standards. Further the acceptance, routine tests and tests during manufacture shall be carried out on the conductor.

3.8.2 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 purpose of acceptance of that lot.

3.8.3 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.

3.8.4 Tests during manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the Contractor to ensure the desired quality of the end product to be supplied by him.

3.8.5 The norms and procedure of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Contractor and the Employer.

3.8.6 The standards to which these tests will be carried out are listed in para 1.0. Where a particular test is a specific requirement of this specification, the norms and procedures of the test shall be as mutually agreed to between the Contractor and the Employer in the Quality Assurance Programme.

3.8.7 For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Contractor in the "Technical Questionnaire" or the acceptance value specified in this specification, whichever is more stringent for that particular test.

3.8.8 Type Tests :

The Contractor shall submit the type test report of the conductors with the same technology as that of the Conductor being offered in this package in last five (5) years.

The type test report shall cover following test items.

a) UTS test on stranded conductor
b) Stress-strain test on composite conductor

3.8.9 Acceptance Tests :

a) Visual and dimensional check
b) Visual check for joints, scratches etc. and lengths of conductor
c) DC resistance test on the complete conductor
d) Dimensional check on steel and aluminium strands
e) Check for lay ratios of various layers
f) Minimum thickness of aluminum test on aluminum-clad steel strands
g) Torsion and Elongation test on aluminum-clad steel wire
h) Breaking load test on steel and aluminium strands
i) Wrap test on steel and aluminium strands
j) DC resistance test on aluminium strands and aluminum-clad steel wire
k) UTS test on welded joint of aluminium strand

NOTE: All the above tests except test mentioned at (j) shall be carried out on aluminium and steel strands **before stranding**

3.8.10 Routine Test :

a) Check to ensure that the joints are as per specification.

b) Check that there are no cuts, fins etc. on the strands.

c) Check that drums are as per specifications.

d) All acceptance tests as mentioned in Clause 3.09.09 above shall be carried out on each coil.

3.8.11 Tests During Manufacture :

a) Chemical analysis of aluminium for making aluminium strands

b) Chemical analysis of steel used for making aluminum-clad steel strands

3.8.12 Additional Tests:

The Employer reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material comply with the specification.

3.8.13 Test Reports

(a) Record of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Employer's representative.

(b) Test Certificates of test during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Employer.

3.8.14 Test Facilities

The following additional test facilities shall be available at Contractor's Works.

(a) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.

(b) Standard resistance for calibration of resistance bridges.

(c) Finished conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 32 metres per minute). The rewinding facilities shall have appropriate clutch system and free of vibrations, jerks etc. with transverse layering facilities.

3.8.15 QUALITY ASSURANCE PROGRAM

The contractor shall submit the Quality Assurance Programme as specified in Clause 1.12 Section-1 of the biding document. A copy of the accepted Quality Assurance Plan must be available at the manufacturer's works of the Plant for reviewing by inspecting officer of the employer.

3.9 INSPECTION :

3.9.1 As specified in clause 1.13 Section-1 of the biding document, Plant to be supplied will be subject to inspection and approval by the Employer's representative before dispatch.

3.9.2 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 the conductor shall be transferred from one drum to another at the same time measuring its length with the help of graduated pulley and Cyclometer. The difference in the average length thus obtained and as declared by the Contractor in the packing list shall be applied to all the drums if the conductor is found short during checking"

3.9.3 The supplier shall submit the factory test certificates of raw materials & bought out accessories at the time of acceptance tests of the Conductor.

3.10 PACKING AND FORWARDING :

3.10.1 The conductor shall be supplied in non-returnable strong wooden or steel drums provided with lagging of adequate strength, to protect the conductor against all damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS: 1778 except otherwise specified hereinafter.

3.10.2 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.

3.10.3 The standard drum drawings are enclosed. However, Contractor should submit the proposed drum drawings along with the bid. The same shall be in line with the requirements of standard drawings and as stated herein. The Contractor shall submit four copies of fully dimensioned drawing of the drum he wishes to supply, for Employer's approval, before taking up manufacturing of conductor.

3.10.4 All wooden components shall be manufactured out of seasoned soft wood free from such defects that may materially weaken the component part of the drums. Preservative treatment for anti-termite /anti-fungus (Aldine / Aldus) shall be applied to the entire drum with preservatives of a quality which is not chemically harmful to the conductor.

3.10.5 If the flanges are made of wood, the flanges shall be of two/three ply construction with each ply at right angles to the other and nailed together. Further the outer face of the flange shall be reinforced with the circumferential battens, fixing in octagonal shape. The nails shall be driven from the inside face of 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 line with the periphery of the barrel.

3.10.6 Spindle hole shall be provided at the centers of the planks of the plies and spindle plates with 110 mm dia. Holes shall be fitted on either side of both the flanges.

3.10.7 If the barrel is made of wood, the wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be fixed to the barrel supports with at least two nails, bolts or steel band. 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. The material of barrel may be steel as a manufacturer's option.

3.10.8 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.

3.10.9 Normally, the nuts on the studs shall stand protrude of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be counter sunk. The ends of barrel shall generally be flushed with the top of the nuts.

3.10.10 The inner cheek of the flanges and drum barrel surface shall be painted with bitumen based paint.

3.10.11 Before reeling, cardboard or double corrugated or thick bituminised 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. After reeling the conductor the exposed surface of the outer layer of conductor shall be wrapped with thin water proof paper 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.

3.10.12 Minimum space of 75 mm shall be provided between the inner surface of the external protective layer and outer layer of the conductor.

3.10.13 Each batten shall be securely nailed across grains as far as possible to the flange edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The 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. When steel drums are applied, the protective battens shall be secured by means of the manufacturer's standard.

3.10.14 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.

3.10.15 The conductor ends shall be properly sealed and secured with the help of U-nails or bolts on one side of the flanges. The composite conductor shall be binded by use of galvanized steel wire/aluminum wire at three locations at least 75 mm apart or more covered with PVC adhesive tape so as to avoid loosening of conductor layers in transit and handling.

3.10.16 Only one length of conductor shall be wound on each drum.

3.11 MARKING :

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

i. Contract
ii. Name and address of consignee
iii. Manufacturer's name and address
iv. Drum number
v. Size of conductor
vi. Length of conductor in metres

vii. Gross weight of drum with conductor
viii. Weight of empty drum with protective lagging
ix. Arrow marking for unwinding

3.12 END SEALING:

Both the ends of each length of conductor should be provided with non-destructive type metal crimped or epoxy/prastic capped seals with printing/embossing/engraving of manufacturer's monogram and drum number.

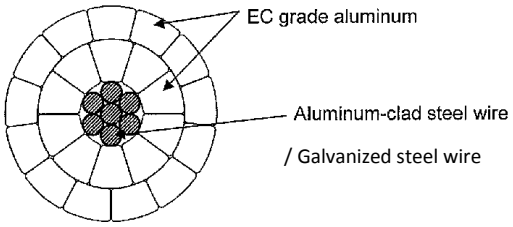
ANNEXURE-1

GUARANTEED TECHNICAL PARTICULARS OF CONDUCTOR & EARTH WIRE

[A] Low Electrical Power Loss Conductors

S.No.	Description	LL-ACSR 490mm^2	LL-ACSR 240mm^2
1.	Particulars of ACSR Conductor		
i.	Standard nominal Aluminum area (sq. mm)	490	240
ii.	Stranding, lay and wire dia (mm)	16/TW(4.56)-AL +9/TW(5.70)-AL +7/2.70-14AS/St	15/TW(3.5)-AL +8/TW(3.95)-AL +7/2.55-14AS/St
iii.	Diameter of complete conductor (mm)	28.62	20.99
iv.	Overall diameter when wrapped with preformed Armour Rod (mm)	N/A	N/A
v.	Weight (kg/km)		
	i) Aluminum clad steel core type	1651	929.2
	ii) Galvanized steel core type	1677	952.9
a.	Core		
	i) Aluminum-clad steel Section (kg)	287.6	256.5
	ii) Galvanized steel Section (kg)	314.2	280.2
b.	Aluminium Section (kg)	1363	672.7
c.	Conductor (kg)		
	i) Aluminum clad steel core type	1651	929.2
	ii) Galvanized steel core type	1677	952.9
2.	Guaranteed ultimate tensile strength of conductor in kN	131.9	90.25
3.	Calculated D.C. resistance/km of conductor when corrected to standard weight at 20^{o}C		
	i) Aluminum clad steel core type	0.0579	0.116
	ii) Galvanized steel core type	0.0591	0.120
4. i.	Standard Cross Sectional Area of Aluminium strand in sq. mm	16.33 (outer) 25.52 (inner)	9.621 (outer) 12.25 (inner)
ii.	Standard Cross Sectional Area of Aluminum-clad/Galvanized Steel strand in sq. mm	5.726	5.107
iii.	Standard Cross Sectional Area of conductor in sq. mm.	531.1	278.0
5.	Minimum Modulus of elasticity of Conductor (GPa)	70.0	75.7
6.	Co-efficient of liner expansion per ^{o}C of		
a.	Aluminium strand Kg/sq.cm	23X10^{-6}	23X10^{-6}

S.No.	Description	LL-ACSR 490mm^2	LL-ACSR 240mm^2
b.	Aluminum-clad steel strand Kg/sq.cm	12.0X10^{-6}	12.0X10^{-6}
c	Galvanized steel strand Kg/sq.cm	11.5X10^{-6}	11.5X10^{-6}
d.	ACSR Conductor Kg/sq.cm		
	i) Aluminum clad steel core type	21.0X10^{-6}	19.8X10^{-6}
	ii) Galvanized steel core type	19.3X10^{-6}	19.4X10^{-6}
7.	Mean Lay-ratio		
i.	First layer	13-28	13-28
ii.	Second layer	10-16	10-16
iii.	Third layer	10-14	10-14
iv.	Fourth layer		
8. i.	Continuous maximum current rating of conductor in still air at 40 oC ambient temperature (amp)*	690	460
ii.	Temperature rise for the above current (^{o}C)	35 ^{o}C	35 ^{o}C
9. i.	Standard length of conductor (km.)	2.0	2.0
ii.	Tolerance in length (in percent)	+/- 5%	+/- 5%
10.	Particulars of strands		
i.	Minimum ultimate tensile strength in kg/sq.mm.	Aluminium/ Steel	Aluminium/ Steel
a.	Aluminimum strand	16.2 (Outer) 15.8 (Inner)	16.5 (Outer) 16.2 (Inner)
b.	Aluminum-clad steel strand	180	180
c.	Galvanized steel strand	200	200
ii.	Nominal strand Dia (mm)	TW(4.67)+TW(5.70) /2.70	TW(3.5) +TW(3.95) /2.55
a.	Maximum (mm)	TW(4.716) +TW(5.814) /2.75	TW(3.535) +TW(4.03) /2.60
b.	Minimum (mm)	TW(4.624) +TW(5.586) /2.65	TW(3.465) +TW(3.87) /2.5
iii	Mass (kg/Km) of strand at Nominal Dia of Aluminium	44.14 (outer) 68.98 (inner)	26.01 (Outer) 33.11 (Inner)
iv.	Mass (kg/Km) of strand at Nominal Dia of core steel		
	Aluminum clad steel type	40.88	36.46
	Galvanized steel type	44.67	39.85
v.	Minimum breaking load in KN for		

S.No.	Description	LL-ACSR 490mm^2	LL-ACSR 240mm^2
a.	Aluminium strand i) Before stranding ii) After stranding	 2.596 (outer) 3.956 (inner) 2.466 (outer) 3.758 (inner)	 1.559 (outer) 1.948 (inner) 1.481 (outer) 1.851 (inner)
b.	Aluminum-clad steel strand i) Before stranding ii) After stranding	 10.135 9.628	 9.039 8.588
c.	Galvanized steel strand i) Before stranding ii) After stranding	 11.216 10.656	 10.005 9.505
c.	Approximate breaking load of conductor in kgs		
	Aluminum clad steel core type	13580	9360
	Galvanized steel core type	14843	10406
vi.	Aluminum cladding		
a.	Minimum thickness for aluminum-cladding (mm)	0.06	0.06
b.	Minimum conductivity for aluminum-clad steel wire (%IACS)	14	14
c.	Purity of aluminum and the standard to which it will conform	99.65 % JIS H 2110	99.65 % JIS H 2110
	Cross Sectional View		

*****Assumed calculation condition:
Standard: IEEE 738
Ambient Temp.: 40 deg.C
Wind velocity: 0.56 m/s, right angle
Solar radiation: 1045 W/m2
Absorptivity: 0.8
Emissivity: 0.45