

**TECHNICAL SPECIFICATION**

**FOR**

**(MEDIUM VOLTAGE) AL59 ACS COVERED CONDUCTOR & ACCESORIES**

# TECHNICAL SPECIFICATION (MEDIUM VOLTAGE) AL59 ACS COVERED CONDUCTOR & ACCESORIES

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## 1. SCOPE :

This specification covers details of AL59 ACS Covered Conductors for use on 33KV & 11KV Distribution system. The covered conductor insulation shall be as per EN 50397-1: 2006.

## 2. SERVICE CONDITIONS:

The conductor to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

- |   |                         |
|---|-------------------------|
| i) Maximum ambient temperature (Degree C)         | ----- 50                |
| ii) Minimum temperature of air in shade (Degree C | ----- 3.5               |
| iii) Relative Humidity (%)                        | ----- 10 to 100         |
| iv) Maximum Annual Rainfall (mm)                  | ----- 1450              |
| v) Maximum Wind Pressure (kg/sq.m.)               | ----- 150               |
| vi) Maximum altitude above mean sea level (meter) | ----- 3400 (MSL –2206m) |
| vii) Isoceraunic level (days/ year)               | ----- 50                |
| viii) Seismic level (Horizontal acceleration)     | ----- 0.3g              |

## 3. CONDUCTOR SIZES:

Actual Area	Stranding wire & Dia.	
	ALU.	ACS.
sq.mm.	No./mm.	No./mm.
31.60	6/2.59	1/2.59
52.88	6/3.35	1/3.35
78.82	6/4.09	1/4.09
104.98	6/4.72	1/4.72
120	26/2.44	7/1.90
160	30/2.59	7/2.59
241	30/3.20	7/3.20

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### 4. APPLICABLE STANDARDS:

Unless otherwise stipulated in this specification, the conductor shall conform to the following Indian/International Standards (amended upto date).

Sr. No.	Indian / International Standard	Title
1	IS : 398 (Part II) / 1996	Specification for aluminium conductors for overhead transmission purpose
2	EN 50397-1:2006	Covered Conductor Specification for voltage 1KV AC to 36KV AC.
3	EN 50397-2:2006	Covered conductor accessories for overhead lines for rated voltages above 1 kV AC and not exceeding 36 kV AC.
4	IS : 10418	Reels and drums for bare conductors.
5	SS 424 08 13 & SS 424 08 14	Aluminium alloy wire for stranded conductors for overhead lines –Al 59 wire
6	IEC - 1232 : 1993-06IEC 63248 :2022	Aluminium Clad steel wire for Electrical purpose
7	SS EN - 50182	Conductor for Overhead lines – Round wire concentric Lay stranded Conductors

### 5. PROPERTIES OF CONDUCTOR:

The properties of stranded AL59 ACS conductor of various sizes shall be as in Table 1.

TABLE - I

AL59 ACS CONDUCTOR DETAIL								
Actual Area	Stranding wire & Dia.		Approx. Overall dia.	Approx. Mass	Calculated Resistance at 20°C (Max.)	Approx. Calculated Breaking Load	Reactance per km.	Current Rating
sq.mm.	ALU. No./mm.	ACS. No./mm.	mm.	Kg/km	Ohm/km	kN.	Ohms.	Amps.
31.60	6/2.59	1/2.59	7.77	121.35	0.923	13.83	0.2862	155
52.88	6/3.35	1/3.35	10.05	203.00	0.551	22.96	0.2700	215
78.82	6/4.09	1/4.09	12.27	302.62	0.370	31.68	0.2575	278
104.98	6/4.72	1/4.72	14.16	403.00	0.278	40.44	0.2485	335
120	26/2.44	7/1.90	15.46	467.25	0.239	52.69	0.2426	383
160	30/2.59	7/2.59	18.13	681.18	0.180	52.69	0.2330	445
241	30/3.20	7/3.20	22.40	1039.80	0.1180	120	0.328	630

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## 6 (a) PROPERTIES OF WIRES:

ALUMINIUM WIRE USED IN CONSTRUCTION OF ALUMINUM CONDUCTOR WITH ALUMINIUM CLAD STEEL						
Diameter of Wire			Cross-sectional area of nom. Wire dia.	Mass	Minimum breaking load after stranding	DC resistance at 20°C
Nom.	Min.	Max				
mm.	mm.	mm.	Sq.mm.	Kg./Km.	kN	Ohm/Km.
2.44	2.410	2.47	4.68	12.63	1.11	6.266
2.59	2.56	2.62	5.27	14.24	1.25	5.609
3.20	3.16	3.23	8.04	21.73	1.93	3.662
3.35	3.32	3.38	8.81	23.82	2.09	3.353
4.09	4.05	4.13	13.14	35.51	3.12	2.249
4.72	4.67	4.77	17.50	47.30	4.16	1.689

ALUMINIUM CLAD STEEL WIRE USED IN CONSTRUCTION OF ALUMINUM CONDUCTOR WITH ALUMINIUM CLAD STEEL						
Diameter of Wire			Cross-sectional area of nom. Wire dia.	Mass	Minimum breaking load after stranding	DC resistance at 20°C
Nom.	Min.	Max				
mm.	mm.	mm.	Sq.mm.	Kg./Km.	kN	Ohm/Km.
1.90	1.87	1.93	2.84	18.68	3.61	29.91
2.59	2.56	2.62	5.27	34.72	6.71	16.096
3.20	3.16	3.23	8.04	52.98	9.487	10.544
3.35	3.32	3.38	8.81	58.09	11.22	9.621
4.09	4.05	4.13	13.14	86.58	16.72	6.454
4.72	4.67	4.77	17.50	115.31	22.72	4.846

## 6 (b) TOLERANCE ON NOMINAL SIZES:

The tolerance shall be permitted on the nominal diameter aluminium wire used in the manufacture of AL59 ACS COVERED CONDUCTOR. However, positive & negative tolerance in this respect shall be as provided in IS: 398 (Part IV)/1994 (amended up to date).

## 7. FREEDOM FROM DEFECTS:

The wire shall be smooth and free from all imperfections such as spills, splits, slag inclusion; dia. 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.

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### 8. JOINTS IN WIRES:

#### 8.1 Conductors containing seven wires:-

There shall be no joint in any wire of a stranded conductor containing seven wires, except those made in the base rod or wire before final drawing.

#### 8.2 Conductors containing more than seven wires:-

In conductors containing more than seven wires, joints in individual wires are permitted in any layer except the outermost layer (in addition to those made in the brass rod or wire before final drawing) but no two such joints shall be less than 15 m apart in the complete stranded conductor, such joint shall be made by resistance or cold pressure butt welding. They are not required to fulfil the mechanical requirement of unjointed wires. Joints made by resistance butt welding shall, subsequent to welding, be annealed over a distance of at least 200 on each side of the joint.

### 9. STRANDING:-

9.1 The wires used in the construction of a stranded conductor shall, before Stranding satisfy all the relevant requirements of this standard.

9.2 The lay ratio of the different layers shall be within the limits given in the Table-III.

TABLE - III: LAY RATIOS FOR AL59 ACS CONDUCTORS

LAY RATIO OF ALUMINIUM CONDUCTORS, WITH ALUMINIUM CLAD STEEL REINFORMCED								
Number of wires		Ratio of Aluminium wire diameter to steel wire diameter	Lay ratio of steel core		Lay ratio for Aluminium wire			
					Outer most layer		Layer immediately beneath Outermost Layer	
Aluminium	Steel		Min.	Max.	Min.	Max	Min.	Max
6	1	1.00	-----	-----	10	14	-----	-----
26	7	1.28	13	28	10	14	10	16
30	7	1.00	13	28	10	14	10	16

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

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

### 10. FILLING (WATER BLOCKING):

The Stranded Conductor shall be longitudinally water tight by means of water blocking material incorporated during the extrusion process. The use of grease/water swellable tape / water swellable powder inside or over the surface of conductor is not permitted. The water blocking material shall be stable at maximum operating conductor temperature of 90 Deg. Cent. The water blocking compound shall be compatible with the conductor material as well as the semi conducting polymer screen layer above it and not adversely affect its electrical or mechanical properties.

### 11. INSULATION:

The Insulation should be dual layered with the Inner Layer being XLPE with a nominal thickness of 1.2 mm for Voltages up to 11 KV and 2.43 mm for 33 KV and the Outer Layer of XLPE which is Fire Retardant, UV Resistant, Anti Tracking and Erosion Resistant with temperature withstand as per relevant standard, nominal wall thickness of 1.1 mm for Voltages up to 11 KV and 1.2 mm for 33 KV. The minimum combined Insulation Thickness of both Layers should not be less than 2.0 mm for Voltages up to 11 KV and 3.0 mm for Voltages upto 33 KV minimum.

The conductor manufacturing and stranding process shall incorporate the longitudinal water blocking also.

The Semi Conducting Screen, Inner Insulation and Outer Insulation should be extruded in one step i.e. triple extrusion to ensure a good, permanent bond between the three layers and also with the conductor. Chemical curing to be avoided.

It shall be possible to remove the Semi Conducting Screen, Inner and Outer Insulation Layers without damage to the conductor.

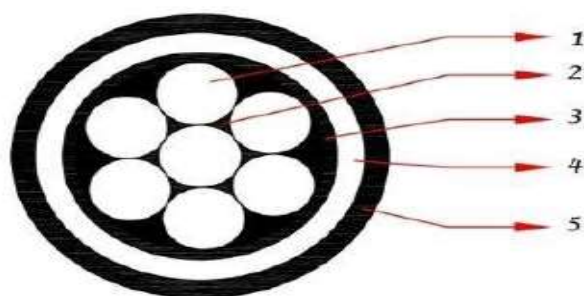
Regarding properties of XLPE insulation of 90°C continuous operating temperature refer below Table – IV

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TABLE : IV		
PROPERTIES OF XLPE INSULATION FOR UPTO 90°C OPERATING TEMPERATURE		
Sr. No.	Properties	Requirements
1	Tensile Strength	12.5 N/mm <sup>2</sup> , Min.
2	Elongation to break	200 percent, Min
3	Aging in air oven: a) Treatment: Temperature: Duration: b) Tensile Strength variation: c) Elongation variation:	135°C 10 days ±25 percent, Max ±25 percent, Max
4	Hot set: a) Treatment: Temperature: Time under load Mechanical stress b) Maximum Elongation under load c) Maximum residual elongation	200±3°C 15 min 20N/cm <sup>2</sup> 175 percent 15 percent
5	Shrinkage: a) Treatment: Temperature Duration b) Shrinkage	130±3°C 2 hour 4 percent, Max
6	Water absorption (Gravimetric): a) Treatment: Temperature: Duration b) Water absorbed	85±2°C 14 days 1 mg/cm <sup>2</sup> , Max
7	Test of Compatibility (Ageing of complete product sample ) d) Treatment: Temperature: Duration: e) Tensile Strength variation: f) Elongation variation:	100°C ± 2°C for 7 days ±25 percent, Max ±25 percent, Max

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Nos.	Description	Unit	Nominal Thickness		
			11 KV	22 KV	33 KV
1	Aluminium Alloy Wire	Sq.mm	AS PER REQUIREMENT		
2	Extruded Longitudinal Water Blocking Layer	mm	AS REQUIRED TO MAKE WATER BLOCKED ARRANGEMENT		
3	Extruded Semi conductive layer	mm	0.3	0.3	0.4
4	Inner Insulation of XLPE, without carbon black	mm	1.2	1.32	2.43
5	Outer Insulation with UV & Track Resistant XLPE	mm	1.1	1.1	1.2

Figure 1 shows the Cross Section of AL59 ACS COVERED Conductor.

### 12. TYPE TEST:

All the following type tests certified in CPRI/ERDA in accordance with EN 50397-1: 2006 shall be performed on MVCC samples drawn by purchaser..

#### 12.1 Electrical tests

##### 12.1.1 Conductor resistance

##### 12.1.2 High voltage test

##### 12.1.2.1 For CC without conductor screen:

##### 12.1.2.2 For CC with conductor screen or upon agreement between customer and Producer:

##### 12.1.3 Spark test on the covering (R)

Test voltage: a.c. 0,7 U or dc 1 U

##### 12.1.4 Leakage current (S)

Test voltage: a.c. 0,7 U

##### 12.1.5 Tracking resistance (S)

#### 12.2 Construction and dimensions (T, S, R)

##### 12.2.1 Compliance with the designs requirements



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12.2.2 Thickness of the covering

12.3 Construction and mechanical properties of the conductor (T, S)

12.3.1 Rated tensile strength

12.3.2 Construction and dimensions

Test voltage (a.c.)	1U
Number of specimen	1
Length of specimen (minimum)	5m
Duration of immersion in water (minimum)	1h
Temperature of water	(20 ± 5) ° C
Test duration	15 min (S) 3 h (T)

Test voltage (a.c.)	1U
Number of specimen	1
Length of specimen (minimum)	5m
Duration of immersion in water (minimum)	1h
Temperature of water	(20 ± 5) ° C
Test duration	4 h (S) 48 h (T)

12.4 Non-electrical tests on the covering (T)

12.4.1 Mechanical properties

- a) before ageing of sample
- b) after ageing of sample

12.4.2 If Carbon black used for UV Stabilization - Carbon black content (T)

12.4.3 Resistance to UV rays (T)

12.5 Tests of compatibility (T)

12.6 Thermal properties of the covering

12.6.1 Shrinkage test (T)

Distance "L" between marks: (200± 5) mm

12.6.2 Hot-set-test (T, S)

12.6.3 Pressure test at high temperature (For Thermo plastic Cable)

12.7 Further tests on the covering

12.7.1 Water absorption (T)

12.7.2 Shore D hardness (For Thermo plastic Cable)

12.8 Test of the longitudinal water tightness

12.8.1 With heat cycle (T)

Number of specimen	1
Length of specimen	3m
Test duration	24 h
Bending radius	20 D

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12.8.2 Without heat cycle (S)

12.9 Marking

12.9.1 Content, legibility (T, S, R)

12.9.2 Durability (T)

Note: T – Type Test

S – Acceptance Test

R – Routine Test

### **13. ROUTINE TESTS:**

All the Routine tests as per EN 50397-1: 2006 amended upto date shall be carried out on each and every delivery length of MVCC . The result should be given in test report.

Number of specimen	1
Length of specimen	3m
Test duration	24 h
Bending radius	20 D

Number of specimen	1
Length of specimen	1m
Test duration	1h

The details of facility available in the manufacturer's works in this connection should be given in the bid.

### **14. ACCEPTANCE TESTS:**

All Acceptance tests as per EN 50397-1: 2006 as amended up to date including the Optional and should offered Anti tracking testing on selective samples in Manufacturer's work during acceptance test.

### **15. TESTING FACILITIES AND DETAILS OF EQUIPMENTS:**

The supplier / tenderer shall clearly state as to what testing facilities are available in the works of manufacturer and whether the facilities are adequate to carry out type, routine and acceptance tests And Anti Tracking as mentioned in EN 50397-1 : 2006 on the MVCC. The facilities shall be provided by the bidder to purchaser's representative for witnessing the tests in the manufacturer's works. If any test cannot be carried out at manufacturer's works reason should be clearly stated in the tender.

### **16. END SEALING:-**

Heat Shrinkable end caps with sealant shall be used for effectively sealing the end terminals of the covered conductor. The inner diameter range of cap shall be such that it shall tightly fit to the covered conductors to prevent moisture ingress.

### **17. PACKING AND MARKING:**

The conductors shall be wound in reels or drums conforming to the latest versions of IS: 10418 (amended upto date), ' Specification for Drums for cables.

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### 18.1 PACKING:

18.1.1 The gross mass of packing for various conductors shall not exceed by more than 10% of the values given in the following table.

Conductor Size in sq.mm.	Gross Mass in kg
31.60 sq.mm. (ALU 6/2.59 + ACS 1/2.59)	1100
52.88 sq.mm. (ALU 6/3.35 + ACS 1/3.35)	1500
78.82 sq.mm. (ALU 6/4.09 + ACS 1/4.09)	1600
104.98 sq.mm. (ALU 6/4.72 + ACS 1/4.72)	2000
120 sq.mm. (ALU 26/2.44 + ACS 7/1.90)	2000
160 sq.mm. (ALU 30/2.59 + ACS 7/2.59)	2000
241 sq.mm. (ALU 30/3.20 + ACS 7/3.20)	2500

18.1.2 The normal length of various conductors shall be as given in the following table:

Conductor Size in sq.mm.	Normal Length in KM
31.60 sq.mm. (ALU 6/2.59 + ACS 1/2.59)	2.0
52.88 sq.mm. (ALU 6/3.35 + ACS 1/3.35)	2.0
78.82 sq.mm. (ALU 6/4.09 + ACS 1/4.09)	1.0
104.98 sq.mm. (ALU 6/4.72 + ACS 1/4.72)	1.0
120 sq.mm. (ALU 26/2.44 + ACS 7/1.90)	1.0
160 sq.mm. (ALU 30/2.59 + ACS 7/2.59)	1.0
241 sq.mm. (ALU 30/3.20 + ACS 7/3.20)	1.0

#### 18.1.2.1 LENGTHS AND VARIATION IN LENGTHS:

The standard length of AL59 ACS Covered Conductor shall be as per mentioned in clause. No 18.1.2 Tolerance of +/- 5% (plus or minus five percent) shall be permitted in this standard length. All the lengths outside these limits of tolerances shall be treated as random length.

Random length shall not be less than 80% (eighty percent) of the standard length specified as above and the total acceptable quantity of such random lengths shall be within 7% (seven percent) quantity of the allotted quantity to each consignee of the respective size of the conductor.

### 18.2 MARKING:

#### IDENTIFICATION MARKS ON COVERED CONDUCTOR:

The following particulars shall be properly legible embossed on the Covered conductor at the intervals of not exceeding one meter throughout length of the cable. The covered conductor with poor and illegible embossing shall be liable for rejection.

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- a) Manufactures name
- b) Voltage grade.
- c) Year of manufacture.
- d) PVVNL
- e) Successive Length.
- f) Size of cable
- g) EN 50397-1: 2006 Also the following information be marked on each package:
  - a) Manufacturer's name.
  - b) Trade mark, if any.
  - c) Drum or identification number.
  - d) Size of conductor Number and lengths of conductors
  - e) Gross mass of the package.
  - f) Net mass of conductor
  - g) EN 50397-1: 2006

### **19.INSPECTION:**

All tests and inspection shall be made at the place of manufacturer unless otherwise especially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities without charges, to satisfy him that the material is being furnished in accordance with this specification.

### **20. VERIFICATION OF LENGTH OF CONDUCTOR:**

- i) The Company shall ascertain the length of AL59 ACS COVERED Conductor at supplier's works and at the receiving store centres by measuring the actual length by length measuring machine used for the purpose. The supplier should ensure that length measuring machine is available for measurement of the length by our inspecting officer.
- ii) Both ends of the AL59 ACS COVERED Conductor will be sealed by the supplier and seals will be contained in the drum and not exposed out of drum.
- iii) The declared length will be measured between manufacturer's seals at both ends of AL59 ACS COVERED Conductor.
- iv) The weight of AL59 ACS COVERED Conductor will also be checked for ensuring correct lay and length of AL59 ACS Covered Conductor.
- v) For the verification of the length of the conductor, 10 % of total lot (in Drums) should be selected at the works. The physical verification of the length of the conductor should be carried out for maximum up to 5 (five) drums. If there are any more drums left for verification, then weight of each verified drum should be carried out and average weight may be calculated.

Then the weight of each of all the remaining selected drums may be taken and if these weights are matching with the average weight, then that particular lot may be accepted

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otherwise rejected.

- vi) Verification of length of conductor will also be carried out at each stores center for two drums out of each lot. If the average length is found correct or more, the lot will be accepted. If the average length is found to be less than the declared, the percentage of such short length will be applied for reduction for the entire quantity supplied in the lot at respective stores for acceptance.
- vii) In case of dispute, joint inspection along with the representative of the supplier shall be carried out after giving 10 (ten) days' notice to the supplier to remain present at stores centre for the purpose. If the representative fails to attend on stipulated date for joint inspection, the decision of the consignee shall be final and binding.

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### **21. REJECTION:**

While measuring the length, the sample piece from each length shall be taken for carrying out the test as per EN 50397-1:2006. All the values of each sample should not exceed the value as per the relevant specification. In case of deviation, whole lot will be rejected at works.

### **22. EN CERTIFICATION MARK:**

The AL59ACS COVERED Conductor with EN marking only is required by the PVVNL Against this tender specification.

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## GUARANTEED TECHNICAL PARTICULARS AL 59 ACS Covered Conductor

SR. No	Description	Unit	To be filled by Bidder
1	<b>Name &amp; Address of Manufacturer</b>		
2	Reference Standard		
3.0	<b>Material of Covered Conductor</b>		
3.1	<b>Aluminium / Alloy Rods</b>		
	a) Si	%	
	b) mg	%	
	c) fe	%	
	d) cu	%	
	e) mn	%	
	f) cr	%	
	g) zn	%	
	h) b	%	
	i) other elements (each)	%	
	j) other elements (total)	%	
	k) al	%	
3.2	<b>Aluminium Alloy strands (Individual)</b>	<b>Nos</b>	
3.3	<b>Diameter</b>		
	a) Nominal	<b>mm</b>	
	b) Maximum	<b>mm</b>	
3.4	<b>Minimum Breaking load of strand</b>		
	a) Before stranding		
	b) After stranding		
3.5	<b>Maximum Resistance of strand at 20 deg. C</b>	<b>Ohm/km</b>	
3.6	<b>Minimum elongation of strand (200 mm gauge)</b>		
	Before and After Stranding		

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4	<b>Complete conductor</b>	
4.1	Calculated breaking load of complete conductor	<b>KN</b>
4.2	Lay ration conductor (lay length/overall diameter)	
	a) 6+1 wire aluminium alloy layer	
4.3	Maximum DC Resistance of complete conductor at 20 deg. C	<b>ohms/km</b>
4.4	Working tension of conductor	
4.5	Modulus of elasticity of	
	a) Conductor	<b>kg/cm<sup>2</sup></b>
4.6	Co-efficient of linear expansion per deg c of	
	a) Conductor	<b>per deg c</b>
4.7	a) Overall diameter of conductor	<b>mm</b>
	b) Actual area	<b>Sq.mm</b>
	c) Cross sectional area of individual aluminium alloy wire	<b>Sq.mm</b>
5	Filling	
6	Insulation	
6.1	Material	
6.2	Nominal Thickness of insulation	
6.3	outer layer of insulation	
6.4	Colour	
7	<b>Length &amp; other details of Covered conductor</b>	
7.1	Standard length of covered conductor	<b>Mtr.</b>
7.3	Direction of lay for outermost layer	
7.4	Linear mass of the covered conductor ( Approx.)	<b>kg/km</b>
	a) Approx. mass of individual aluminium / alloy wire	<b>kg/km</b>
7.5	Embossing / printing on cable	
7.6	Approximate Standard drum length	<b>mtrs</b>
7.7	Drum dimension in MM	<b>mm</b>
8	Continues AC current capacity	<b>Amp</b>
9	Short current rating of covered conductor KA for 1 Sec	<b>kA</b>



# TECHNICAL SPECIFICATIONS FOR 11 KV & 33 KV MEDIUM VOLTAGE COVERED CONDUCTOR (MVCC) ACCESSORIES

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5	MARKING
	Annexure-I
	Annexure-II

# TECHNICAL SPECIFICATIONS FOR 11 KV & 33 KV MEDIUM VOLTAGE COVERED CONDUCTOR (MVCC) ACCESSORIES

## 1.SCOPE:

This specification covers design, manufacture, assembly, testing and supply of Accessories for AL59 ACS Covered Conductors for use on 33 kV & 11 kV distribution systems.

## 2.SERVICE CONDITIONS:

The Accessories to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

i)	Maximum ambient temperature (Degree C)	----- 50
ii)	Minimum temperature of air in shade (Degree C	----- 3.5
iii)	Relative Humidity (%)	----- 10 to 100
iv)	Maximum Annual Rainfall (mm)	----- 1450
v)	Maximum Wind Pressure (kg/sq.mm.)	----- 150
vi)	Maximum altitude above mean sea level (meter)	----- 3400 (MSL –2206m)
vii)	Isoceraunic level (days/ year)	----- 50
viii)	Seismic level (Horizontal acceleration)	----- 0.3g

## 3. APPLICABLE STANDARDS:

Unless otherwise stipulated in this specification, the accessories of conductor shall conform to the following Standards (amended upto date).

1	EN 50397-1:2006	Covered Conductor Specification- Up to 33 KV
2	EN 50397-2:2006	Covered Conductor Accessories Specification- up to 33 KV
3	NFC 33-041 (SEPTEMBER 2013)	Insulated cables and their accessories for power systems – Anchoring devices for overhead distribution with bundle assembled cores, of rated voltage 0.6/1 kV.
4	EN 50483-4 (MARCH 2009)	Test requirements for low voltage aerial bundled cable joints
5	EN 50397-2 (MARCH 2010)	Covered conductors for overhead lines and the related accessories for rated voltages above 1kV a.c. and not exceeding 36kV a.c. PART 2 : Accessories for covered conductors : tests and acceptance criteria
6	EN 50182	Conductors for overhead lines- Round wire concentric lay conductors

## 4.TYPE OF MEDIUM VOLTAGE COVERED CONDUCTOR ACCESSORIES:

The Accessories of Medium Voltage Covered Conductor (MVCC) are specified below and shall consist of the following:

## TECHNICAL SPECIFICATIONS FOR 11 KV & 33 KV MEDIUM VOLTAGE COVERED CONDUCTOR (MVCC) ACCESSORIES

Sl. No.	Description	Application
1	Tension Assembly (TA)	<ul style="list-style-type: none"> <li>For fitting onto a pole for tensioning at the beginning or end of a length of MVCC, or for anchoring while a major change in direction.</li> <li>The Tension assembly consists of one wedge type Tension / anchoring clamp and one Tracking protection IPC.</li> </ul>
2	Insulator Clamp / Tie (IC)	<ul style="list-style-type: none"> <li>For supporting and aligning MVCC at an intermediate pole in a length, with small angle of deviation.</li> <li>The Insulator Clamp hold the MVCC in its position on top of the pin or post insulator.</li> <li>Insulator Tie consists of either an "Insulated Plastic" or "Metallic helical" Type for Line Alignment.</li> </ul>
3	Suspension Clamp (SC)	<ul style="list-style-type: none"> <li>For supporting a length of MVCC at an intermediate pole in a length, with large angle of deviation with a disc insulator.</li> <li>The suspension clamp consists of an "Assembly with one locking type Suspension clamp with provision to fix in Insulators.</li> </ul>
4	Insulation Piercing Connector for "Bare to Covered interconnection" (IPC – Type 1)	<ul style="list-style-type: none"> <li>For main (Bare) to main (MVCC) networking connection.</li> <li>This connector is to ensure the electrical characteristics within the required limits, while ensuring necessary insulation protection against tracking and water penetration on MVCC.</li> </ul>
5	Insulation Piercing Connector for Networking / Branching / Looping (IPC – Type 2)	<ul style="list-style-type: none"> <li>For main (MVCC) to main (MVCC) networking or branching of MVCC to another MVCC or Branch Cable or Looping for transformer junctions.</li> <li>This connector is to ensure the electrical characteristics within the required limits, while ensuring necessary insulation protection against tracking and water penetration on MVCC.</li> </ul>
6	Insulation Piercing Connector with Aluminium Bail for earthing (IPC – Type 3)	<ul style="list-style-type: none"> <li>For Temporary Earthing Provision from MVCC Cable for maintenance purpose.</li> <li>This connector is to ensure the electrical characteristics within the required limits, while ensuring necessary insulation protection against tracking and water penetration on MVCC.</li> </ul>
7	Tension Joints (TJ)	Mid-span tension joints for jointing MVCC over a span.

# TECHNICAL SPECIFICATIONS FOR 11 KV & 33 KV MEDIUM VOLTAGE COVERED CONDUCTOR (MVCC) ACCESSORIES

## 4.1 Tension / Anchoring Clamp:

Anchoring assemblies are used to firmly hold the MVCC to a concrete or steel pole and transmit the mechanical tension.

- at the end of a run
- at a major change in direction of over 20 degrees.

The clamp should consist of an Aluminium alloy corrosion resistant casted body, Rigid sling ("bail") of stainless steel with Tracking IPC and self-adjusting plastic wedges which shall anchor/hold the cable. The following key criterion to be followed for the design of the same

- There shall be no losable part (except Tracking IPC and bail) in the process of clamping arrangement
- Locking mechanism should be wedge type self-locking. Wedges are to be made of high strength, climatic resistance Engineering Plastic with glass fibre.

The fittings shall be able to withstand the specific minimum failure load (SMFL) and shall not damage the covering. SMFL is the minimum load specified by the purchaser or declared by the supplier at which mechanical failure will not take place.

### 4.1.1 Rigid Sling (Bail) of Anchor Assembly

- The Anchoring assembly shall be supplied with a Galvanized steel rod to connect the Tension Clamp to the Insulator clamp on the pole.
- The Rigid Bail forming part of clamp should have sufficient distance between bracket and body of clamp and shall have sufficient mechanical strength to withstand the mechanical test for the complete assembly tests in this specification.
- Flexible bail is not acceptable due to the reason to withstand the load.
- Rigid Bail should be fitted with provision to remove from the clamp to have easy installation.

### 4.1.2 Wedge Type Tension Clamp for Anchoring Assembly

- Wedge type clamps shall be used for clamping the MVCC without damaging the insulation and shall be capable of clamping an uncut MVCC so that it can continue without break to the connecting point or next span.
- The clamp shall be of aluminium with fully insulating type of mechanical and weather resisting thermoplastic wedges.
- No tools shall be needed for fitting the MVCC into the clamp.
- Type tests as per IEC and specification shall be conducted from NABL accredited independent Lab of India/the International Laboratory Accreditation corporation,
- Mutual Recognitions Arrangement (ILAC, MRA) signatory Laboratory like COFRAC.

### 4.1.3 Testing Requirements for an Anchoring Assembly.

The following tests are intended to establish design characteristics as per EN 50397 – 2 and NFC 33-041.

#	Test	Type test	Acceptance Test	Routine test
1	Visual examination	x	x	x

## TECHNICAL SPECIFICATIONS FOR 11 KV & 33 KV MEDIUM VOLTAGE COVERED CONDUCTOR (MVCC) ACCESSORIES

2	Dimensional verification	x	x	x
3	Mechanical tests	x		
3.1	Tensile test at ambient temperature	x	x	
3.2	Tensile test at low temperature	x		
3.3	Tensile test at high temperature	x		
3.4	Slippage test at ambient temperature	x	x	
4	Environmental tests			
4.1	Corrosion test	x		
4.2	Climate ageing test	x		
4.3	Resistance against tracking in heavy polluted areas	x		
5	Check for permanent marking	x	x	

### 4.2. Insulator Clamps / Ties

The Clamps / ties shall be designed suitably to hold the MVCC in its position on top of the insulator. The Clamps is preferred to be made of Insulating Plastic materials or protected with Insulating Plastic material to ensure tracking resistance and to avoid any insulation damage to covered conductor due abrasion while mechanical or wind induce vibration.

#### 4.2.1 Testing Requirements for an Insulator Clamps / Tie.

Tests shall meet the requirement of EN Standard 50397 - 2

Sl. No.	Test	Type test	Acceptance test	Routine test
1	Visual examination	x	x	x
2	Dimensional verification	x	x	x
3	Check for Marking	x	x	x
4	Mechanical tests	x	x	x
4.1	Failure Load Tests	x	x	x
4.2	Slip Load Tests	x	x	x
4.3	Lift / Side Load Tests	x	x	x
4.4	Thermal Tests under load	x		
4	Environmental tests			
4.1	Corrosion test	x		
4.2	Climate ageing test	x		
4.3	Resistance against tracking in heavy polluted areas	x		

### 4.3. Suspension Clamps

The Suspension Clamps shall be made of Insulating Plastic to ensure tracking resistance and to avoid any insulation damage to covered conductor due abrasion while mechanical or wind induce vibration.

## TECHNICAL SPECIFICATIONS FOR 11 KV & 33 KV MEDIUM VOLTAGE COVERED CONDUCTOR (MVCC) ACCESSORIES

### 4.3.1 Testing Requirements for Suspension Clamps

Tests shall meet the requirement of EN Standard 50397 – 2.

### 4.4 Insulation Piercing Connectors for MVCC

- Insulation Piercing Connectors (IPC) are used for making Tee / Tap-off/ connections to an MVCC / Bare Overhead Line.
- Insulation Piercing Connectors are designed to make a connection between the uncut main conductor and a branch cable conductor without having to strip either cable to expose the conductor. Instead, the tightening action of the IPC will first pierce the Insulation, then make good electrical contact between the main and branch conductor while simultaneously insulating and sealing the connection.
- The insulation piercing connectors shall be of the following type(s) depending on the applications.

#### 4.4.1 Insulation Piercing Connectors

- The connector bodies shall be made entirely of mechanical and weather resistant plastic insulation material made of weather & UV resistant reinforced polymer and no metallic part outside the housing is acceptable except for the tightening bolt or nuts.
- Any metallic part that is exposed must be free from potential during or after connector installation.
- Screws or nuts assigned for fitting with IPC (Insulating Piercing connector), must be fitted with torque limiting shear heads to prevent over tightening or under tightening.
- While the min & max torque values are to be specified by Manufacturer, these should not exceed 27 N mtr. for IPC for main conductor < 95 sq.mm, and 42 N mtr. for main conductor >95, but < 240 sq.mm.

Sl. No.	Test	Type Test	Acceptance Test	Routine test
1	Visual examination	x	x	x
2	Dimensional verification	x	x	x
3	Check for Marking	x	x	x
4	Mechanical tests	x	x	x
4.1	Failure Load Tests	x	x	x
4.2	Slip Load Tests	x	x	x
4.3	Lift / Side Load Tests	x	x	x
4.4	Thermal Tests under load	x		

- The IPC must perform piercing and connection on Main and Branch cable simultaneously using single bolt for tightening as multiple bolts do not ensure even tightening. The shear bolt/nut shall be suitable for tightening with a hexagonal socket of 13 mm or 17mm.

## TECHNICAL SPECIFICATIONS FOR 11 KV & 33 KV MEDIUM VOLTAGE COVERED CONDUCTOR (MVCC) ACCESSORIES

- The contact teeth or blade of the connector is made of tinned copper with equivalent cross section with respect to %IACS to suit the max branch cable size declared.
- The IPCs shall be water proof and the water tightness shall be ensured by appropriate elastomeric materials and not by grease, gel or paste alone. Grease can be applied to protect the contact blade alone and shall not be visible on the outer surface of the connector. Connector should not be dipped in grease.
- Each IPC should be provided with a cap to seal the cut end of the Branch cable. It should be of a design that once the connector is installed, it shall not be possible to remove the cap without dismantling the connector.
- All the metallic parts of the connector should be corrosion resistant and there should not be any appreciable change in contact resistance & temperature after overloads & load cycling and should conform to the long duration tests specified in this standard.

### 4.4.2 Testing Requirements for Suspension Clamps

The following tests are intended to establish design characteristics as per NFC 33-003, 004, 020 and EN 600068 – 1.

Sl. No.	Test	Type test	Acceptance Test	Routine test
1	Visual examination		x	x
2	Dimensional verification		x	x
3	Mechanical tests	x	x	x
4	Voltage and Water Tightness test	x	x	x
5	Climatic Ageing Test	x		
6	Corrosion Test	x		
7	Electrical Ageing Test	x		
8	Check for marking	x	x	

### 4.5 Mid Span Insulated Jointing Sleeves

The sleeves should be Pre-Insulated type. Sleeve should be made of Aluminium, insulated with an Anti-UV black thermoplastic tube hermetically sealed two ends with 2 flexible rings. Strip length, Hexagonal crimping die reference and size to be marked on the outer surface of plastic sleeve.

Reference standard, type test and design requirements as per NFC 33 021

## TECHNICAL SPECIFICATIONS FOR 11 KV & 33 KV MEDIUM VOLTAGE COVERED CONDUCTOR (MVCC) ACCESSORIES

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Sl. No.	Test	Type Test	Acceptance Test	Routine Test
1	Visual examination	x	x	x
2	Dimensional verification	x	x	x
3	Check for Marking	x	x	x
4	Voltage and Water Tightness test	x	x	x
5	Climatic Ageing Test	x		
6	Corrosion Test	x		
7	Electrical Ageing Test	x		

### 4.5.1 Heat Shrinkable End Cap

The Insulated End Cap with sealant shall be suitable for effectively sealing the end terminal of the covered conductors. The inner diameter range of the Cap shall be such that it shall tightly fit to the covered conductors to prevent entry of moisture.

### 5.0 MARKING:

#### 5.1 On Covered Conductor

The covered conductors shall carry the following marking as per 50397-1

#### 5.2 On Accessories

- Manufacturer's name with designation if any.
- Batch code and Manufacturing period (MM/YY) is to be marked.



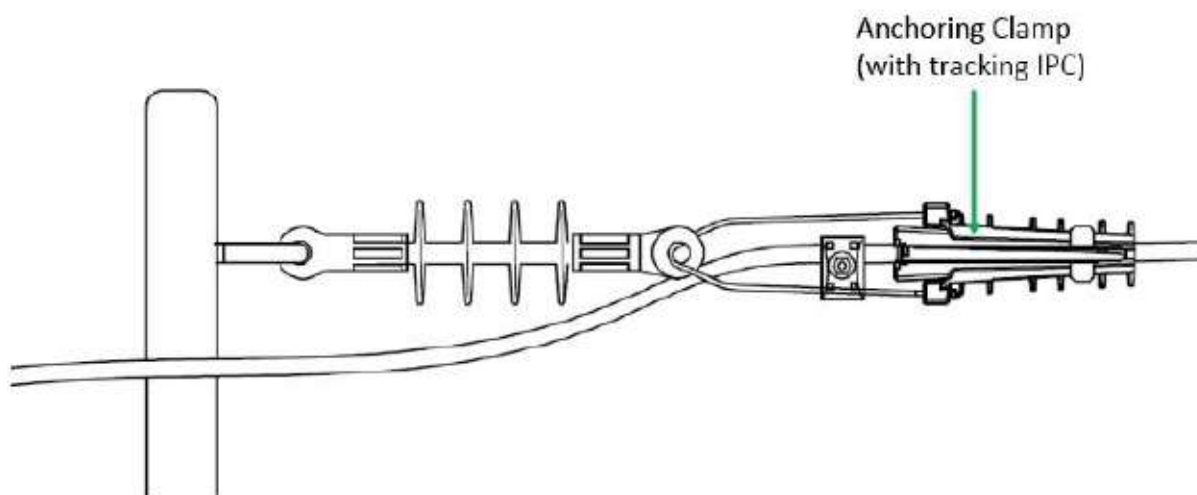
# TECHNICAL SPECIFICATION OF (MEDIUM VOLTAGE) AL59 ACS COVERED CONDUCTOR & ITS ACCESORIES.

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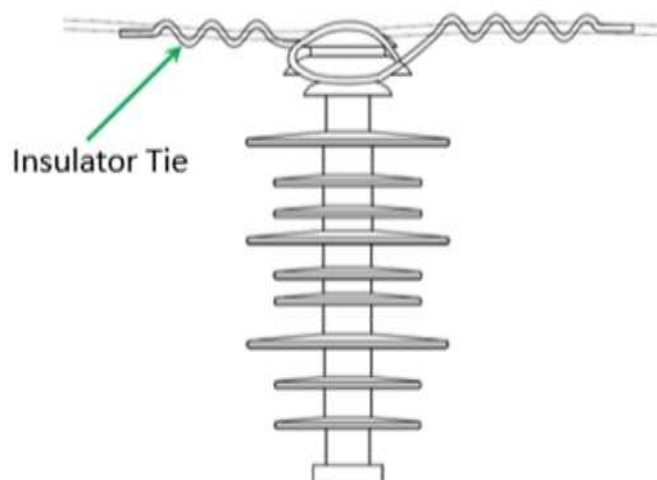
## ANNEXURE I: - TYPICAL GENERAL ARRANGEMENT DIAGRAM AND DRAWINGS

1. Tension Assembly (TA) with Anchoring clamp and one Tracking protection IPC

Anchoring with protection against Tracking.



2. Insulator Clamp / Tie (IC)



3. TYPE-1: Insulation Piercing Connector for Networking / Branching /Looping, TYPE -3: Insulation Piercing Connector with Aluminum Bail for earthing and Tension Joints(TJ)



# TECHNICAL SPECIFICATION OF (MEDIUM VOLTAGE) AL59 ACS COVERED CONDUCTOR & ITS ACCESORIES.

## ANNEXURE-II - Guaranteed technical particular format

### 1. GTP for Dead-End / Anchoring Assembly (Dead-End Clamp with Bracket)

Sl. No.	Description	Particulars
1	Name of the Supplier	
2	Type of Design	
3	Weight	
4	Cable Range	Range to in line with this specification
5	Material	
6	Ultimate Tensile Strength	For conductor range of 50 - 70 sq.mm = 20 KN For conductor range of 70 - 120 sq.mm = 30 KN For conductor range of 120 - 200 sq.mm = 30 KN
7	Installation(With/Without disassembly)	Ready- to-use (Without disassembling)
8	Marking	
9	Dimensions	

### 2. GTP for Insulator Clamp / Tie (IC)

Sl. No.	Description	Particulars
1	Name of the Supplier	
2	Length	
3	Weight	
4	Cable Range	Range to in line with this specification
5	Material	
7	Installation(With/Without disassembly)	Ready- to-use (Without disassembling)
8	Marking	

### 3. GTP for Suspension Clamp

## TECHNICAL SPECIFICATION OF (MEDIUM VOLTAGE) AL59 ACS COVERED CONDUCTOR & ITS ACCESORIES.

Sl. No.	Description	Particulars
1	Name of the Supplier	
2	Cable Range	Range to in line with this specification
3	Material	
4	Minimum Breaking Load - Vertical	
5	Installation(With/Without disassembly)	Ready- to-use (Without disassembling)
6	Marking	
7	Dimensions	
8	Weight	

### 4. GTP for INSULATION PIERCING CONNECTOR

Sl. No.	Particulars	
1	Name of supplier	
2	Type of connection required	Bare to Covered conductor Covered conductor to Covered conductor Tapping connector
3	Are torque limiting shear heads provided to tightening bolts	
4	Range of cable sizes accommodated for Main & Branch	Range to in line with this specification
5	Tightening Torque	
6	Torque for establishing connection between main and Tap (Nm)	70% of min torque specified
7	Marking and embossing on the connector	

### 5. GTP for INSULATED TENSION / MIDPSAN JOINTS

Sl. No	PARTICULARS	
1	Name of Supplier.	
2	IS manufacturer of Accessories an ISO 9001-2000 Company?	
3	Type No & Size Range	Range to in line with this specification
4	Is any metallic part carrying potential in operation exposed during installation	
5	Installation	Crimping by Hexagonal Compression