

BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED

TECHNICAL SPECIFICATIONS FOR 11 KV COVERED CONDUCTOR AND ACCESSORIES

1. SCOPE:

These Specifications lay down the Constructional, Dimensional and Performance Requirements for Covered Conductors which consist of a Conductor surrounded by a Covering made of Insulating Material (as described hereunder) as protection against Accidental Contacts with other Covered Conductors and with Grounded Parts such as Tree Branches, etc.

2. SERVICE CONDITION

The polymeric surge arresters to be supplied shall be suitable for satisfactory continuous operation under conditions as specified below:

- Maximum ambient temperature : 45°C
- Minimum ambient temperature : -5° C
- Relative humidity : 0 to 100%
- Average annual rainfall : ≤1000 mm
- Max. Altitude above mean sea level : ≤1000 m (3300Ft)
- Isoceraunic level (Max) : ≤50 Days
- Seismic level : 0.25 g
- Max. wind speed : ≤ 39 m/s

3. APPLICABLE STANDARDS :

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

Sl. No.	INDIAN/ INTERNATIONAL STANDARDS	TITLE
1	EN 50397-1:2006	Covered Conductor Specification for voltage 1KV to 33KV.
2	EN 50397-2	Accessories for covered conductors - Tests and acceptance criteria
3	IS : 398 (Part IV) / 1994	Specification for aluminium conductors for overhead transmission purpose
4	EN-50182 :2001	Conductors for overhead lines
5	EN 60811 series	Insulating and sheathing materials of electric and optical fiber cables common test methods (IEC 60811 series)
7	IEC 61284	Overhead lines requirements and test for fittings
8	IS : 10418	Reels and drums for bare conductors

4. CONSTRUCTION REQUIREMENTS:

i) CONDUCTOR:

a) **CONDUCTOR MATERIAL:** Aluminum Alloy (AAAC) as per EN-50182

b) **NOMINAL CROSS SECTION:** 70/99/120 Sq mm AAAC conductor.

c) **CONDUCTOR DESIGN:** The Conductor shall be stranded, round and should be Non-Compacted. Non-Compacted Conductors shall comply with all the requirements of EN 50397-1-2006. The D.C. Resistance of the conductor shall not exceed that given in EN 50397-1-2006 by more than 5%.

ii) PROPERTIES OF CONDUCTOR:

The properties of stranded all aluminium alloy conductors as per EN 50397-1-2006

Sl.No	Actual Area in Sqmm	Stranding & wire dia. In mm	Approx. overall dia. mm	Approx Mass in kg/kM	Calculated resistance at 20 DC. (max.) Ω /kM	Approx. calculated Breaking Load in kN	Nominal Current Rating in Amps
1	70	7/3.57	10.7 \pm 0.25	182	0.493	20.6	247
2	99	7/4.25	12.75 \pm 0.30	271	0.318	25.3	303
3	120	19/2.84	14.2 \pm 0.30	315	0.288	35.2	345

The properties of stranded all aluminium alloy wire as per EN 50397-1-2006/398-(Part-4)

Sl.No	wire dia. In mm	Cross sectional Area In Sq mm	Approx Mass in kg/kM	Calculated resistance at 20 DC. (max.) Ω /kM	Minimum Breaking Load in kN after stranding
1	2.84	6.33	17.40	5.19	1.89
2	3.57	10.01	26.95	3.41	2.92
3	4.25	14.18	38.38	2.35	4.17

iii) TOLERANCE ON NOMINAL SIZES:

No negative tolerance shall be permitted on the nominal diameter aluminium wire used in the manufacture of AAA Covered Conductor. However, positive tolerance in this respect shall be as provided in EN-50182 (amended upto date).

iv) STRANDING :-

- The wires used in the construction of a stranded conductor shall, before stranding satisfy all the relevant requirements of this standard.
- The lay ratio of the different layers shall be within the limits given in the below table

TABLE: LAY RATIOS FOR ALUMINIUM ALLOY STRANDED CONDUCTORS

No. of wires in Conductors	Lay Ratio in			
	6 - wire layer		12 - wire layer	
	Min.	Max	Min	Max
7	10	14	-	-
19	10	16	10	14

- c) 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.
- d) 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.

v) 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.

vi) JOINTS. IN WIRES:

- a) 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.

- b) 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 fulfill 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.

2) FILLING (WATER BLOCKING):

The Stranded Conductor shall be longitudinally water tight by means of a water blocking material incorporated during the extrusion process. The material used for blocking shall not have any harmful to the cable lifespan as per standards. 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.

3) SEMICONDUCTING SCREEN:

A semi conductive polymeric screen should be applied over the filled stranded conductor to ensure a lower voltage stress on the Insulation applied over the screen. The thickness of the semi conductive polymeric screen should be between **0.2 mm and 0.4 mm**.

4) 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 the Outer Layer being a suitable Polymer which is UV Resistant, Non Tracking and Erosion Resistant with a nominal wall thickness of 1.1 mm for Voltages up to 11 KV. The minimum combined Insulation Thickness of both Layers should be **2.3 mm for 11 KV**.

Nominal thickness of 2.4 mm for Voltages for 33 KV and the Outer Layer being a suitable Polymer which is UV Resistant, Non Tracking and Erosion Resistant with a nominal wall thickness of 1.1 mm for Voltages 33 KV. The minimum combined Insulation Thickness of both Layers should be **3.5 mm for 33 KV**. The covering shall be extruded directly over the conductor in 2 layers an inner semi-conducting layer for corona suppression followed by the XLPE insulation.

The conductor manufacturing and stranding process shall incorporate the longitudinal water blocking also. The final shape over the outer layer shall be circular with the conductor screen in firm contact with the insulation to prevent slippage.

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.

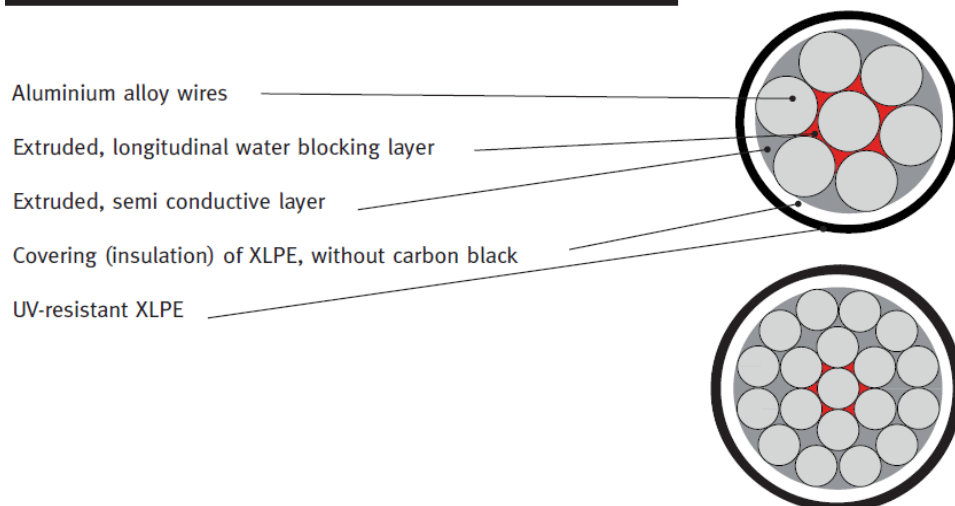
It shall be possible to remove the Semi Conducting Screen, Inner and Outer Insulation Layers without damage to the conductor.

TABLE-1:- PROPERTIES OF XLPE & PE INSULATION

Sl.No	Property	Requirement	
1	Compound Design	X	T
	Basic Material	XLPE	PE
	Max. operating Temperature of the of the conductor	90°C	70°C
2	Mechanical properties		
I	<u>Before Aging</u>		
	a) Tensile Strength Minimum.	12.5 N/Sq.mm	12.5 N/Sq.mm
	b) Elongation at break	200. %	300 %
II	<u>Ageing in air oven:</u>		
	a) <u>Treatment:</u> Temperature Duration	135 °C 7 Days	110 °C 14 Days
	b) Tensile Strength Variation in %	± 25%	-
	c) Elongation Variation in %	± 25%	-
	d) Minimum Elongation at break	-	300 %

3	Hot Set: a) <u>Treatment:</u> 1. Temperature 2. Time under load 3. Mechanical stress b) Elongation under load c) Permanent Elongation (Set) after cooling	200 ± 3 °C 15 minutes 0.2 Mpa. 175 % Max. 15 % Max.	- - - -
4	Shrinkage: a) Sample length mark b) <u>Treatment:</u> Temperature Duration c) Shrinkage	200mm 130 ± 3 Deg.C 1 Hour 4% Max.	200mm 100 ± 3 Deg.C 1 Hour 4% Max
5	Water absorption (gravimetric): a) <u>Treatment:</u> Temperature Duration b) Water absorbed	85 ± 2 Deg. C 14 Days 1 mg/Sq.cm. (Max.)	85 ± 2 Deg. C 14 Days 1 mg/Sq.cm. (Max.)
6	Pressure Test at high Temperature a) Temperature b) Duration c) Co-efficient k d) Maximum Depth of indentation	- - - -	80 °C 4 Hours 0.8 50 %
7	Shore D hardness minimum hardness	-	55 ShD

Figure 1 shows the Cross Section of a Covered Conductor with AAAC Conductor
FIGURE 1 (AAAC conductor with insulation)



5) TESTS:

The type test, routine tests and acceptance tests shall be conducted on covered conductor as per EN 50397-1-2006 Table -2 (Annexure-II of this Specification). The covered conductor offered shall be fully type tested as per EN 50397-1-2006 at CPRI/ERDA/Accredited Govt. Labs recognised by BIS and the date of type test shall not be older than 5 years.

i) TYPE TESTS: TEST FOR COVERED CONDUCTORS as per EN 50397-1-2006

Sl.No	Test Requirements
1	Conductor Resistance Test
2	Construction & Dimensions (Thickness of Insulation & Covering, compliance with design requirements)
3	Construction & Mechanical Properties of the conductor- (Tensile strength, Construction& dimensions)
4	Percentage Elongation at break of Insulation before ageing, after ageing
5	Test for compatibility- (Completed Cable ageing)
6	Carbon black content test or UV Resistance test on outer covering
7	Shrinkage test on outer covering & Insulation
8	Hot set test on Insulation
9	Water Absorption test on Insulation
10	Test for longitudinal water tightness
11	AC High Voltage test
12	Leakage Current Measurement
13	Tracking & Erosion test
14	Slippage test
15	Marking- (Content, legibility)
16	Shore D Harness (for PE covering)
17	Pressure at higher temperature (For PE covering)

6. ROUTINE TESTS: as per EN 50397-1: 2006

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.

Sl.No.	Tests
1	Conductor resistance test
2	Spark Test on covering – [Test Voltage 0.7 X Phase to Phase Voltage of System (AC) or Phase to Phase Voltage of System (DC.) Requirement No Breakdown.]
3	Construction & dimensions [compliance with design requirements, Thickness of the covering]
4	Marking (Content, legibility)

7. ACCEPTANCE TESTS: as per EN 50397-1: 2006

All Acceptance tests as per EN 50397-1: 2006 as amended upto date including the optional And should offered Anti tracking testing on selective samples in manufacturer's work during acceptance test.

Sl. No	Tests
1	Conductor Resistance Test
2	Dimensional verifications, Construction & mechanical Properties of the conductor
3	Construction & dimensions (compliance with design requirements, Thickness of the covering)
4	AC High Voltage test on covered conductor
5	Hot set test on Insulation
6	Test for longitudinal water tightness
7	Marking (Content, legibility)

1. ELECTRICAL TESTS:

A) Conductor Resistance Test: To be done as a Routine as well as Type Test as per EN 50397-1-2006.

B) High Voltage Test as per EN 50397-1-2006. – Type test

Test Voltage --- Phase to Phase Voltage of the System for which the Covered Conductor is used.

- No. of Specimens --- One
- Length of Specimen (minimum) ---- 5 metres
- Duration of Immersion in Water (minimum) ---- 1 Hour
- Temperature of Water ---- (20 +/- 5) Degrees Centigrade
- Test Duration ----- 4 Hours for Routine Test
----- 48 Hours for Type Test
- Requirement: No Breakdown

C) Spark Test on Covering: Routine test

Test Voltage 0.7 X Phase to Phase Voltage of System (AC,) or
Phase to Phase Voltage of System (DC)

Requirement: No Breakdown

D) Leakage Current Test - Type test

Test Voltage 0.7 X Phase to Phase Voltage of System (AC)

Requirement: Maximum Leakage Current 1mA

E) Tracking Resistance: - Type test

2. NON – ELECTRICAL TESTS ON COVERING: Type tests

A) Mechanical Properties:

a) Before Ageing of Sample: As per Table 1 (as per EN 50397-1-2006)

b) After Ageing of Sample: As per Table 1 (as per EN 50397-1-2006)

c) Ageing of Complete Product Sample: As per Table 1 (as per EN 50397-1-2006)

- d) Hot-Set-Test: As per Table 1 and in accordance to (as per EN 50397-1-2006)
- e) Pressure Test at High Temperature: As per Table 1 and in accordance with EN 60811-3-1, Sub Clause 6.1.
- h) Water Absorption: As per Table 1 and in accordance with EN 50397-1-2006

3. TEST FOR LONGITUDINAL WATER TIGHTNESS

- a) As Type Test with Heat Cycle and in accordance with 50397-1-2006.

No of Specimen – 1

Length of Specimen – 3 meters

Test Duration -- 24 hours

Bending Radius – 20 X Diameter of Covered Conductor

Requirement – No Leakage

- b) As Routine Test without Heat Cycle and in accordance with IEC 60502 -2

No of Specimen – 1

Length of Specimen – 1 meter

Test Duration – 1 Hour

8. TESTING FACILITIES AND DETAILS OF EQUIPMENTS:

The supplier/tenderer/manufacturer 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.

9. 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.

10. 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.

11. LENGTHS AND VARIATION IN LENGTHS:

The standard length of AAAC Covered Conductor shall be as per standards. 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.

12. MARKING : IDENTIFICATION MARKS ON COVERED CONDUCTOR:

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

“Manufacturer/Trade name, Code designation, Year of manufacture, BESCOM, Successive length, EN 50397-1:2006, Project name/DWA/PO No.”

Also The following information be marked on each package/Drums:

- 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.

General Manager (Ele)
QS&S BESCOM

Annexure-I

GTP : Supplier shall confirm by signing with stamp on the GTP

Sl.No.	Parameters	offered Values for 11KV 70/99/120 Sq.mm
1	Conductor type	
2	Lay up of Conductors (mm)	
3	Conductor Dia (mm)	
4	Inner Semiconducting Layer thickness (mm)	
5	Inner XLPE Layer thickness (mm)	
6	Outer UV Resistance - XLPE Thickness (mm)	
7	Over all diameter (Min-Max) (mm)	
8	Weight (Kg/Km)	
9	Rated Operated Voltage (KV)	
10	DC-resistance at 20 Degree C, Maximum (Ohm/KM)	
11	Resistance Temperature coefficient (/°C)	
12	Maximum Continuous Operating temperature (°C)	
13	Max load(IEC 287), cond. temp 80 °C, air temp. 50 °C, wind speed 0.5 m/s, Solar radiation 1200W/m ² , Approximate value (A)	
14	Max short circuit current, 1 sec (KA)	
15	Tensile Strength of Conductors (kN)	
16	Aluminium Alloy	
17	Color	
18	Identification/Marking	

Data sheet providing details of the conductor under data provided above shall be submitted along with the offer

Prequalification Requirement

The offered triple extruded AAAC (Al+Mg+Si alloy) covered conductor shall be suitable for use under operating condition as specified below:

1. Ambient air temperature : 45 deg C
2. Maximum temperature of conductor at rated current : 90 deg C
3. Wind condition at site : 1 meter / sec
4. Solar radiation at site : 1200 watts / sq m
5. Maximum allowable temperature under Short circuit condition : 250 deg C

Annexure-II

Table-2 of EN 50397 -1:2006 – Tests

No	Tests	Value	Test	Requirements	Test methods
1	Electrical Tests				
1.1	Conductor resistance		T, S ^B	^a	HD 605, Sub-clause 3.1.1
1.2	High voltage test				
1.2.1	-for CC without conductor screen:			No breakdown	HD 605, Sub-clause 3.2.2.2
	Test voltage (AC)	1 U			
	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 3h	S T		
1.2.2	or CC with conductor screen of upon agreement between customer and producer:			no breakdown	HD 605, Sub-clause 3.2.2.2
	Test voltage (AC.)	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	4h 48 h	S T		
1.3	Spark test on the covering ^c		R	no breakdown	EN 50356
	Test voltage:	AC. 0.7 U or DC 1 U			
1.4	Leakage current		T	Maximum 1mA	Annex B
	Test voltage (a.c.)	0.7 U			
1.5	Tracking resistance ^d		T	Annex C	Annex C
2	Construction and dimensions				
2.1	Compliance with the design requirements		T, S, R	Sub-clause 4.2	Visual inspection
2.2	Thickness of the covering		T, S, R	Sub-clause 4.2.3	EN 60811-1-1, Sub-clause 8.1
3	Construction and mechanical properties of the conductor				
3.1	Rated tensile strength		T, S ^b	^a	^a
3.2	Construction and dimensions		T, S	^a	^a
4	Non-electrical tests on the covering				
4.1	Mechanical properties				
	a) before ageing of sample		T	Sub-clause 4.2.3	EN 60811-1-1, Sub-clause 9.1
	b) after ageing of sample		T	Sub-clause 4.2.3	EN 60811-1-2, Sub-clause 8.1, ageing method a)
4.2	Carbon black content ^e		T	Sub-clause 4.2.3	EN 60811-4-1, Clause 11
4.3	Resistance to UV rays ^f		T		HD 605 S 1:1994/A2:2001, Subclause 2.4.23

5	Test of compatibility ^g		T	Sub-clause 4.2.3	EN 60811-1-2, Sub-clause 8.1.4
	Ageing of complete product sample				
6	Thermal properties of the covering				
6.1	Shrinkage test		T	Sub-clause 4.2.3	EN 60811-1-3, Clause 10
	Distance “L” between marks	(200±5) mm			
6.2	Hot-set-test ^h		T, S	Sub-clause 4.2.3	EN 60811-2-1, Clause 9
6.3	Pressure test at high temperature ⁱ		T	Sub-clause 4.2.3	EN 60811-3-1, Sub-clause 8.1
7	Further tests on the covering				
7.1	Water absorption		T	Sub-clause 4.2.3	EN 60811-1-3, Sub-clause 9.2
7.2	Share D hardness ⁱ		T	Sub-clause 4.2.3	HD 605, Sub- clause 2.2.1
8	Test of the longitudinal water tightness ^g				
8.1	With heat cycle		T	no leakage	IEC 60502-2, Annex F
	Number of specimen	1			
	Length of specimen	3 m			
	Test duration	24 h			
	Bending radius	20 D			
8.2	Without heat cycle		S	no leakage	IEC 60502-2, Annex F ^j
	Number of specimen	1			
	Length of specimen	1 m			
	Test duration	1 h			
9	Marking				
9.1	Content, legibility		T, S, R	Clause 5	visual inspection
9.2	Durability		T	Sub-clause 5.4	HD 605, Sub- clause 2.5.4
10	Slippage test		T	Annex D	Annex D

T- Type Test, R- Routine Test & S –Acceptance test

a - Requirements and/or test procedures respectively, whatever applicable, according to EN 50182, to Annex A of this standard or to 4.2.1 of EN 50182

b - For compacted conductors only

c - Alternatively a high voltage test can be performed on the whole production length under the following conditions: Test voltage 4 kV a.c., duration of immersion in water (minimum) 10 minutes, water temperature (20 ± 5) °C, test duration 5 minutes, no break down.

d - For $U \geq 30$ kV or on request

e - If carbon black is used for UV-stabilisation

f - If other than carbon black is used for UV-stabilisation

g - For longitudinal watertight versions only.

h - For cross-linked polyethylene only

i - For thermoplastic polyethylene only

j - Water column connected to one end of specimen by means of an appropriate fitting.

TECHNICAL SPECIFICATION FOR COVERED CONDUCTOR ACCESSORIES

1 Joint

The joint shall be suitable for the covered conductor for which they are designed. The joint shall have the same basic insulation properties as the conductor covering. In this case, the test shall be carried out according to EN 50397-1 table 2, ref. 1.2 "High Voltage (HV) test". The conductor shall have a sufficient length so that the joint is immersed and the test duration shall be same as for sample test.

Mid Span Insulated Jointing Sleeves

The mid span Insulated jointing sleeves shall be of the tubular type, suitable for making full tension joint between two conductors of same size, It shall be provided with a center stop "indent" for correct positioning of the conductors to be joined. The tensile strength of the mid span jointing sleeve after crimping/compression shall not be less than 95% of the strength of the covered conductors. Heat shrinkable insulation tubing of adequate length shall be provided.

The jointing sleeves shall be pre-filled with any suitable oxide inhibiting compound and their current rating shall not be less than that of the covered conductors.

2. INSULATION PIERCING CONNECTORS SUITABLE FOR 11 KV COVERED CONDUCTORS

1. Insulation Piercing Connector having 320 AMP Cu Carrying capacity with maximum Outline size in mm: 97 x 63 x 54 for 50 sq mm & 393 AMP Cu Carrying capacity with maximum Outline size in mm 131 x 82 x 57 for 99 sq mm Covered Conductor.
2. Bodies of Insulation Piercing Connector shall made of glass fibre reinforced polymer having Insulated and Waterproof seals where Insulation material should be Weather, UV and Corrosion resistant.
3. Insulation Piercing Connector should have Blades made of special tinned copper with End cup Design suitable for Covered Conductor.
4. Insulation Piercing Connector should have Shear-head with one screw design to ensure good contact properties and avoid damaging cables.
5. Insulation Piercing Connector should have Lowest Torque, easy to install & no special tools necessary to operate.
6. Piercing of Insulation Piercing Connector should have structural design.
7. Insulation Piercing Connector should have a design such that there is no stripping of insulation on the covered conductor. It shall be able to get the Lowest contact resistance& Superior insulation as well as sealing performance.
8. Material of Insulation Piercing Connector should withstand for all routine & acceptance test as per NFC 33 020-1998 listed below:
 1. Flashover - 15 kV for 1 min in water.
 2. Short circuit test,
 3. Mechanical test
 4. Heat cycle

Technical Specification: Wedge Connectors for MV & HT Electrical Systems

1. SCOPE

This specification covers the design, manufacture, testing & supply of wedge type connectors which are to be used for line jumpers, cut-points, T-connections, making connection to the equipment's like isolators, circuit breakers, CTs and PTs, Lightning Arresters, Busbars etc.

The connectors shall have maximum contact surface with the conductor, extremely low and stable contact resistance, resulting proven minimum power loss. These shall maintain constant force within the connection for the life of connector while compensating for thermal expansion and increased life span.

2. STANDARDS

Unless otherwise specified elsewhere in this specification, the rating as well as performance and testing of the HT & MV overhead line connectors shall conform to the latest revisions available at the time of placement of order of all the relevant standards as listed below: -

- 1) ANSI C 119.4 and
- 2) IS 5561/1970.

3. HT & MV WEDGE CONNECTOR: "FIRED WEDGE CONNECTORS"

3.1 The connector shall confirm Electrically to Extra Heavy Duty, Class AA and Mechanically to Class 1 as per ANSI C 119.4. It also shall confirm to Indian Standard - IS 5561. It consists of a spring 'C' member and a Wedge, both made from a special Aluminium alloy of high ductility and electrical conductivity. The 'C' member and a Wedge shall be factory coated with a conductive inhibitor containing abrasive particles to help in cleaning the contact surface during Installation.

The connector shall be useful for the conductor size of diameter more than 10mm such as RABBIT, RACOON, DOG, COYATE, PANTHER and above.

It shall use a power tool with booster for installation to ensure installation quality and repeatability. This is also needed to eliminate operator dependency. During the assembly, the wedge shall be inserted at a speed of about 40 m/s using the specified tool. High-speed insertion with the specified inhibitor shall be very effective in abrading all sliding surfaces and in disrupting surface oxide film to generate large number of contact spot in the electrical surfaces. When connected, this tap shall provide a reliable electrical and mechanical connection for solid, stranded or compressed conductor combinations including AAC, AAAC and ACSR. Wedge locking nothing but Notch formation at the end of wedge shall be observed. This will ensure that in any case wedge will not loosen and come back.

During disassembly of connector, take-off clips are designed for use with the specified tool. Upon disassembly, the conductor as well as connector can be reused.

3.2 'C' MEMBER:

The C member shall be formed from extruded Aluminium so that the grain (extrusion direction) runs perpendicular to the conductor (e.g. from C-groove end to C-groove end). This orientation of grain direction provides for lower rates of stress relaxation in the metal and will maintains the level of contact pressure at or near the value at initial installation for the life of connection.

Susceptibility to stress corrosion cracking will also improve. The material used shall be specially designed with tighter tolerances on the chemical composition to ensure consistency of the C- member production regarding dimensions and mechanical properties.

3.3 Wedge

The dimensions for the wedges are manufactured to close tolerances to ensure repeatability and reliability of the connection.

3.4 Inhibitor

An oxidation inhibitor shall be applied to the surface there by elimination of oxidation of metallic surface. The chemical composition of the inhibitor shall be synthetic and compatible with the rubber gloves used by the utilities. This inhibitor shall contain special Aluminium abrasive particles, optimized in size and quantity, to ensure repeatability and reliability of the electrical contact made in every connection.

3.5 The connectors shall have maximum contact surface with conductor and, extremely low and stable contact resistance and minimum power loss. These shall maintain constant force within the connection for the life of the connector/clamp while compensating for thermal expansion or creep and increased life span.

The mechanical stresses generated during the wedge insertion shall cause plastic deformation of the C-clamp and shall increase the geometrical confirmation of the clamp to the conductor.

3.6 Installation Tool

Tool is to be used for HT Wedge Connectors installations, due to which operator dependency & human errors in connector installations are eliminated.

(NOTE: "Wedge Connector to be installed manual efforts" i.e. by using tools like hammer/spanner are NOT acceptable)

The tool is having 4 moving parts: the ram, the power unit, the breech cap and the gas release knob. The gas produced by the power booster during the installation is captive inside the power unit. This allows the tool to remain self-supporting on the lines during installations until the gas release knob is turned counter clockwise. This allows the gas produced by the power-booster to be released and the tool to be removed.

3.7 Power-Booster

Power charge repeatability (PCR) is critical to the supply of a reliable product, which can be applied safely and consistently every time. These power-boosters are designed with the primer cap enclosed to ensure that it can only be used with the specified tool and to ensure that there is no incorrect installations.

4. FREEDOM FROM DEFECTS: -

4.1 The wedge type connectors shall be smooth and free from cavities, blowholes, and such other defects, which would likely cause them to be unsatisfactory in service.

4.2 The wedge type connectors shall be so designed and proportioned that they are capable of safely withstanding stresses to which they may be subjected (including those due to short circuit and climatic conditions) and that the effects of vibration both on conductor and connector itself are minimized.

They shall be designed, manufactured, and finished to avoid sharp radius of curvature, ridges and excrescences, which might lead to, localized pressure on or damage to the conductor in service.

Sufficient contact pressure should be maintained at the joint by the provision of the required number of bolts or other fixing arrangements. But the contact pressure should not be so great as to cause relaxation of the joint by cold flow. The joint should be such that the pressure is maintained within this range under all conditions of service.

5. TESTS:

5.1 TYPE TESTS

The following Type Tests shall be carried out as specified in respective standard as per ANSI C119.4 for any one of the connector from same design

- a) Current Cycle Test (CCT) or Current Cycle Submersion Test (CCST)
- b) Mechanical test / Wire Pull-out Test

As per IS: 5561

- c) Tensile Test.
- d) Resistance Test
- e) Temperature Rise Test.
- f) Short Time Current Test.
 - For Raccoon and Dog conductors: 25KA for 3 secs
 - For higher sizes: as per electrical fault system requirements
- g) Dimensional Check

Special Test:

Corona RIV Test on any one of the wedge connector for conductor dia higher than 30mm.

Salt fog test as per ASTM B117 for any one of the connector

5.2 TEST CERTIFICATE

The tenderer shall furnish detailed type test reports of the offered Wedge Type Connector for the tests as per this specification. All the above Type Tests shall be carried out as per the relevant standards at National or International labs, capable of carrying out specified tests. These type tests should have been carried out as per respective standards. Testing for family of connector shall be as per standard, if applicable.

5.3 ACCEPTANCE TESTS

- a) Tensile Test.
- b) Resistance Test.
- c) Dimensional

The acceptance tests are to be carried out in presence of Company's representative. The supplier shall, therefore, give sufficient notice to the Company for arranging witnessing of the tests.

5.4 ROUTINE TESTS

- a) Visual inspection.
- b) Dimensional Check.

5.5 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 as per specification. The bidder shall provide the facilities 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.

6. DRAWING

The bidders shall supply the material as per drawing approved by customer/testing lab.

7. Guaranteed Technical Particulars (GTP)

GTP of LT & HT Wedge Connectors shall be as per Annexures

8. MARKING

Each C- member and wedge is marked with distinct identification code. This identification code is also marked on the packaging to ensure that the correct parts are used for the application. The installer can make a quick visual check before installing.

9. PACKING

For packing, Polythene Bags, Corrugated Boxes, Wooden Boxes shall be used. The packing shall be fit to withstand rough handling during transit and storage at destination. The heads and threaded portion of fasteners fitting should be properly protected against damage. The gross weight of the packing shall not normally exceed 50 kg per box or case. All different fitting components shall be packed in different cases and shall be completed with minor accessories fitted in places. The tenderer should be approved the packing list before dispatching the material.

10. PERFORMANCE OF WEDGE CONNECTORS

Bidder shall submit performance certificates/Purchase orders to prove satisfactory performance of connectors for minimum 10 years after installation.

ANNEXURE-II

Guaranteed Technical Particulars for MV & HT Wedge Connectors				
Sr. No	Description	Unit	As per Tender	Bidder's offer
1	Name of the Manufacturer			
2	Place of Manufacture			
3	Connector Type		Fired Wedge Connector	Yes/No
4	Applicable Standard/s		ANSI 119.4 & IS5561	
	Material of Connector			
5	a. 'C' Member		As per Specification	Yes/No
	b. Wedge Member			
	c. Inhibitor			
6	Connector Suitable for		Mention Conductor	
			Name, Type and Diameter	
7a	Tooling & Power Booster required		Yes	Yes/No
7b	Speed of Wedge during	m/s	40	
	Notch at the end of wedge after			
7c	installation (Wedge Locking provision)		Yes	Yes/No
8	Rated Current	Amps		
9	Short Time Current Rating	kA	As per Specification	
10	Rated Tensile Strength	Kgf		
11	Type Test Reports			
	a. Current Cycle Test (Class AA)		As per ANSI C 119.4	Yes/No
	b. Mechanical Test (Class 1)			
	c. Salt fog test		ASTM B117	
12	Type Test Reports		As per IS-5561	Yes/No
13	Dimension	mm		