TECHNICAL SPECIFICATION FOR INSULATION PIERCING CONNECTORS, ANCHOR (DEAD END) & SUSPENSION ACCESSORIES & OTHER ACCESSORIES FOR AERIAL BUNCHED CABLES FOR WORKING VOLTAGE UP TO AND INCLUDING 1100 VOLTS

01. SCOPE

This specification covers the design, manufacture, assembly, testing and supply of Accessories for anchoring, suspending & making connections to Aerial Bunched Cables rated 1100 volts and insulated with cross-linked polyethylene.

02. STANDARD

The design, performance and test requirements shall confirm to this specification and the following standards. However in case of any conflict, the requirements of this specification shall prevail.

1	NFC 33-020	Document defines the characteristics and the tests applicable to insulation piercing connectors for overhead distributions and services with bundle assembled cores, of rated voltage 0.6/1KV and NF EN 50483-4:2009: Test requirements for low voltage aerial bundled cable accessories -- Part 4: Connectors as mentioned in NFC 33-020 -2013.
2	NFC33-021	Documents defines characteristics and tests applicable to pre-insulated compression type connecting equipment for overhead distributions and services with bundle assembled cores, of rated voltage 0.6/1KV
3	NFC 20-540	Environmental testing. Test methods. Climatic ageing test of equipment and synthetic materials for outdoor use.
4	NFC 33-004	Insulated Cables and their accessories for Power System - connecting equipment for overhead Distribution and Services of rated Voltage 0.6/1kV with at least one insulated core - Electrical aging test
5	NFC 33-040	Documents defines characteristics and tests applicable to suspension equipments for overhead distribution with bundle assembles cores, of rated voltage 0.6/1 KV
6	NFC 33-041	Documents defines characteristics and tests applicable to anchoring devices for overhead distribution with bundle assembled cores, of rated voltage 0.6/1 KV
7	NFC 33-042	This document defines characteristics and tests applicable to anchoring devices for overhead and overhead-underground services with insulated cables, of rated voltage 0,6/1 kV
8	IS 14255	LV Aerial Bunched Cables and other IS as referred there

The accessories shall also be compatible with the cables of sizes & dimensions as defined in the Cable Specifications for the cables with which they are intended to be used.

03. CLIMATIC CONDITIONS

For the purpose of designing the climatic conditions as specified in **Annexure-1** shall be considered.

04. CABLE DATA

The standard sizes and characteristics of the phase and street lighting conductors, messenger wires shall be as specified in IS: 14255-1995 with latest amendments.

The Accessories of LT XLPE Insulated Aerial Bunched Cables (ABC) with insulated messenger cum neutral are specified below:

a) The ABC accessories should be of proven design with a major utility. Order copies and Performance Certificates should be enclosed with the offer.

b) Since ABC accessories are to be used with insulated neutral-cum-messenger, their design should incorporate specific features to prevent damage to the insulation which meeting the required electrical, mechanical & thermal requirements.

c) The accessories should provide "Double Insulation" so that a single point failure of insulation will not result in the system tripping.

05. THE ABC ACCESSORIES

The ABC Accessories shall consist of the following:

a)	Insulation Piercing Connectors (IPC)	:	For making tap-off/branch connectors/service connector to an ABC line.
b)	Anchoring Assembly (AA)	:	For fitting onto a pole for anchoring the end of a length of ABC, or for a major change in direction.
c)	Suspension Assembly (SA)	:	For supporting a length of ABC at an intermediate pole in a length, with small angle of deviation.
d)	Junction Sleeves	:	For Phases, neutral messengers & Street lighting conductor.
e)	ABC Service Main Distribution Box	:	For Distribution of multiple no. of Service Connections from Main AB cable.

05.1. Insulation Piercing Connectors (IPC)

In the process of replacing the Bare Conductors with LT AB Cables to reduce power theft & Transmission Losses, it is important to analyze the proper method of providing service connection from AB Cables to consumers without damaging the cable. Removal of Bare Conductor, Stringing of LT AB Cable & re-establishing the service connections should be simultaneous process.

In this regard the Insulating Piercing Connectors are required-

a) For providing service connections from LT pole

b) For providing supply to Junction/ Distribution Box from AB Cable &

c) For establishing Tee connection from LT ABC to LT ABC.

d) For establishing system earthing with insulated messenger cum neutral wire wherever required.

These Insulating Piercing Connectors should not be exposed to any bare conductor in the environment during connection. The connectors should be totally Weather & Moisture-proof so that no water or moisture can enter through the pierced holes onto the cable insulation. It must have Shear Head type mechanism to control the effective Torque during connection and to ensure perfect installation. Connectors should not have any losable parts, which may drop and then lost while installation at overhead conditions. For individual connectors Torque required for different conductor sizes should be mentioned in the equipment.

05.1.1. Insulation Piercing Connectors (IPC) are used for making Tee / Tap-off / Service connectors to an ABC / Bare Overhead Line.

05.1.2. 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 end and branch conductor while simultaneously insulating and sealing the connection.

05.1.3. **Constructional Features of IPC**

The connectors should be totally insulated with no loose parts. The connectors should be totally Weather & Moisture proof so that no water or moisture can enter through the pierced holes on the cable insulation.

05.1.3.1. The housing shall be made entirely of mechanical and weather resistant & UV resistant reinforced polymer insulation material and no metallic part outside the housing is acceptable except for the tightening bolt.

05.1.3.2. Any metallic part that is exposed must not be capable of carrying a potential during or after connector installation.

05.1.3.3. 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 (min & max torque values to be specified by Manufacturer).

05.1.3.4. The IPC must perform piercing and connection on Main and Branch cable simultaneously.

05.1.3.5. 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.

05.1.3.6. Design of IPC should be such as to not cause damage to insulation of adjacent conductors due to vibration and relative movement during service.

05.1.3.7. The connector shall have a rigid removable end cap which can be slide fitted onto the main connector body on either right or left by the installer (depending on site requirement) for sealing the cut end of the branch cable. Once the connector is fitted, it should not be possible to remove the cap without removing the connector.

05.1.3.8. All the metallic parts of the connector should be corrosion resistant and should be proven in Salt Fog chamber & Wet SO_2 gas chamber and there should not be any appreciable change in contact resistance & temperature after overloads & load cycling.

i. The contact plates should be made of Aluminium Alloy and for street light phase contact plates should be made of tinned copper

ii. Connector teeth should be factory greased & sealed to retard water or moisture ingress & corrosion.

iii. The Insulation material should be made of weather & UV resistant reinforced polymer.

iv. The outer metallic part should have potential free tightening bolts to allow safe installation on live lines.

05.1.4. **Mechanical Tightening and Electrical Continuity**

05.1.4.1. Connectors shall be tightened upto 70% of the minimum torque indicated by the Manufacturer. At this torque electrical contact should have occurred between conductors to be joined. Then connectors shall be tightened up to the breakdown of the shear heads and lastly, upto 1.5 times the maximum torque indicated by the manufacturer.

05.1.4.2. For the connector fitted with two screws on the same core, after the breakdown of the shear heads tightening may be carried out manually and alternatively using a torque meter. The test conditions shall be as close as possible to those defined for the use of the test machine as per NF-C standard.

05.1.4.3. At 1.5 times the maximum torque indicated by the manufacturer, there shall be no breakdown of any part of the connector or the core conductor.

05.1.4.4. **Maximum rated torque** shall not exceed 20 N.m for conductor <95 sq.mm and 30N.m for >95 but <150 sq.mm.

05.1.4.5. Tightening screws shall have hex.

05.1.5. **Effect of Tightening on Main Core of IPC**

05.1.5.1. The connector shall be fitted approx. at the center of the main core, which is secure between two anchoring points 0.5 mtr. To 1.5 mtr. apart. At the time of fitting the connectors, the main core shall be under longitudinal tension at 20% of the load indicated in Table-1 :

Table - 1

Nominal Cross – section (sq.mm.)	Tensile Strength (Newton)
16	1200
25	1800
35	2500
50	3500
70	5000

Tensile strain shall be increased to the full value indicated in the Table 1 and held minute.

There should be no breakdown of the core conductor.

05.1.6. **Effect of Tightening on Branch Core of IPC**

05.1.6.1. Test specimen shall be made up as in clause 05.1.5. [Page 4 of this document] except that this shall be done the smallest cross sections of main and branch conductors within its range.

05.1.6.2. An increasing tensile load shall be applied to the Branch Conductor along the axis of the recess for the Branch cable. Load shall increase at 100 – 500 N/minute until it reaches the value specified in the Table 2 and maintained for 1 minute.

Table - 2

Nominal Cross – section (sq.mm.)	Tensile Strength (Newton)
16 (Alu)	290
25	450
35 & above	500

05.1.6.3. No slippage or breaking of conductor shall occur.

05.1.7. **Dielectric & Water Tightness Test of IPC**

05.1.7.1. The connector is tightened up to the minimum torque indicated by the manufacturer.

05.1.7.2. Connectors are mounted on

- Minimum cross section of main core.
- Maximum cross section of main core.

05.1.7.3. In each case Branch is of minimum cross section.

05.1.7.4. Protection caps for the branch cable are to be used in accordance with the requirements of clause 05.1.3.7. [As noted in Page 3 of this document]. An additional water tight cap of any design may be used to seal one end of the main cable if it is immersed under water. No additional gel or any protection is to be provided while installing connector.

05.1.7.5. The entire assembly shall be immersed at a depth of approx. 30 cms. for 30 minutes with the free ends of main and branch cable out of the water.

05.1.7.6. An AC voltage of 6 kV shall be applied between the water bath and each of the cores in turn for 1 minute. There shall be no flashover or electrical tripping with a trip setting of 10 mA ± 0.5mA.

05.1.8. **Electrical & Ageing Test of IPC**

05.1.8.1. Two test configurations are used according to Table 3 with the connections tightened to the minimum torque specified by their manufacturers and resistance recorded.

Table - 3

Configuration	Main core cross section	Branch core cross section Tensile Strength (K.N)
1st Configuration	Maximum	Maximum
2nd Configuration	Maximum	Maximum

05.1.8.2. The configurations are subjected to 200 heat cycles by injecting suitable current into them. In

each cycle the temperature of the conductor shall be raised from ambient to 120 + 5°C as, measured by a thermocouple.

05.1.8.3. The duration of each heating cycle is chosen to maintain a sufficiently steady temperature of 120 + 5°C for 15 minutes. The duration of each cooling cycle is chosen to bring the conductor temperature to within 2°C of ambient.

05.1.8.4. Nominal heating current is indicated in the Table-4. It shall be permissible to accelerate the temperature rise by using a current up to 1.5 times the nominal current and to accelerate the cooling period by use of a fan or air blower.

Table - 4

Nominal Cross – section (sq. mm.)	Nominal Heating Current (A)
16	102
25	139
35	175
50	225
70	283

05.1.8.5. The over current test of Clause 5.1.9 shall be done after 50 cycles if the connector is a safety connector designed to ground a phase connector while the line is being worked on.

05.1.8.6. At the end of the 200 cycles the resistance shall again be measured. It shall not differ from the initial value by more than 12%.

05.1.9. **Over Current Test of IPC**

05.1.9.1. Over current test is required to establish the performance of Safety Connectors that are intended to provide a safe path to ground for the phases while the line is de-energised for working. It establishes the performance of the connector under short term over load conditions.

05.1.9.2. After the first 50 cycles of clause 5.1.8, the connectors are subjected to 4 over currents of 1 sec duration each.

05.1.9.3. The conductor temperature at the start of the over current test should be not more than 35°C.

05.1.9.4. Current density during over current shall be 100 A/sq.mm for Aluminium and 95 A/sq.mm for Aluminium – Alloy Conductor.

05.1.9.5. Variation in time of over current is permissible between 0.85 sec & 1.15 sec., provided if maintains the relationship $I^2t = K$ where,
I = rms value of over current in Amps.
t = time in seconds
K = Constant

05.1.9.6. After the over current test the electrical ageing test of clause 5.1.8 shall be resumed.

05.1.9.7. According to NFC 33-020 -2013, clause 6.9: as a preliminary measure, it is ensured that resistance of the contacts is below 630μΩ.

05.1.10. **Test of IPC**

05.1.10.1. Type Test Reports should be submitted from an Independent Laboratory of Repute or the Works Laboratory in case of a foreign manufacturer covering the following (on any convenient size of fitting of same design made from the same materials).

05.1.10.2. The installation of the connectors shall be done by the laboratory following instructions provided by the manufacturer.

05.1.10.3. The Test report shall record the embossing and marking on the connector.

NFC	Clause	Test	Type Test	Acceptance test
		Visual		√*
		Dimensional		√*
NFC 33-020; 2013	6.3	Mechanical Test	√	√**
NFC 33-020; 2013	6.3.1	Shear head function's test and connector bolt tightening test	√	√*
NFC 33-020; 2013	6.3.2	Test for mechanical damage to the main conductor	√	√
NFC 33-020; 2013	6.3.3	Branch Cable Pull-out test	√	√
NFC 33-020; 2013	6.4	Dielectric voltage test and water tightness test	√	√**
NFC 33-020; 2013	6.5	Low Temperature assembly test	√	
NFC 33-020; 2013	6.6	Climatic Ageing Test	√	
NFC 33-020; 2013	6.7	Corrosion Test	√	
NFC 33-020; 2013	6.8	Electrical ageing test	√	
NFC 33-020; 2013	6.9	Temperature Rise and Over Current Test	√	√**

The above tests are to be carried out as per sampling plan below.

In case of random failure/defect, double the sample lot is to be drawn and there should be no failure/defect exceeding half the permissible defects (rounded down) shown in the chart.

Lot Size	For tests Marked*		For Tests Market **	
	Sample Size	Max. permissible Defects	Sample Size	Max. permissible Defects
Upto 100	2	Nil	2	Nil
101 to 1000	6	Nil	4	Nil
>1001	0.01% subject to min. 6 pieces	0.1% of pieces checked	4	Nil

Capacity needed: For ABC 16 to 95 mm^2

Model 1 for customer service Main 16 to 95 mn^2

Tap 2.5 to 10 mm^2 (For Street lighting) Design as per furnished drawing (Anx-I)

Model 2 for customer service Main 16 to 95 mm^2

Tap 04 to 35 mm^2 (for distribution box charging) Design as per furnished drawing (Anx-II)

Model 3 for customer service Main 25 to 95 mm^2

Tap 25 to 95 mm^2 (For ABC to ABC Tee Joint) Design as per furnished drawing (Anx-III)

05.2. Dead End Clamp or Anchoring Clamp for Insulated Messenger:

The clamps should be designed to Anchor LT-AB cable with insulated messenger. The clamp should consists of an Aluminium alloy corrosion resistant castled body, bail of stainless steel and self adjusting plastic wedges which shall anchor / hold the neutral messenger without damaging the insulation.

i. No losable part in the process of clamping arrangement
ii. The clamp should conform to the standard NFC 33-041 and 33-042 or equivalent I.S. if any.
iii. The clamp body should be made of corrosion resistant Alluminium alloy, bail should be of stainless steel and wedges should be weather and UV resistant polymer.
iv. Ultimate tensile strength of the clamp should be as per Table-6 of Technical Specification

05.2.1. Anchoring assemblies are used to firmly attach the messenger of ABC to a support and transmit the mechanical tension.
   i. At the end of a run or to the supporting structures
   ii. At a major change in direction.

05.2.2. Each Anchoring Assembly shall include.
   i. One number tension bracket.
   ii. One number wedge type tension clamp
   iii. Flexible Rope for fixing tension clamp to bracket.

05.2.3. Anchoring assemblies shall be supplied in sets to ensure compatibility of the materials against corrosion or wear of moving parts.

05.2.4. **Tension Bracket of AA**

05.2.4.1. The tension bracket shall be made out of a single piece of Aluminium alloy suitable for attachment to a pole either by
   i. 16mm galvanized steel bolt (s) or
   ii. Two stainless Steel straps of 20 x 0.7 mm.

The tension bracket should be designed to ensure the Flexible rope cannot slip out at any angle.

The tension bracket should be rated and tested for the loads specified in Table-5. The load shall be applied at an angle of 45^0 from the normal to the surface of mounting of the bracket.

Table - 5

Conductor Size (Sq.mm.)	Rating	Load for deformation <10mm (Newtons)	Load for deformation <30mm & no-break (Newtons)
25-35	1500 Kg.	12,000	15,000
50-95	2000 Kg.	15,600	19,500

05.2.5. Flexible Rope of AA

05.2.5.1. The Anchoring assembly shall be supplied with a stainless steel flexible Rope to connect the Tension Clamp to the Tension Bracket.

05.2.5.2. The rope should have sufficient flexibility to ease the torsional movement of the ABC System.

05.2.5.3. The Rope should be pre-fitted with compression type end fittings to secure the tension clamp.

05.2.5.4. A wear resistant moveable saddle should be un-loose-ably fitted on the Rope to prevent abrasion at the point of fitting into the tension bracket.

05.2.5.5. The Rope should have sufficient mechanical strength to withstand the mechanical test for the complete assembly tests in this specification.

05.2.6. Wedge Type Tension Clamp of AA

05.2.6.1. Wedge type clamps shall be used for clamping the messenger without damaging the insulation.

05.2.6.2. The clamp shall be capable of clamping an uncut messenger so that it can continue without break to the connecting point or next span.

05.2.6.3. The clamp shall be fully insulating type of mechanical and weather resisting thermoplastic.

05.2.6.4. No bolts or loose parts are allowed as part of the Clamping system.

05.2.6.5. No tools shall be needed for fitting the messenger into the clamp.

05.2.6.6. The clamp shall be self tightening and capable of holding without slippage the load specified in the Table-6.

Table - 6

Conductor Size		Rating (Kg.)	T start (1 minute) (Newtons)	T final (1 minute) (Newtons)
Sq. mm.	Dia. (mm)			
25-35	08-11	1000 Kg.	8,000	10,000
50-54	12-14	1500 Kg.	12,000	15,000
70-95	13.5-16	2000 Kg.	12,000	15,000

05.2.6.7. After fitting the insulated messenger in the clamp, load T start will be held for 1 minute & then load increased to T final at rate between 5000 – 7,500 N/mtr. In each case there shall be no breakdown of any part of clamp and slippage of messenger in relation to the clamp.

05.2.7. Voltage Test on Clamp of AA

05.2.7.1. Voltage test is carried out on anchor clamps to ensure no damage is caused to the insulated messenger.

05.2.7.2. A conductive rod of dia. corresponding to the average dia. that can be accommodated in the clamp is fitted into the clamp, protruding by approx. 50mm at each end of the tightening piece.

05.2.7.3. The rod and clamp is subjected to tensile load as stated in Table 7 below when fixed to a

support in its normal manner.

Table - 7

Conductor Size		Normal rating (kg)	Load Applied (N)
Sq. mm.	Dia. (mm)		
25-35	8-11	1000	2000
50-54	12-14	1500	4000
70-95	13.5-16	2000	4000

05.2.7.4. A power frequency voltage of 6 kV is applied for 1 minute between the rod and conductive part of the clamp, or fixation point in absence of conductive part.

05.2.7.5. No breakdown or flashover shall occur. There shall be no tripping due to leakage with a setting of 10 + 0.5 mA.

05.2.8. Endurance under Mechanical & Thermal Stress of AA

05.2.8.1. This test is done on clamp rated 1500 Kg. or 2000 Kg. using insulated messenger 50 to 70 sq. mm.

05.2.8.2. A neutral messenger is fitted between two anchor clamps, with clamp spacing approx. 5 mtr. & 1 mtr. of messenger protruding from the end. Marks are made to enable measurement of slippage.

05.2.8.3. The sample is subjected to 500 cycles of 90 minutes each as described below :

05.2.8.3.1. Messenger temperature is raised by passing an AC current to 60+3^{0}C within 15 minutes. This temperature is maintained for at least 30 minutes to give a total heating period of 45 minutes per cycle.

05.2.8.3.2. Messenger is allowed to cool naturally to ambient for further 45 minutes to complete 90 minutes Cycle time.

05.2.8.3.3. Mechanical load is applied during the cycle as per table 8 below. Load F1 is applied throughout the cycle, except for a short period of 5 sec. to 60 sec. when it is gradually increased from F1 to F2 at any time during the last 15 minutes of the 90 minute cycle.

Table - 8

Conductor Size		Rating (Kg.)	F1 (Newtons)	F2 (Newtons)
Sq. mm.	Dia. (mm)			
25-35	08-11	1000 Kg.	2,200	5,000
50-54	12-14	1500 Kg.	4,000	7,500
70-95	13.5-16	2000 Kg.	4,500	10,000

05.2.8.3.4. There should be no slippage greater than 4 mm after 2 cycles or greater than 8 mm after 500 cycles.

05.2.8.3.5. Voltage test is done at the end of the 500 cycles by immersing the test specimen of neutral messenger and clamps in water of resistively not less than 200 Ohm mtr. for 30

minutes.

05.2.8.3.6. A voltage of 10 kV ac is applied for 1 minute between messenger and water bath using a trip setting of 10 + 0.5 mA. There should be no breakdown or tripping.

NFC	Clause	Test	Type Test	Acceptance test
		Visual		√*
		Dimensional		√*
NFC 33-041; 1998	2.3	Mechanical Test like Tensile Strength Test	√	√**
NFC 33-041; 1998	2.4	Voltage Test	√	√*
NFC 33-041; 1998	2.6	Climatic Ageing Test	√	
NFC 33-041; 1998	2.7	Corrosion Test	√	
NFC 33-041; 1998	2.9	Endurance test under mechanical and thermal Stresses	√	
NFC 33-041; 1998	2.9.3.1	Slip Strength Test	√	√**

05.3. Suspension clamp for insulated neutral messenger:

The clamp should be designed to hang L.T – AB cable with insulated neutral messengers. The neutral messengers should be fixed by an adjustable grip device. A movable link should allow longitudinal and transversal movement of the clamp body.

i. No losable part in the process of clamping arrangement.
ii. The clamp should conform to the standard NFC 33-040 or equivalent I.S, if any.
iii. The clamp and the link made of Polymer should provide an additional insulation between the cable and the pole.
iv. The clamps and movable links should be made of weather and UV resistant glass fibre reinforced polymer.
v. Clamps should be fixed with pole by eye hook / bracket. Bracket should be made of corrosion resistant alluminium alloy.
vi. Ultimate tensile strength of the clamp should be as per Table – 10 of Technical Specification.

05.3.1. Suspension Assembly is used for supporting an ABC by installation on the messenger at an intermediate point of support such as a pole. It can accommodate small angles of deviation upto 30^0.

Each Suspension Assembly shall consist of :

i. One number Suspension Bracket.
ii. One number moveable (articulated) connecting link.
iii. One number Suspension Clamp.

05.3.2. Suspension Assemblies shall be supplied in sets to ensure compatibility of the materials against corrosion or wear of rotating/moving parts.

05.3.3. Suspension Bracket of SA

05.3.3.1. The Suspension Bracket shall be made from single piece aluminium alloy suitable for attachment to a pole by either.

i. 16 mm galvanized steel bolt or

ii. Two stainless steel straps.

05.3.3.2. The Suspension Bracket shall be provided with an upper bulge to prevent the clamp from turning over on the Bracket for more than 45^0 from the horizontal or to within less than 60 mm from the pole / fixing structure.

05.3.3.3. The Suspension Bracket should be so designed to ensure that the articulated link cannot slip out of it.

05.3.3.4. Suspension Brackets shall be designed to withstand a load applied at the anchoring point of the movable link as per Table – 9 below without deformation of more than 10mm or breakdown at 33^0 below horizontal (there should be no longitudinal component of load parallel to the plane of fixing).

Table - 9

Conductor Size		Normal Rating	Load (Newtons)
Sq. mm.	Dia. (mm)		
25-54	8-15	1500 Kg.	12500
70-95	13-17	2000 Kg.	14000

05.3.4. **Movable (Articulated) Link of SA**

05.3.4.1. Movable Links are used between the Suspension Bracket and Suspension Clamp to allow a degree of movement and flexibility between the two.

05.3.4.2. Moveable Links should be made fully of insulating type of mechanical and weather resistant thermoplastic. A metallic wear resistant ring should however be fitted at point of contact between the Suspension Bracket and the movable link.

05.3.4.3. The Movable link should be unloosably fitted to the Bracket and the Clamp.

05.3.5. **Suspension Clamp of SA**

05.3.5.1. Suspension Clamps are used for locking the messenger of the ABC bundle without damaging the insulation or allowing the messenger to become dismounted from the fitting.

05.3.5.2. The Suspension Clamp shall accommodate messenger wires from 25 to 95 sq.m.

05.3.5.3. The Suspension Clamp shall be made fully of insulating type of mechanically strong and weather resistant plastic.

05.3.5.4. Bolts should not be used for clamping / locking the messenger in the Clamp.

05.3.5.5. There shall be no losable parts in the Suspension clamp.

05.3.5.6. The Suspension Clamp should be unloosably fitted to the rest of the Suspension Assembly.

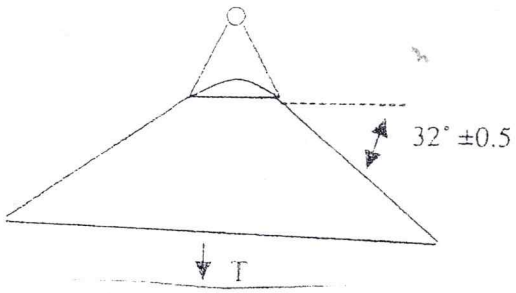
05.3.6. **Mechanical Test on Clamp of SA**

05.3.6.1. The Sub Assembly shall be subjected to a vertical load applied as per drawing in accordance with Table-10. There shall be no breakdown or permanent deformation at load T initial for 1 minute or when the load is increased to T final and released.

Table - 10

Conductor Size		Rating (Kg.)	T start (I minute)	T final (I minute)
Sq. mm.	Dia. (mm)		(Newtons)	(Newtons)
25-54	8-15	1500 Kg.	9,600	12,000
70-95	13-17	2000 Kg.	12,800	16,000

Fig. : A



05.3.6.2. A sample messenger shall be fitted into a fixed suspension clamp and subjected to a gradually applied longitudinal load of 300 N. There shall be no permanent slippage.

05.3.7. **Voltage Test of SA**

A copper foil is wrapped at the clamping point around the maximum size of messenger allowed in that clamp. An ac voltage of 6 KV is applied between the copper foil and nearest conductive point of the clamp or into its absence to the point of fixation. The voltage should be withstood for 1 minute without breakdown or flashover.

05.3.8. **Test Under Mechanical & Thermal Stress**

05.3.8.1. The test specimen is made up of approx. 10mts. of messenger wire strung between two anchor clamps with a Suspension Clamp fixed in the middle. Masses of 40 Kg. are suspended at a distance of 1-2mtr. On either side of the Suspension Clamp with a fixing mechanism of mass 2 ±1 Kg.

05.3.8.2. The specimen is subjected to 500 cycles of 90 minutes each. Each cycle consists of the following:

i. For first 75 minutes a constant longitudinal tension of 4000 N is applied to the messenger for rating of 1500 Kg. and of 4500 N rating of 2000 Kg. while 64 cycles right and left oscillation are produced on the clamp 32^0 on either side of the vertical.

ii. During the first 45 minutes an intermittent current of 4-5 A/sq.mm is applied to maintain the conductor temp at 60 ± 3^{0}C.

iii. During the next 45 minutes of the cycle the conductor is allowed to cool down naturally to the ambient.

iv. At the 75th minute, after having completed 64 oscillations, the oscillations are stopped and the longitudinal tension is increased to 7500 N for 1500 kg. Rating and 10000 N for 2000 Kg. Rating.

05.3.8.3. No messenger slippage should occur within the Suspension Clamp during the 500 cycles.

05.3.8.4. At the end of the 500 cycles, the messenger is immersed in water for 30 minutes. It is then tested to withstand 10 kV ac for 1 minute with a trip setting of 10 ± 0.5 mA. There should be no breakdown or flashover.

NFC	Clause	Test	Type Test	Acceptance test
		Visual		√*
		Dimensional		√*
NFC 33-040; 1998	2.3	Mechanical Test like Tensile Strength Test	√	√**
NFC 33-040; 1998	2.4	Voltage Test	√	√*
NFC 33-040; 1998	2.6	Climatic Ageing Test	√	
NFC 33-040; 1998	2.7	Corrosion Test	√	
NFC 33-040; 1998	2.9	Endurance test under mechanical and thermal Stresses	√	

In case of random failure/defect, double the sample lot is to be drawn and there should be no failure/defect exceeding half the permissible defects (rounded down) shown in the chart.

Lot Size	For tests Marked*		For Tests Market **	
	Sample Size	Max. permissible Defects	Sample Size	Max. permissible Defects
Upto 100	2	Nil	2	Nil
101 to 1000	6	Nil	4	Nil
>1001	0.01% subject to min. 6 pieces	0.1% of pieces checked	4	Nil

The above tests (for AA & SA) are to be carried out as per sampling plan below. In case of random failure/defect, double the sample lot is to be drawn and there should be no failure/defect exceeding half the permissible defects (rounded down) shown in the chart.

	For tests Marked*		For Tests Market **	
Lot Size	Sample Size	Max. permissible Defects	Sample Size	Max. permissible Defects
Upto 100	2	nil	1	Nil
101 - 500	5	1	2	Nil
501 - 2500	10	2	2	Nil
2501 & above	10 + 0.2%	2 + 10% pf addl. Sample quantity	4	1

06. JUNCTION SLEEVES

The sleeves should be Pre-Insulated for phases, neutral messengers and street lighting conductors.

i. Sleeve should be made of Alluminium, insulated with an Anti-UV black thermoplastic tube hermetically sealed two ends with 2 flexible rings.

ii. Die reference, size and strip length are indicated on the sleeve itself.

iii. Sizes needed: 16-70 & upto 150 mm2 for Alluminium XLPE insulated cable.

iv. Reference standard: NFC 33021 or equivalent I.S. if any.

v. Design as per furnished drawing.

07. EYE HOOKS

i. Eye hooks should be designed as to hold suspension clamps and Dead end clamps and to be installed with the pole clamp.

ii. Eye-hooks should be made of forged Galvanised steel. Eye-hooks should be electro galvanized- Coating thickness as per IS: 1573-1986. For Hot dip Galvanization, minimum Value of Mass of zinc coating should be 610 g/m2

iii. The clamps corrosion resistance should conform the standards I.S. 2629 & I.S.2633.

iv. Ultimate Tensile strength (UTs) of the clamp should 20 KN.

v. Design as per furnished drawing.

Test	Type Test	Acceptance test
Visual		√
Dimensional		√
Mechanical Test (Slip Strength Test	√	√
Ultimate Tensile Strength Test	√	√
Galvanizing (for ferrous parts)	√	√
Chemical Composition Test as per IS 2486 (Part 1):1993 and IS 2004:1991	√	

08. Technical Specification of Three Phase 4 wire L.T. Service Main Distribution Box for Aerial Bunch Conductor

08.1. Scope

08.1.1. The L.T Distribution Box shall be used for connection through over head conductors or ABC lines and forgiving connections to the consumers. The specification covers the design, Manufacture, inspection, testing and supply of L.T distribution box. The L.T Distribution box will be installed at the poles and it shall withstand solar radiations, rain, wind pressure and pollution.

08.2. CONSTRUCTIONAL AND TECHNICAL PARTICULARS-

08.2.1. The distribution box shall be made from 20 SWG CRCA MS Sheet by DEEP DRAWN METHOD WITH POWDER COATING. Size of the box shall be 418mm x 300mm x 120mm. There shall not be any welding joint to make base and cover of the distribution box. Roof of the box shall be tapered on both sides to drain the rain water.

08.2.2. Distribution box shall have Insulated Multiple OUT GOING Connectors for R, Y, B phases and Neutral. Distribution box shall have arrangement for one incoming AB cable of size 3x70+1x16+1x50 sq mm. Arrangement for 3 to 4 outgoing cables of size up to 4 core 25 sq mm for 3 phase connection shall be provided in the distribution box. Each incoming and outgoing cable shall be fixed inside the connection terminals by two screws of size not less than M8.The connection terminals shall be such that the outgoing cables can be fixed or removed easily without disconnecting the power supply. No current carrying part shall be approachable by hand or finger. Any current carrying part should be at a minimum distance of 5mm from the outer edge of the insulations. Insulation shall be Fire retardant.

08.2.3. Connections terminals for R, Y & B Phases shall be mounted in a single line and neutral shall be mounted parallel to R, Y & B Phases. Mounting arrangement shall be such that minimum clearance of 40mm is maintained between each phase and neutral.

08.2.4. Box shall be provided with U-latch sealing arrangement. A hole of 8mm and 2.5mm shall be provided in the U-latch to provided a padlock and sealing of the box respectively. U-latch shall be jointed with stainless steel rivet. Box should be duly powdered coated after 7-tank phosphating process. Box should be of light Admiralty Grey Color (IS: 5:1993, COLOR NUMBER 697).The L.T. Distribution Box shall be powder coated only. The facility 7-Tank phosphating and powder coating shall be in-house of the tenderer to insure proper quality, since these boxes are for outdoor applications.

08.2.5. Holes for incoming cables and 9 to 12 no holes for outgoing cables shall be provided on the lower wall of the box Cable holes shall be provided with rubber or plastic glands duly pasted with the box. Incoming and outgoing cable gland shall have internal diameter of 20 mm. Cable glands shall be made

such that internal diameter of glands provided for cables should be closed with film of minimum Imm thickness. Cable will go through the cable gland by piercing the film of the glands .Gap of the minimum 100 mm shall be maintain between the lower wall and neutral mounted inside the distribution box for easy handling of incoming and outgoing cables.

08.3. **MARKING**: - Following shall be provided on the cover of the box.

a) Manufacturers name duly embossed
b) Utility name duly embossed
c) Name of scheme duly embossed
d) Danger marking in red color

08.4. M.S. Earthing screw of diameter 6mm with washer shall be provided in the threads of the earth clamp welded to the main body of the box.

08.5. The Box shall comply with the requirement IP-54. The Box shall be fully type tested along with dimensional details as per the requirement of relevant Indian Standard (latest edition) IS: 13947, Part-I and latest amendments. Tests shall be carried out from laboratories which are accredited by National Board of Testing and Calibration Laboratories (NABL) of Govt. of India to prove that the complete box meet the requirement of IP-54. The type test reports shall not be older than 5 years.

08.6. Distribution Box shall be duly packed in 3-ply corrugated box. The tolerance permissible on the overall dimensions of the MMB (Maximum Material Boundary) shall (±) 3%.

08.7. Pole mounting clamp 50x6 mm Hot Dip galvanized, heavily coated as per IS:2633.

08.8. Material of Bus Bar: EC grade Aluminum should conform IS 4026:2007 with current carrying capacity 200 Amps.

08.9. **TESTS**: Following tests shall be performed on the box during inspection:

TEST	DESCRIPTION
Visual Examination	The L.T. Distribution Box will be inspected visually, externally and internally for proper powder coating layer, fitting of the all the components in accordance with technical specification.
Verification of Dimensions	Verification of dimensions external/internal clearances will be carries out as per technical specifications.
Verifications of Fittings	Components like insulated connection terminals, screws etc will be verified as per technical specifications.
High Voltage Test	The Voltage of 2.5KV, 50HZ shall be applied for 1 min. as follows: a) Between each phase b) Between each phase and earth screw c) On the insulation of connection terminals There shall not be any puncture or flashover during these tests.
Current Carrying Capacity	Current of 200 Amps. shall be applied for 30 minutes through high current source on the each phase. There shall not be over heating of the terminals during the test.
Chemical Composition test of Bus bar	Aluminium used shall be grade 63401 WP conforming to IS 5082:1998
Chemical Composition test of Sheet (CR3)	As per IS: 513 (Part I); 2016
	Other tests as per relevant IS.

ANNEXURE – 1

METEOROLOGICAL DETAILS

Sl. No.	Parameters	Unit	Value
1	Maximum ambient air temperature	°C	50
2	Maximum temperature of air in shade	°C	50
3	Maximum temperature of air in Sun	°C	60
4	Maximum daily average temperature	°C	45
5	Maximum yearly average temperature	°C	30
6	Maximum yearly weighted average temperature	°C	32
7	Minimum ambient air temperature	°C	4
8	Minimum temperature of air in shade	°C	4
9	Maximum relative Humidity	%	100
10	Average annual Rainfall	mm	3175
11	No. of months of tropical monsoon	No.	5 (June-Oct.)
12	Average no. of rainy days per annum	No.	80
13	Maximum wind pressure	Kg/m^2	100
14	Number of Dust Storms	Days/annum	5
15	Average no. of stormy rainfall (exceeding 30 minutes in 24 hrs.)	Days/annum	10
16	Average number of thunderstorms	Days/annum	100
17	Earthquake acceleration	$Mtr./sec^2$	0.04x2 g.
18	Seismic Zone as per IS : 1893 – 1984	-	III & IV
19	Maximum height above mean sea level	Mtrs.	1000

Note :

1) Any specific meteorological data other than those listed above applicable for a particular equipment/item will be available in the technical specification for that equipment/item.
2) When values specified above contradicts with respective equipment TS, the later will prevail for that equipment.
3) The atmosphere in the area is laden with industrial and town gases and smoke with dust in suspension during the dry months and subject to tough colder months.
4) Heavy lightning is usual in the area during the months from May to November.

ANNEXURE-2

GENERAL CONDITIONS FOR MANUFACTURE

The products shall be in accordance recognized standards used in L.T. ABC or equivalent I.S., if any.

1	Marking	:	Each product shall be clearly identified with manufacturer name or trade mark, reference and capacity of the item and batch no.
2	Packaging	:	Manufacturer shall mention the packaging of each item. Installation instruction should be included in packaging.
3	Type test	:	Each supplier should provide type test reports with the offer, carried out in accordance with one of the reference standards in NABL Accredited Laboratory.
4	Routine test	:	Supplier shall provide a control plan, which will be implemented on each item. Routine test reports should be submitted by the manufacturer with inspection call.
5	Quality	:	All suppliers should preferably be ISO-9000 certified.

1) Anchoring and suspension clamps should be installable on existing poles using appropriate devices (hooks, pigtails, brackets etc.).

2) All crimped connectors should be installed with mechanical or hydraulic hand crimping tools.

ANNEXURE – 3

GUARANTEED TECHNICAL PARTICULARS FOR ANCHOR CLAMPS SUITABLE FOR INSULATED SERVICE LINE CABLE

Sl. No.	Parameters	Unit	Bidder's Offer
1	Type of Clamp		
2	Name of the Manufacturer		
3	Standard		
4	Place of Manufacturer		
5	Range of conductor size	mm. (Dia.)	
6	Type of design		
7	Installation (with / without disassembly)		
8	Type & grade Metallic / Nonmetallic material		
9	Marking		
10	Colour of Nonmetallic parts		
11	Dimensions	Mm	
12	Approximate weight	Kg	
13	Breaking Load	KN	

ANNEXURE – 4

GUARANTEED TECHNICAL PARTICULARS FOR EYE HOOK (FLAT TYPE)

Sl. No.	Parameters	Unit	Bidder's Offer
1	Type of Clamp		
2	Name of the Manufacturer		
3	Place of Manufacturer		
4	Type of design		
5	Type & grade Metallic / Nonmetallic material		
6	Type of hot dip galvanizing & thickness of Zinc coating		
7	Dimensions	Mm	
8	Approximate weight	Kg	
13	Ultimate tensile strength	KN	

ANNEXURE – 5

GUARANTEED TECHNICAL PARTICULARS FOR WATERPROOF PREINSULATED COMPRESSION TYPE BIMETALLIC SOCKET FOR LT 1.1KV

1	Name & address of the Manufacturer	
2	Applicable standard	
3	Type of Cable jointing kit	
4	Application	
5	Nominal system voltage (kV)	
6	Maximum system voltage (kV)	
7	Number of cores	
8	Type of Insulation	
9	Type of screening	
10	System Neutral Earthing	
11	Maximum performance	
12	AC voltage	
13	Load cycling 90°C + 5°C (no. of cycles)	
14	Impulse voltage	
15	Partial discharge voltage	
16	Thermal short circuit	
17	DC voltage	
18	Dynamic short circuit	

ANNEXURE – 6

GUARANTEED TECHNICAL PARTICULARS FOR PREMOULDED STRAIGHT JOINT FOR LT 1.1 KV

1	Name & address of the Manufacturer	
2	Applicable standard	
3	Type of Cable jointing kit	
4	Application	
5	Nominal system voltage (kV)	
6	Maximum system voltage (kV)	
7	Number of cores	
8	Type of Insulation	
9	Type of screening	
10	System Neutral Earthling	
11	Maximum performance	
12	AC voltage	
13	Load cycling 90°C + 5°C (no. of cycles)	
14	Impulse voltage	
15	Partial discharge voltage	
16	Thermal short circuit	
17	DC voltage	
18	Dynamic short circuit	

ANNEXURE – 7

GUARANTEED TECHNICAL PARTICULARS FOR INSULATING PIERCING CONNECTORS

		For Street Light	For DB Charging	For ABC to ABC TEE
1	Name of the Manufacturer			
2	Is Manufacturer of accessories as ISO 9001-2000 company a) Copies of certificate enclosed b) Are GA Drawing enclosed			
3	Applicable			
4	Applicable standard			
5	Type of connectors	Main : 16-95sqmm Tap : 1.5-10 sqmm	Main: 16-95sqmm Tap : 4-35 sqmm	Main: 25-95sqmm Tap : 25-95 sqmm
6	Application	For 1.1 KV	For 1.1 KV	For 1.1 KV
7	Is any metallic part carrying potential in operation exposed during installation			
8	Are end caps of branch cable a) Slide on type b) Rigid			
9	Are torque limiting shear heads provided to tightening bolts			
10	Range of cable sizes accommodated for main & branch	Main : 16-95sqmm Tap : 1.5-10 sqmm	Main: 16-95sqmm Tap : 4-35 sqmm	Main: 25-95sqmm Tap :25-95 sqmm
11	Min. & Max. torque defined			
12	Torque for establishing connection between main and branch			
13	Max. tensile load for no breakdown of main conductor (for each cross section)			
14	Max. tensile load on branch conductor for no break/slippage			
15	Voltage withstand under water emersion			
16	Is electrical Ageing test report enclosed			
17	No. of Cycles			
18	Max. temp. at each cycle			
19	Marking and embossing on the connection			

ANNEXURE – 8

TESTING STANDARDS :

The Insulating Piercing Connector should conform to following std. :

Tests	Tests Standard / Test Procedure
Corrosion Qualification Test	As per NF C 33-020 (Sept '2013), or equivalent I.S., if any. Exposure in Saline Environment : The exposure should be carried out as per NF en 60068-2-11 (Aug. '99) std. requirement. The concentration of Saline solution must be of 5% + 1% in mass, & the temperature of the test chamber must be maintained at 35°C + 2°C. Exposure in Sulphur environment saturated of humidity – The exposure should be carried out as per NF T 30-055 (Mar. '74) std. requirement. SO2 concentration in the chamber should be 0.067% in volume. The temperature of the test chamber should be increased to 40°C + 3°C. The total test should include four identical periods of 14 days, in which 7 days of exposure in Saline environment & in other 7 days – 8 hrs. cycles in SO_2 environment & 16 hrs. in laboratory environment.
Electrical Ageing Test	As per NF C 33-020 (Sept '2013) & NF C 33-004 (Jun '98) or equivalent I.S., if any. Total no. of cycles 200, Heating time -60 mins., Cooling time -45 mins., Pause time – 2 mins.
Dielectric Investigation Test in	As per NF C 33-020 (Sept '2013) or equivalent I.S., if any. The connector should be placed in an ambient temperature between
Water	15°C & 30°C & relative humidity between 25% & 75%. The tightening of the connectors should be at minimal value of the torque indicated by the manufacturer. The sample should be placed in tank full of water on 30 cm height, after an immersion length of 30 mins. The set is subjected to a dielectric test under a voltage of 6 KV at industrial frequency during 1 min. No flashover / breakdown should occur at 6 KV during 1 min.
Mechanical Tests	As per NF C 33-020 (Sept '2013) or equivalent I.S., if any. For checking electrical continuity, shear heads & mechanical behaviour of the connector's suitable tests as per the above specification have to conduct.