Gujarat Power Research & Development Cell
(A Govt. of Gujarat Initiative)
Gujarat Urja Vikas Nigam Ltd
CIN: U40109GJ2004SGC045195,
IIT Gandhinagar Research Park, IIT Gandhinagar,
Palaj-382355, Gandhinagar, Gujarat, India
www.guvnl.com; www.gprd.in; guvnlrnd@gmail.com

TECHNICAL SPECIFICATIONS
FOR
1.5 METER LONG
MAINTENANCE FREE, ECO-FRIENDLY, READY CAPSULE, PIPE-in-CAGE (PiC)
TYPE EARTHING

ANNEXURE- XX: TECHNICAL SPECIFICATIONS FOR 1.5 METER LONG, MAINTENANCE FREE, ECO-FRIENDLY, READY CAPSULE, PIPE-in-CAGE (PiC) TYPE EARTHING

TECHNICAL SPECIFICATIONS FOR MAINTENANCE FREE, ECO-FRIENDLY, READY CAPSULE PIPE-in-CAGE (PiC) TYPE EARTHING

1.0 SCOPE:

This specification covers supply, installation, testing and commissioning of maintenance-free, Ready Capsule, Pipe-in-cage, special type earthing system to be provided **for Metering Console under PM-KUSUM scheme.** The technical specification is designed keeping in view the following advantages,

- In this type of Earthing Electrode, the electrode, the surrounding enhancing material bonding with the electrode, and the cage are in pre-fabricated, ready-to-use form so that on-field mal-practice in form of less digging of earth pit, less Earth enhancement filling, improper watering at the site, can be overcome. This makes the quality check very convenient.
- Due to pre-fabricated, ready to use methodology, no on-field wastage of Earth enhancement material is done.
- Installation procedure is effective, convenient, less time consuming, and cheaper.
- Transportation and storing of material, compared to separate components (i.e. electrode, Earth Enhancement compound, etc.) on the field is convenient, cheaper, and too easy to do.
- Quality assurance of this type of earthing can be carried out very effectively with minimum effort.

2.0 APPLICABLE STANDARDS:

This earthing system shall be conformed to the relevant standard specification unless otherwise specified, in line with the requirement of any of the latest applicable standards. The applicable amendments as and when imposed shall be applicable.

1.	IS: 3043/1987	Code of practice for Earthing
2.	IEC 62561-7	The requirement of Earthing Enhancement Compound
3.	IEEE-80- 2000	IEEE Guide for Safety in AC Sub Station Grounding
4.	ASTM G57-06	Test Method for Field Measurement of Soil Resistivity, Using the Wenner, Four-Electrode Method
5.	IS: 2629 & IS: 4736	For hot-dip galvanizing for Iron and Steel
6.	IS:1161/1979	Steel Tubes for Structural Purposes: Specification
7.	IS: 1239 (Part-1 & Part-2)	Steel Tubes, Tubulars, And Other Wrought Steel Fittings — Specification
8.	IS:13229-1991	Zinc for Galvanizing
9.	Is:9537:1983	Conduits for electrical installations
10.	IS:13592:1992	UPVC pipes for soil and waste discharge systems

11.	IEEE Std 142-2007	IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
12.	IS:5216-1982	Recommendations on Safety Procedures and Practices in Electrical Work
13.	CEA	Measures relating to Safety and Electric Supply) Regulations, 2010
14.	EN-12547-2	Characterization of Waste – Leaching – Compliance Test for Leaching of Granular Waste Materials and Sludges – Part 2
15.	EN 12506	Characterization of Waste – Analysis of Eluates – Determination of pH, As, Ba, Cd, Cl-, Co, Cr, Cr VI, Cu, Mo, Ni, NO2-, Pb, total S, SO42-, V and Zn.

3.0 GENERAL REQUIREMENTS:

a) This maintenance-free earthing system shall be based on ready capsule type, Pipe-in-Cage technology concept in which, One Galvanized hollow pipe (Electrode) is kept inside the Galvanized Perforated cage as per drawing. The space between the electrode and cage shall be filled with a specially developed earth enhancement material(EEM) made up of Conductive Cement, Graphite carbon powder, Sodium montmorillonite/ Sodium Bentonite Powder, Hydrous aluminum silicate, etc. to reduce earth resistivity.
b) The system shall be almost maintenance-free and require no periodic or scheduled maintenance for an expected period of 15 years.
c) There shall be no requirement to add any other chemical or water at any time after initial installation because of the hygroscopic characteristic of Earth Enhancement Material (EEM).
d) The material offered shall conform to relevant standards with high quality and good workmanship capable to perform continuous and satisfactory operations in the actual service conditions at the site.

4.0 EARTH ELECTRODE:

The earth electrode is the main component of the earthing system which is meant for collecting, releasing, and discharging earth leakage and fault currents. The earth electrode should be ready capsule type made with Pipe-in-Cage (PiC) technology concept. It includes the hollow MS pipe, as a primary electrode which should have IS marking as per IS: 1161-1979/IS: 1239. For the effective life of the earthing system, the whole unit shall be provided a zinc coating not less than 80 microns through a hot-dip process. The zinc used for galvanizing should follow Zn 98.0 Grade as per IS: 13229-1991 and the process and measurement of hot-dip galvanizing should be as per IS: 2629.

The outer cage of the GI pipe shall be provided with a maximum of 3.5 mm dia holes and shall be hot-dip galvanized with a minimum of 80 microns.

a) **Dimensions:** For normal Ag land, an electrode having 1500 mm length is preferable, but where soil resistance is too high, electrodes having 2000 mm length are to be used.
Primary Electrode: Dimensions of the electrode are as under, however, detail dimensions are shown in the attached drawing No. GPRD- 15. All the tolerances and other specifications to the same should be as per IS: 1161-2014/ IS: 1239.

I. **Length (L):**
   a) 1400 mm (pipe) +100mm (terminal) = 1500 mm (Min.)
   The whole electrode should be made from the single piece i.e. without any joint or welding
II. **Outer Diameter (Ø):** 48 mm (hollow) (Minimum)
III. **Thickness (t):** 3.2 mm (Min.) with hot -dip galvanized up to 80 microns
IV. **Weight of electrode:** To be followed according to limit specified in IS

Perforated Cage: The perforated cage is to be prepared from a minimum 150 mm outer dia. MS pipe having a minimum thickness of 1.5 mm and 80 micron Galvanized coating with a welded GI plates on the top and bottom portion of the pipe such that earth enhancement material can be accommodated in between the primary electrode and perforated cage. The welded portion shall be applied with a zinc spray to maintain the uniform galvanizing across the whole design.

I. **Dimensions:-**
   a) 1380 mm X 150 mm for 1500 mm Electrode (Minimum)
II. **Circular Hole for Cage:** 3.5 mm Dia. Or lesser
   Center to center distance between two consecutive holes in any directions shall be in the range of 45 mm to 70 mm.
III. **Thickness of Perforated Cage:** 1.5 mm (min.) with hot-dip galvanized of 80 microns

b) **Terminal**: Primary electrode must be provided with a connection terminal facility as shown in the drawing by pressing of 100 mm at the top side of the pipe to form a strip having dimensions as mentioned in the drawing **without joint or welding. The pipe shall be pressed by hydraulic press only. No hammered pressed/ welding shall be acceptable.** Two numbers of the holes of diameter as mentioned in the drawing shall be provided in the pressed portion of the top side of the pipe for connecting the strip with the earth electrode.

c) **Electrically Insulated Enameled Paint Coating or PVC Cap:** As shown in the drawing No. **GPRD- 15** , **Either** the electrically insulated enameled paint coating has to be applied on the **150 mm length of PiC electrode (Cage)** immediately after the compressed portion of the electrode (terminals) **Or Insulated PVC cap of appropriate die-electric strength with a minimum thickness of 2 mm can be provided to prevent the flow of current in the upper portion.** The enameled paint coating should have minimum Dielectric strength-20 Kv/mm and min. 4 coat should be applied to the surface of the electrode. This is done to prevent the danger to the living being from Step potential.

d) **Zinc coating:** The earth electrode consists of one mild steel pipe with the provision of connections at the top end as shown in the attached drawings No. **GPRD- 15**. The entire electrode shall be hot-dip galvanized **with at least 80 microns** over all the surfaces **without leaving any point of the electrode un-galvanized and the cage shall be hot-dip galvanized with at least 80 microns in accordance with IS 4736: 1986**. The process of hot-dip galvanizing shall be followed as per IS 2629. For uniform distribution of fault currents, an earth electrode must be cylindrical in shape.

e) Short Time Current Rating: The earth electrode shall be capable to withstand a minimum of 20 KA (rms) short time current for 1 sec.

f) **Embossing of Unique Serial No. and manufacturing details :-**

Following things are to be permanently embossed with the clearly visible stamping on the connecting terminal and/or top flate plate of Cage for each PiC Earthing capsule.

1. Small Logo/Name of manufacturers of PiC earthing capsule
2. DISCOM wise unique serial no. (for eg. PG0000001) in coordination with the concerned tender publishing authority such that DISCOMs can maintain and track the inventory of the same
3. The manufacturing month and year.

5.0 EARTH CONDUCTIVITY ENHANCEMENT MATERIAL:

a) Placement of Earth Enhancement Material:-

It shall be placed between the primary earth electrode and perforated cage to improve the conductivity of the earth electrode & ground contact area. Earth enhancement material (Backfill compound) shall be according to **IEC 62561-7,** and superior conductive material that improves earthing effectiveness especially in areas of poor conductivity such as rocky ground, sandy soil & areas of moisture variation with different soil strata.

b) Material composition:-

The suggested composition of the compound is as under.

*Earth enhancement Back Filling Compound Composition with maximum permissible tolerance of ± 10 % in each content.	Conductive Cement*	15 %
	Graphite carbon powder*	45%
	Sodium montmorillonite/ Sodium Bentonite Powder	30 %
	Hydrous aluminum silicate	10 %
• The maximum permissible limit of Salt content is below 2 % • The Sulphur content in the back-fill compound shall not be more than 2 % in any case. • All the components used in the mixture shall be having a mesh size of at least 200 mesh. • The verification of the quality of the earth enhancement compound shall be done by measuring the resistivity of the compound by performing a soil box test. • The graphite carbon powder should have high carbon content with a minimum of 95% of carbon content or more. The coal powder having low carbon content must not be used in the compound as it contains high fly ash content which is resistive in nature. • The conductive cement should have bonding capability as well as high conductivity. Use of normal cement will increase the resistivity of the compound.		

c) Maintenance-Free:-

The Earth Enhancement Material/ Backfill compound shall be a Highly Conductive Compound and maintenance-free. The watering shall be required at the time of its installation only. No re-charging with water, salts, or any other chemical shall be required and it shall maintain almost constant earth resistance during its life cycle without manual watering. It must set firmly and should not dissolve or decompose or otherwise pollute the soil or the local water table.

d) Hygroscopic:-

It should have the capacity to retain more than 10% moisture at 105ºC. It should have better hygroscopic properties to absorb moisture. It should absorb & release the moisture in the dry weather condition and help in maintaining the moisture around the earth electrode. Test certificate for the same from NABL approved Government/government supported laboratory shall be submitted) It should expand & swell considerably & remove entrapped air to create a strong connection and bond between

the earth electrode & soil. It should diffuse into the soil pores & create conductive roots enlarging the conductive zone of the earth pit.

e) Non-toxic:-

Material shall **be non-toxic, non-reactive, non-explosive & non-corrosive.** It shall not cause burns, irritation to eye, skin, etc. It shall not pollute the soil or local water table & shall meet environmentally friendly requirements for landfills.

f) Leachability Test:-

The requirement for earthing enhancement materials is that they must be chemically and physically stable. Specifically, they must be chemically inert to the surrounding soil and must not decompose or leach over time. Resistance to leaching is a quality of proper EEM because leaching compromises the material's lifetime value. Regardless of the material used, EEM that is washed away cannot uphold the superior conductivity it was intended to provide. **The leach test shall be tested as per IEC 62561-7 Clause 5.3** at NABL accredited Government/ government-supported laboratory. Conformance is verified by testing in accordance to EN 12457-2 and EN 12506.

g) Sulphur Content:-

A significant amount of sulfur cannot exist in the EEM for the system to be effective. If an earthing enhancement material contains a significant amount of sulfur, it can corrode the ground rod electrode. Sulfur causes corrosion to zinc, copper, lead, and iron—all of which are commonly used metals in ground rods. Sulphur Determination test As per IEC 62561-7 clause 5.3. IEC 62561-7 requires that any earthing enhancement material should contain less than 2% sulfur. The test certificate complying with the above requirements should be submitted.

h) Corrosion Test :-

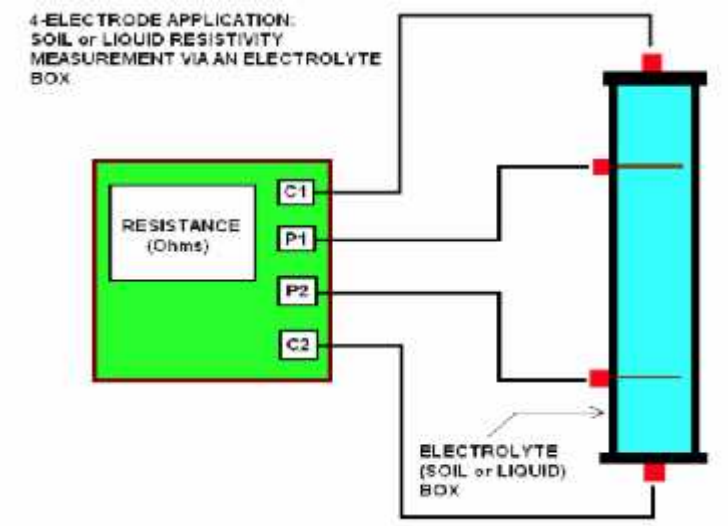
The significance of the test is important because earth enhancement materials have to be physically and chemically inert with the earth electrodes in order to avoid corrosion damage to the earthing electrode. The corrosion rate is determined by using potentio dynamic polarization resistance methods as outlined in ASTM G59-97 and ASTM G102-89. The resulting open circuit potential polarization curves will be used to determine the Tafel curves.

For galvanized earth electrodes, the polarization resistance shall be > 3 Ω × m^2 for nonaggressive environments and > 7,6 Ω × m^2 for aggressive environments. The test certificate complying with the above requirements should be submitted.

i) Soil Box Test – Conductivity test :-

It is required that the resistivity of the Earth enhancement Material shall not be higher than 0.20 Ω-m (i.e. 20 ohm-cm), when it is tested with 4 electrode method using a soil box having cross-section area of 4 cm x 3.2 cm=12.8 Cm^2 and keeping the electrodes at a distance of 12.8 Cm. in a soil box. The supplier shall produce the facility of the soil box for testing. One destructive sample should be randomly selected from the presented lot to test for the soil box test. It is required that the test instrument of standard make such as Megger, Chauvin Arnoux or Fluke should be used for the testing of the soil box. Further, the meter should be able to measure the resistance with 4 Pole method and should have a high accuracy of ± 2% or

less.



(Soil Box testing method)

(Sample Soil Box)

Proposed Sampling criteria for destructive sample testing of Lot :-

1. Quantity less than 100 = 1 Sample
2. Quantity >= 100 & < 500 = 2 sample
3. Quantity >=500 & <1000 = 3 sample
4. Quantity >=1000 and <2000 = 4 sample
5. Quantity >2000 (To be decided by Competent authority)

j) PH Value test:-

It should be **alkaline in nature with a pH value of > 7 & < 9**. Test certificate from NABL approved Government/government-supported laboratory to be provided for the compound so designed.

6. PROCEDURE OF INSTALLING EARTH ELECTRODE:

a) The earth pits **should be dug with the help of an augur** /bore machine having diameter 200 mm to 254 mm. **a.** as per the length of the electrode**. The manual excavation of the pit shall not be entertained**. The ready to use electrode is inserted in the pit vertically and then the pit is filled with local soil and water.

b) At the time of installation, tight filling of mother soil with sufficient watering is required to make contacts of soil uniformly surrounding to the electrode to provide the low resistive path to dissipate the fault current in all directions from the circular surface of the electrode. The loose earth filling surrounding the newly installed earthing may not give low resistance of earthing.

c) The resistance of the earth pit should be measured before connecting the earth electrode to the network and a record of the same shall be preserved. Due care should be taken, as not to measure the earth electrode in live connected condition, the results derived so may be misleading.

d) The connection from Earthing Electrode to meter console for PM KUSUM scheme by way of using 25 mm x 3mm GI strip and GI Nut-bolts The rigid PVC pipe as per the IS:13592:1992 having ultra-violate protection shall be use to cover this GI strip.

e) To validate the quality of the capsule, necessary tests/inspection (Proto inspection, lot inspection, Resistance/ Resistivity, Material validation testing, etc.) shall be carried out on the ready capsule If required by the Engineer In charge.

f) Earthing Display board made up of FRP material having a size of 200 mm x 150 mm x 3 mm with the following details. It should free standing with a suitable mounting stand or bind properly with 4 no.s PVC cable ties .(If required)

(1) Name of Manufacturer/ Trade Name / Supplier
(2) PO NO:
(3) Feeder Name
(4) Earth Pit No
(5) Drawing No _____
(6) Length of Electrode in mm
(7) Date of Installation
(8) Resistance value in Ohm on Installation date
(9) Soil Resistivity in Ohm-Meter

7. INSPECTION:

a. The purchaser or his authorized inspector shall have all rights for free access to the manufacturer's works. The manufacturer or his authorized representative shall remain present at all reasonable times and conduct all tests and measurements as per the technical specifications in presence of the purchaser representative shall give facilities to inspect the manufacturing process at any stage of manufacture. The purchaser shall have the right to reject the whole or part of any work or material that does not conform to the requirements of the specifications. All the reasonable/complete facilities considered necessary for the inspection by the inspector/s inspecting shall be provided by the manufacturer free of cost.

The sample tests to be carried out for inspection of product is as below. However, this is just an indicative one, the additional required tests shall also be carried out, if required as per specification.

Sr. No.	Technical Particulars	Remarks	Confirm (Yes/No)
			Samp.-1
1	**Electrode:** (Confirming to IS: 1161-2014/IS 1239.)	The electrode should be ISI marked with the mini. Parameters of weight, thickness and dimensions as mentioned or better.	**Conforms/ Not Conforms**
	For 3000 mm Electrode		
	Length(L): 1400 mm(pipe)+100mm(terminal)=1500 (Min)		
	Outer Diameter (Ø): 48 mm (hollow) **(± 10 %)**		
	Thickness (t): 3.2 mm(Min) **(+0.4 mm, -0.8 mm)**		
	Weight of electrode : As per IS standards		
	Cross section Area : 4.53 cm2		
	(all tolerance will be applicable as per IS:1161-2014/IS : 1239)		

2	**Galvanized Perforated cage for Earthing :-**	The cage should have thickness and holes as specified or better.	**Conforms/ Not Conforms**
	a) 1380 mm X 150 mm for 1500 mm Electrode		
	b) Circular Hole Size of Net: 3.5 mm Dia. Or lesser. Center to center distance between two consecutive holes in any directions shall be in the range of 45 mm to 70 mm.		
	c) Thickness of Net : 1.5 mm (min.) with hot dip galvanized		
	I. Design Versatility :-		
	The cage should be designed with high durability such that in worst transport condition also, the particles of Earth Enhancement Material should not leach out.		
	II. Handling :-		
	The cage with all content should be design kept in view handling condition at site.		
3	**Zinc coating on electrode :-**		**Conforms/ Not Conforms**
	The entire primary electrode & cage shall be hot dip galvanized with at least 80 microns over all surfaces without leaving any point of the electrode un-galvanized and cage shall be hot dip galvanized with at least 80 microns in accordance with IS 4736: 1986. The process of hot-dip galvanizing shall be followed as per IS: 2629. For uniform distribution of fault currents, an earth electrode must be cylindrical in shape.	The cage should have thickness and holes as specified or better.	
4	**Mixture proportion for Earth enhancement Back Filling Compound Confirming to IEC: 62561-7**		**Conforms/ Not Conforms**
	Resistivity < 0.2 Ω-m		
5	**Earth pit**:-	No manual excavation shall be allowed	**Conforms/ Not Conforms**
	Method of digging Earth Pit:-through Bore/auger machine		
	Diameter = not more than 10”dia.		

ANNEXURE- XX: TECHNICAL SPECIFICATIONS FOR 1.5 METER LONG, MAINTENANCE FREE, ECO-FRIENDLY, READY CAPSULE, PIPE-in-CAGE (PiC) TYPE EARTHING

Sr. No.	Technical Particulars	Remarks	Confirm (Yes/No)
			Samp.-1
1	**GI Strip for connection from Earth Electrode to meter console:**	Dimension and coating of GI Strip shall be verified.	
	GI Strip of 25mm wide, 3mm thick, having hot dip galvanized-zinc coating of 80-100 microns		
2	**Earthing Display board made up of FRP material having size of 200 mm x 150 mm x 3 mm thick with following details. It should free standing with suitable mounting stand.**	Earthing display board as per specification should be provided.	
	(1) Name of Manufacturer/ Trade Name / Supplier		
	(2) PO NO:		
	(3) Feeder Name:		
	(4) Transformer center Name :		
	(5) Length of Electrode in mm		
	(6) Date of Installation		
	(7) Resistance value in Ohm on Installation date		
	(8) Soil Resistivity in Ohm-Meter		
3	**Dimensions of Rigid UV protected PVC Pipe :-**	Shape and coating of cage and electrode shall be measured and should be as specified or better.	
	Outside Diameter : 40 mm (tolerance:- -0.4 mm)		
	Inside Diameter : 34.4 mm (Min.) (Heavy Duty)		
	The rigid PVC pipe as per the IS:13592:1992 having ultra-violate protection shall be use to cover this GI strip		
4	**Verification of test instrument as per specification :-**	Verification of test instrument catalogue as per tender norms.	
	The bidder has to submit technical catalogue of the earth resistivity measurement instrument to be used in tender for measurement.		
5	**Verification of workmanship and material used as per specifications, instructions and drawing; such as GI nut bolts, connections, etc.**		

8. Guidelines for Procedure of Installing Earth Electrode and Earth Resistance Measurement:-

a) The packing of the Earth capsule should be done in such a manner that no any material leakages should happen even in the worst transport & handling condition. These packing shall be marked with the name of the manufacturer or trade name, quantity, date of manufacture, etc.

b) Before installation, the surface of the earth electrode shall be cleaned properly, all resistive material shall be removed from the surface.

c) The earth pits should be dug with the help of an auger /Bore machine having diameter 200 mm to 254 mm. The manual excavation of the pit shall not be entertained. The earthing electrode shall be installed at the proper depth and put vertically in the center of the pit and then the pit is filled with local soil and water. At the time of installation, sufficient watering is required to mix up the soil uniformly surrounding to the electrode. The care shall be taken that there should be tight bonding between the electrode and mother soil. So proper dumping is required at the time of installation, otherwise the porous (gap) between electrode and mother earth will not allow quick dissipation of fault current.

d) **Connections:** The scope of work shall cover supply, installation, and Connection of GI Strip of 25mm wide, 3mm thick, having hot-dip galvanized-zinc coating of 80-100 microns. The connections from the PiC Earth electrode to the concern non-current-carrying part should be erected through the digging of the slot of 1.5 ft of depth through the soil such that the strip should not be easily exposed to the living beings. Also, it should be cover inside the the uPVC pipe, up to a length of 2.5 meters from the ground level, it should be erected through the cover of the uPVC Pipe.

Dimensions of Rigid PVC Pipe:-
Outside Diameter : 40 mm (tolerance:- -0.4 mm)
Inside Diameter: 34.4 mm (Min.) (Heavy Duty)

As mentioned in IS: 9537, the dimension of the PVC pipe should be having Outside Dia- 40mm (tolerance:- -0.4mm), Inside Dia- 34.4mm (Min.). However, additionally, the pipe should be conforming to the tests for the effect of sunlight as per Clause no. 8.5 of IS: 13592 with the latest amendments thereof. A valid test report of the NABL accredited lab should be provided for the same.

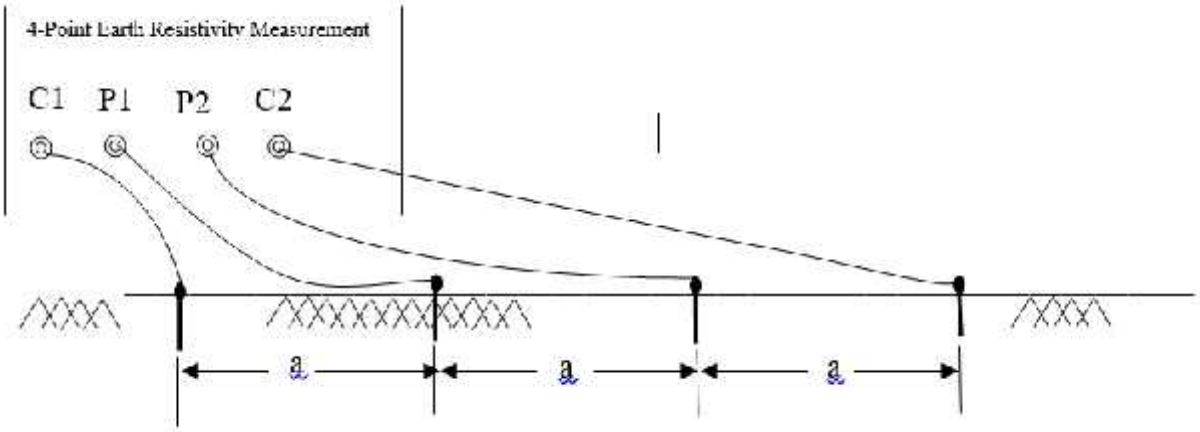
8. CHECK LIST OF TESTS CERTIFICATES TO BE SUBMITTED :

The bidder is required to submit the test certificates as mentioned below, with the bid for successfully able to participate in the bid. All these test certificates shall be carried out at any NABL accredited Government/ Government supported laboratory. These tests should not be older than 5(five) years as on the scheduled date of opening of the Technical bid.

a) Hygroscopic property test
b) Toxic Content test on Conductive materials (RoHS Certification of non-hazardous material)
c) Leachability Test
d) Short Circuit Withstand Test on Earth electrodes
e) PH Value Test
f) Sulphur determination Test
g) Granular Size of Material (Mesh Size of material)
h) Corrosion Test
i) PVC Pipe UV stabilization test

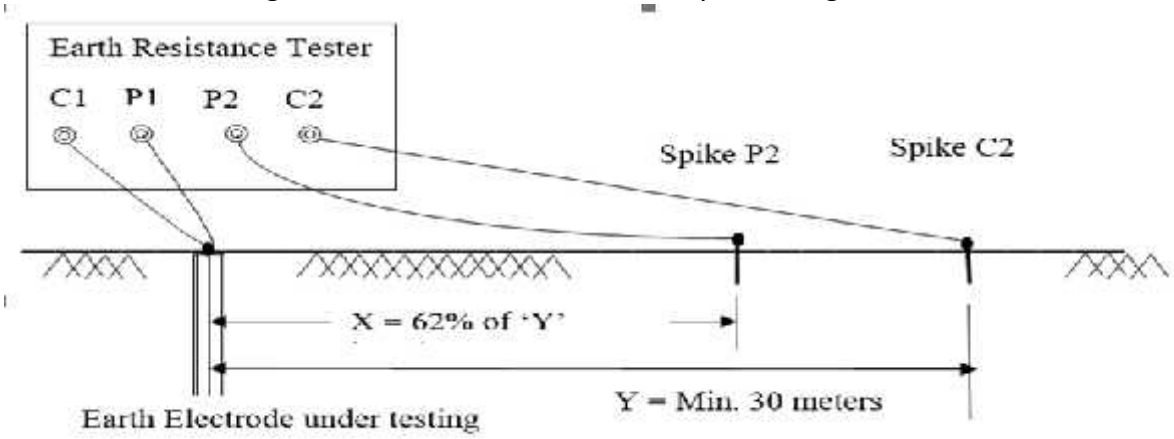
9. PROCEDURE OF MEASUREMENT/TESTING:-

a. MEASUREMENT OF EARTH RESISTIVITY :



b. MEASUREMENT OF EARTHING RESISTANCE:

The value of earthing resistance should be measure by following method of measurement.



The connecting wire length of the terminal connecting earth electrode with C1-P1 of megger should not be more than 1 meter. All three electrodes should be in linear alignment to avoid the unnecessary addition of extra earth resistance during the measurement process.

10. GUARANTEE:

The product shall be guaranteed to sustain its initial value of system resistance without its maintenance with a tolerance of **± 10% for a period of at least 5 years** from the date of commissioning. The value to be taken as a base value for maintenance-free operation should be measured after period of at least one month from the date of commissioning. However, it is desired to have trouble-free operation for a period of 15 years. Any defect discovered during the guarantee period has to be rectified free of charge

GUARANTEED TECHNICAL PARTICULARS

Sr. No.	Technical Particulars	Confirmation (Yes)
1	**Electrode:** Confirming to IS: 1161-2014/IS:1239. **For 1500 mm Electrode** **Length (L):1400** mm(pipe)+100mm(terminal)= 1500 (Min) **Outer Diameter (Ø):** 48 mm (hollow) **Thickness (t):** 3.2 mm(Min) **Weight of electrode :5.3** (Kg.) At least **Cross section Area :** 4.53 cm2 **(all tolerance will be applicable as per IS:1161-2014/ IS:1239)**	
2	**Galvanized Perforated cage for Earthing :-** **I. Dimensions :-** 1380 mm X 150 mm for 1500 mm Electrode a) Circular Hole Size of Net: 3.5 mm Dia. Or lesser. Center to center distance between two consecutive holes in any directions shall be in the range of 45 mm to 70 mm. b) Thickness of Net : 1.5 mm (min.) with hot dip galvanized **II. Design Versatility :-** The cage should be designed with high durability such that in worst transport condition also, the particles of Earth Enhancement Material should not leach out. **III. Handling :-** The cage with all content should be design kept in view handling condition at site.	
3	**Electrically Insulated Enameled Paint Coating or PVC Cap** Uniform Paint coating on 150 mm long electrode after terminals **Or Insulated PVC cap of appropriate die-electric strength with a minimum thickness of 2 mm can be provided to prevent the flow of current in the upper portion.** The enameled paint coating should have minimum Dielectric strength-20 Kv/mm and min. 4 coat should be applied to the surface of electrode. Optionally, PVC cap of appropriate die-electric strength can be provided to prevent the flow of current in the upper portion.	
4	**Zinc coating on electrode :-** The entire primary electrode & cage shall be hot dip galvanized with at least 80 microns over all surfaces	

<table>
<tr><td></td><td>without leaving any point of the electrode un-galvanized and cage shall be hot dip galvanized with at least 80 microns in accordance with IS 4736: 1986 in accordance with IS 4736: 1986. The process of hot-dip galvanizing shall be followed as per IS: 2629. For uniform distribution of fault currents, an earth electrode must be cylindrical in shape.</td><td></td></tr>
<tr><td>5</td><td>Mixture proportion for Earth enhancement Back Filling Compound Confirming to IEC: 62561-7
<table>
<tr><td>Conductive Cement:</td><td>15 %</td></tr>
<tr><td>Graphite carbon powder</td><td>45%</td></tr>
<tr><td>Sodium montmorillonite/ Sodium Bentonite Powder</td><td>30 %</td></tr>
<tr><td>Hydrous aluminum silicate</td><td>10 %</td></tr>
</table>
Sulphur content < 2 %
Content tolerance of ± 10 %
Resistivity < 0.2 Ω-m
Salts contents < 2 %
All the component used in the mixture shall be having mesh size between 150-200 mesh.</td><td></td></tr>
<tr><td>6</td><td>Earth pit:-
Method of digging Earth Pit:-through Bore/auger machine
Diameter not more than 10”dia.</td><td></td></tr>
<tr><td>7</td><td>Confirmation of Scope of work, Supply, Installation, commissioning and testing procedure as mentioned in specification</td><td></td></tr>
</table>

****