



Gujarat Power Research & Development Cell

(A Govt. of Gujarat Initiative)

Gujarat UrjaVikas Nigam Ltd

CIN: U40109GJ2004SGC045195,

IIT Gandhinagar Research Park, IIT Gandhinagar,
Palaj- 382 355, Gandhinagar, Gujarat, India

www.guvnl.com; www.gprd.in; guvnlrnd@gprd.in



GUVNL/GPRD/PiC Tech Specs /RP-041/Tech Specs /513

Date : 28.02.2022

(Through E-mail & Hard Copy)

To,

The Additional Chief Engineer (Tech),
Gujarat Urja Vikas Nigam Ltd,
S P Vidyut Bhavan,
Race Course,
Vadodara.

Sub.: Proposal for Amendments/changes in existing technical specifications with Submission of draft for Concurrence/Confirmation of CE of all DISCOM for Amendment of Technical Specifications of Maintenance free, Ready capsule, Pipe-in-Cage (PiC) type Earthing for HT/LT Distribution network.

Ref: (1) GUVNL/SE Tech-3/DE-2/1686 dated 22.06.2021
(2) DGVCL/C.E.(O&M)/Tech /Earthing-PiC/Tech Specification/15375 Dated: 15.09.2021
(3) MGVCL/Tech/1676 Dated : 06.09.2021
(4) PGVCL/Tech/71 Dated : 06.01.2022
(5) UGVCL/R&C/QC Cell/TS/Tech. Specification/PiC Earthing/229 Dated: 08.02.2022

Vide letter under reference (1), the GPRD cell was asked to furnish the view/comments/suggestions of DISCOMs in regards to the amendment in technical Specification of newly developed Maintenance free, Ready capsule, Pipe-in-Cage (PiC) type earthing for power network. For the same, various meetings were done with representatives from all DISCOMs. The suggestions of all DISCOMs are enclosed herewith.

In context to the same, it was asked to submit the proposal for amendments/changes in the existing technical specifications with detailed justifications. Pls find enclosed

GUVNL, Head Office, S. P. Vidyut Bhavan, Race Course, Vadodara-390 007.

Phone No.: 2310582, 83, 84, 85, 86 Fax No: 2337918 / 2338164

Website: www.guvnl.com, email: setech.guvnl@gebmil.com

herewith technical specifications, drawing and review/suggestions of all DISCOM with GPRD's comment.

Accordingly, you are requested to take further action at your end please.

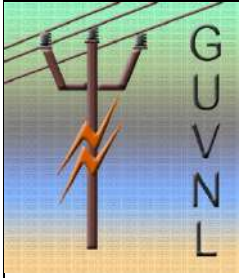

i/C Superintending Engineer(R&D)
GPRD Cell, GUVNL.

CFWCs To :-

- ✓ 1. The Director Technical, GUVNL, Vadodara.
2. The Chief Engineer (O&M), DGVCL, Surat.
3. The Chief Engineer (T&O), MGVCL, Vadodara.
4. The chief Engineer (Tech), PGVCL, Rajkot.
5. The Chief Engineer (Op), UGVCL, Mehsana.

Enclosure:-

1. Proposed Draft Technical specification
2. Proposed Draft Drawings
3. Comment by DISCOM for proposed changes and GPRD comments



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@gprd.in



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

Sr. No	Technical Specification No./Revision	Date of revision
1.	GUVNL/GPRD/TS/PiC Earthing/RP-041/R0	14/06/2018
2.	GUVNL/GPRD/TS/PiC Earthing/RP-041/R1	09/03/2021
3.	GUVNL/GPRD/TS/PiC Earthing/RP-041/R2	12/08/2021

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

This specification is divided in two parts. The first part (Part-A) covers the scope of supply of maintenance-free, Ready Capsule, Pipe-in-cage, special type earthing system to be provided for the distribution network. The other part (Part-B) covers the scope of installation, testing, and commissioning of maintenance-free, Ready Capsule, Pipe-in-cage, special type earthing system in the distribution network.

The part-C is for the turnkey based tender (Part-C) i.e. scope covering carting of PiC capsules, GI Strip, etc. from RSO/division/subdivision store to the destination, installation, testing, and commissioning of maintenance-free, Ready Capsule, Pipe-in-cage, special type earthing system and other relevant accessories (Like GI Strip, PVC Pipe, Nut-Bolts, Name plate, etc.) , both Part-A and Part-B shall be considered.

(PART-A)

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

1.0 SCOPE:

This specification covers supply of maintenance-free, Ready Capsule, Pipe-in-cage, special type earthing system and other relevant accessories (Like GI Strip, PVC Pipe, Nut-Bolts, Name plate, etc.) to be supplied at the designated locations provided **by the DISCOMs**. 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

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

5.	IS: 2629 & IS: 4736	For hot-dip galvanizing for Iron and Steel
6.	IS:1161/1979 Or IS: 1239 (Part-1 & Part-2)	Steel Tubes for Structural Purposes: Specification Or Steel Tubes, Tubulars, And Other Wrought Steel Fittings — Specification
7.	IS:13229-1991	Zinc for Galvanizing
8.	IS:9537:1983	Conduits for electrical installations
9.	IS:13592:1992	UPVC pipes for soil and waste discharge systems
10.	IEEE Std. 142- 2007	IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
11.	IS:5216-1982	Recommendations on Safety Procedures and Practices in Electrical Work
12.	CEA	Measures relating to Safety and Electric Supply) Regulations, 2010
13.	EN-12547-2	Characterization of Waste – Leaching – Compliance Test for Leaching of Granular Waste Materials and Sludges – Part 2
14.	EN 12506	Characterization of Waste – Analysis of Eluates – Determination of pH, As, Ba, Cd, Cl-, Co, Cr, Cr VI, Cu, Mo, Ni, NO ₂ -, Pb, total S, SO ₄ ²⁻ , 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-

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

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. ($\pm 10\%$ Tolerance)~~ holes and shall be hot-dip galvanized with a minimum of 80 microns.

a) **Dimensions:** Here, two different size electrodes are proposed, i.e. 2000 mm and 3000 mm length electrodes. Generally, an electrode having a 3000 mm length is preferable, but where digging of 3000 mm pit is not possible, two parallel earthing of electrodes having a 2000 mm length are to be used.

Primary Electrode: Dimensions of the electrode are as under, however, detailed dimensions are shown in the attached drawing No. GPRD-16 (Rev.2) & GPRD-17 (Rev.2). All the tolerances and other specifications to the same should be as per IS: 1161-2014/ IS:1239.

Length (L):

- a) 1900 mm (pipe) +100mm (terminal) =2000 mm
- b) 2900 mm (pipe) +100mm (terminal) =3000 mm

The whole primary electrode should be made from a single piece i.e. without any joint or welding

- I. Nominal Bore Diameter : 40 mm (Medium duty)
- II. **Outer Diameter (ϕ):** 48.3 mm (hollow) (With tolerance : 47.9 mm – 48.8 mm)
- III. **Thickness (t):** 3.2 mm (tolerance : -10%, + not limited) with hot-dip galvanized of minimum 80 microns
- IV. **Weight of electrode:** To be followed according to limit specified in IS (3.56 Kg/meter, Tolerance : $\pm 10\%$)

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 microns Galvanized coating with a welded GI plate on the top and bottom portion of the cage 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) 1880 mm (L) X 150 mm (ϕ) for 2000 mm Electrode
- b) 2880 mm (L) X 150 mm (ϕ) for 3000 mm Electrode

Tolerances in length: (-1%, + not limited)

II. Circular Hole for Cage: 3.5 mm Dia. (Tolerance: $\pm 10\%$)

Center to center distance between two consecutive holes in any direction shall be in the range of 45 mm to 70 mm.

III. Thickness of Perforated Cage: 1.5 mm (min.) with minimum 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 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 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 or Heat shrinkable insulated Sleeve:

As shown in drawing No. GPRD- 16(Rev. 2) & GPRD-17(Rev. 2) following insulation needs to be provided on top 250 mm length of PiC Electrode (150 mm Cage + 100 mm terminal) to prevent the flow of current in the top portion

1. The electrically insulated enameled/bituminous paint coating of 40 micron thickness and of sufficient dielectric strength can be provided
2. Insulated PVC cap of appropriate die-electric strength with a minimum thickness of 2 mm can be provided
3. The heat shrinkable insulated sleeves of appropriate die-electric strength has to be applied

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- 16(Rev.2) & GPRD-17(Rev.2). 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/punching of Unique Serial No. and manufacturing details:-

Following things are to be permanently embossed/punched with the clearly visible stamping on the connecting terminal and/or top flat plate of Cage for each PiC Earthing capsule which should be non-removable.

1. Small Logo/Name of manufacturers of PiC earthing capsule (Size to be defined)
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 (Size to be defined)
3. The manufacturing month and year.

g) Tender sample submission (To be discussed) :-

The bidder has to submit 2 No.s of samples along with bid at concern store/designated location of DISCOMs. The DISCOM will carry out destructive test on one of the sample provided and the other sample will be preserved as a sample. The following tests will be carried out on the sample failing to which the technical acceptance of the bid will not be considered.

1. Verification of dimensions
2. Verification of resistivity of EEM (During destructive testing, the DISCOM will carry out the test when the EEM is in dry condition)
3. Coating thickness test of Galvanizing (Cost of Proto sample to be discussed)

h) Packaging And Material Handling :-

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. The packing of the Earth capsule should be done in such a manner that no material leakages should happen even in the worst transportation & handling condition For the same the PiC should be wrapped with PVC packing tap.

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 $\pm 10\%$ 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 150-200 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 as mentioned in Cl. 5.0(i) - The graphite carbon powder should have a minimum 95% of carbon content. The usage of coal powder is restricted due to its high fly ash content which is resistive in nature. - The conductive cement should have bonding capability as well as high conductivity. The use of normal cement will increase the resistivity of the compound. Hence the usage of normal cement content is restricted.		

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 105°C. 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. 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 the 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 5.2** at NABL accredited Government/ government-supported laboratory. Conformance is verified by testing in accordance with 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 that the earth enhancement materials have to be physically and chemically inert with the earth electrodes in order to avoid corrosion damage to the earthing electrode. This test is to be followed as per clause no. 5.5 of IEC 62561-7. The corrosion rate is determined by using potentiodynamic polarization resistance methods as outlined in ASTM G59-97 and ASTM G102-89.

i) Soil Box Test – EEM Conductivity test:-

The Earth enhancement material should diffuse. It should expand & swell considerably & remove entrapped air to create a strong connection and bond between earth electrode & soil into the soil pores & create conductive roots enlarging the conductive zone of the earth pit.

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 Cm² and keeping the electrodes at a distance of 12.8 Cm. in a soil box.

The soil boxes are designed such that the cross-sectional area of the soil (or liquid) sample (A), with the box filled level, divided by the separation between the pins (L) is equal to 1 cm.

For example

A = Cross-sectional area (Inner side conducting plate) = 4 cm x 3.2 cm = 12.8 cm²

L = Pin separation (P1-P2) = 12.8 cm

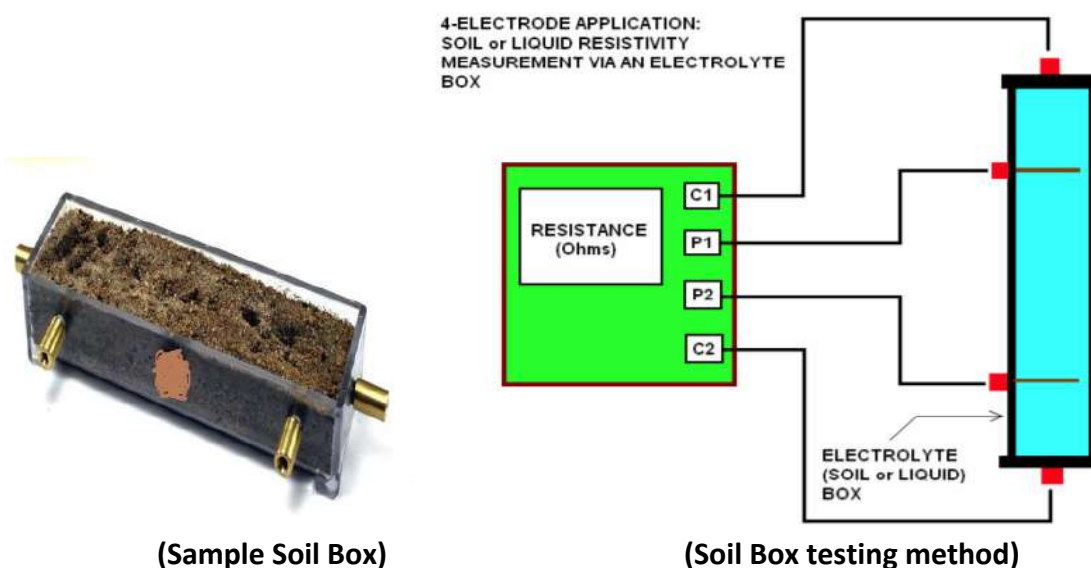
A / L = 1 cm

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

Soil Box Example:

Measured Resistance (4 Point method with Earth tester) = 19.7 Ω
 Resistivity Value = 19.7 $\Omega \times 1\text{cm}$
 = 19.70 $\Omega\text{-cm}$
 = 0.197 $\Omega\text{-meter}$

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 only be used for the testing of the soil box. Further, the meter should be able to measure the resistance with the 4 Pole method and should have a high accuracy of $\pm 2\%$ or less with a professional testing kit.



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.

k) Weight of EEM :-

The weight of EEM **should be measured while performing destructive testing**. The weighing scale having stated accuracy and valid calibration certificate as mentioned in Annexure-1 should only be used. The weight requirement of EEM per kg of Cage is as below

Weight of EEM Per meter of perforated Cage length: - 15 KG/meter ($\pm 5\%$)

- Weight of EEM in 2880 mm Perforated cage dimensions: - 43 Kg (**-5%, +not limited**)
- Weight of EEM in 1880 mm Perforated cage dimensions: - 28 Kg (**-5%, +not limited**)

It is mandatory that above measurement should be carried out while EEM is in dry condition.

6.0 QUALITY CHECK AND INSPECTION :-

The quality check of the sample is to be carried out as per following list.

A) TYPE TEST :-

The bidder is required to submit the type test certificates as listed below, along 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.

1. Toxic Content test on Conductive materials (RoHS Certification of non-hazardous material)
2. Leachability Test as per clause no. 5.2 of IEC 62561-7
3. Short Circuit Withstand Test on Earth electrodes (20 KA rms for 1 sec)
4. PH Value Test (pH value of > 7 & < 9)
5. Sulphur determination Test as per clause no. 5.3 of IEC 62561-7
6. Granular Size of Material (Mesh Size of material at least 150-200 mesh)
7. Corrosion Test (as per clause no. 5.5 of IEC 62561-7)
8. PVC Pipe tests for the effect of sunlight (Clause no. 8.5 of IS: 13592)

B) ROUTINE TEST :-

The supplier has to submit following routine test certificate. The routine test certificate is to be provided for each and every sample and is to be submitted **at the time of inspection to the inspector of DISCOM.**

1. Serial No. :
2. Dimensions and weight of the electrode (Length, OD, thickness, weight, coating thickness of galvanizing)
3. Dimensions and weight of the outer cage (Length, OD, thickness, weight, coating thickness of galvanizing,)
4. Resistivity and **weight** of EEM
5. GI Strip Dimensions and coating thickness of galvanizing
6. PVC Pipe dimensions

C) Acceptance Test :-

The user acceptance test shall be carried out by the representative DISCOM on following sampling basis. The test carried out will be the destructive test (**Destructive Testing definition:** Testing methods, the use of which destroy or impair the part or product insofar as its intended use is concerned, but which give proof or an indication of the strength or quality of similar or duplicate parts or products. Such tests involve the subjection of the test piece to various influences, of destructive magnitude, such as impact, stress, pressure, cyclic movement, etc.)

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

In the process of acceptance testing, after taking the reading of dimensions, the bottom plate is required to be cut through cutter, and then the whole main electrode is to be drawn out. The dimensions of the whole main electrode and its weight is to be verified according to following table. The Earth enhancement material is also to be drawn out for verification of resistivity test with soil box having dimensions as mentioned above. The other tests are to be carried out as per following table.

Proposed Sampling criteria for destructive sample testing of a lot :-

1. Quantity less than 50 = 1 Sample
2. Quantity ≥ 50 & < 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)

Note:- The samples shall be selected randomly from the lot under testing

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 acceptance test on the materials of PiC will be performed as per detail mentioned in following tables.

A. ACCEPTANCE TEST FOR PiC EARTHING :-

Sr. No.	Technical Particulars	Remarks	Confirm (Yes/No) or Measurement Reading			
			Samp.-1	Samp.-2	Samp.-3	Samp.-4
1	PiC Earthing Sample details (Permanently embossed/punched with the clearly visible stamping) :-					
	Small Logo/Name of manufacturers of PiC earthing	All things should be permanently embossed/punched with the clearly visible stamping on the connecting terminal and/or top flat plate of Cage for each sample				
	Unique serial no.					
	The manufacturing month and year					
2A	Electrode: (Confirming to IS: 1161-2014/IS 1239) Nominal Bore : 40 mm (Medium duty)					
	For 3000 mm Electrode	The electrode should be ISI marked with the mini. Parameters of weight, thickness and dimensions				
	Length (L): 2900 mm (pipe) + 100 mm (terminal)=3000mm (Tolerance : -1%, + not limited)					

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

	Outer Diameter (ϕ): 48.3 mm (hollow) (With tolerance : 47.9 mm – 48.8 mm) Thickness (t): 3.2 mm (tolerance : -10%, + not limited) Weight of electrode : 10.6 (Kg.) (Tol : ± 10 %)	as mentioned or better.				
(all tolerance will be applicable as per IS:1161-2014/IS : 1239)						
2B	For 2000 mm Electrode	The electrode should be ISI marked with the mini. Parameters of weight, thickness and dimensions as mentioned or better.				
	Length (L): 1900 mm (pipe) + 100 mm (terminal)=2000mm (Tolerance : -1%, + not limited)					
	Outer Diameter (ϕ): 48.3 mm (hollow) (With tolerance : 47.9 mm – 48.8 mm)					
	Thickness (t): 3.2 mm (tolerance : -10%, + not limited)					
	Weight of electrode : 7.1 (Kg.) (Tol.: ± 10 %)					
3	I. Galvanized Perforated cage for Earthing :-	The cage should have thickness and holes as specified or better.				
	a) 2880 mm (L) X 150 mm (ϕ) for 3000 mm electrode Tolerances in length: (-1%, + not limited)					
	b) 1880 mm (L) X 150 mm (ϕ) for 2000 mm electrode Tolerances in length: (-1%, + not limited)					
	Circular Hole Size of Net: 3.5 mm Dia. (Tolerance: ± 10%)					
	The thickness of Net: 1.5 mm (min.) with hot-dip galvanized					
	Center to center distance between two consecutive holes in any direction shall be in the range of 45 mm to 70 mm.					
	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. For the same the PiC should be wrapped with PVC packing tap.					
	II. Handling :-					
	The cage with all content should be design kept in view handling condition at site.					
4	Zinc coating on electrode :-	The measurement should be taken by coating thickness tester. It should be $\geq 80 \mu$				
	Galvanizing on the main electrode (in 80 micron min.):					
	Galvanizing on the Perforated cage (in 80 micron min.):					

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

5	Earth Enhancement Material (EEM) :-					
	Resistivity Test of Earth enhancement Back Filling Compound Confirming to IEC: 62561-7	Soil box test to be carried out with calibrated earth tester - Destructive Testing				
	Resistivity $\leq 0.2 \Omega\text{-m}$					
	Weight of EEM :-					
	Weight of EEM in 2880 mm Perforated cage dimensions Tol.:(-5%, +not limited)					
	Weight of EEM in 1880 mm Perforated cage dimensions Tol.:(-5%, +not limited)					

B. ACCEPTANCE TEST FOR OTHER ACCESSORIES OF PiC EARTHING:-

Sr. No.	Technical Particulars	Remarks	Confirm (Yes/No) or Measurement Reading			
			Sam p.-1	Samp.- 2	Samp.-3	Samp .-4
1	GI Strip : 25mm wide, 3mm thick, zinc coating min. 80 microns	The size of the GI Strip should be measured with calibrated digital vernier calipers & Galvanized coating with coating thickness tester				
	GI Strip dimensions (B x H) in mm					
	GI Strip coating (in μ)					
2	Earthing Display board made up of FRP material having a size of (L X B x H) in mm - minimum 200 mm x 150 mm x 3 mm with following bare minimum parameters	The size of the FRP board should be measured with the digital calibrated vernier calipers and display board should contain all the details as mentioned.				
	(1) Name of Manufacturer/ Trade Name / Supplier					
	(2) PO NO:					
	(3) Feeder Name					
	(4) PiC Earthing Serial 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					
3	Dimensions of Rigid PVC Pipe (Sunlight protected):-	The size of the PVC Pipe should be measured with calibrated digital Vernier callipers				
	Outside Diameter : 40 mm (tolerance:- -0.4 mm)					
	Inside Diameter: 34.4 mm (Min.) (Heavy Duty)					
	The pipe should have BIS marking of IS:9537 on its body					
4	Verification of test instrument as per specification:-	The details of the test instrument should be as				

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

	The bidder has to submit a technical catalog of the earth resistivity measurement instrument to be used in the tender for measurement.	per specification and the calibration certification should be verified (Within 1 Year)				
	Make of instrument					
	4 Pole testing available					
	Professional earth testkit accessories (Company provided : Cable Reels, Spikes, etc.)					
5	uPVC Cable Tie Dimension :-	Dimensions to be verified				
	Dimensions of uPVC Cable Tie (600 mm x 7 mm x 1.3 mm)					

All the measurements needs to be taken with the calibrated Digital Vernier calipers, Digital micro meter screw gauge, Digital weighing machine, etc.

7.0 GUARANTEED TECHNICAL PARTICULARS (GTP) :

The bidder needs to fill up the details and conforms the technical particulars of the products as per GTP.

A. GURANTEED TECHNICAL PARTICULARS FOR PiC EARTHING :-

Sr. No.	Technical Particulars	Remarks	Details
1	Electrode: (Confirming to IS: 1161-2014/IS 1239) Nominal Bore : 40 mm (Medium duty)	The electrode should be ISI marked with the mini. Parameters of weight, thickness, and dimensions as mentioned or better.	
	(a) For 3000 mm Electrode		
	Length (L): 2900 mm (pipe) + 100 mm (terminal)=3000 mm (Tolerance : -1%, + not limited)		
	Outer Diameter (Ø): 48.3 mm (hollow) (With tolerance : 47.9 mm – 48.8 mm)		
	Thickness (t): 3.2 mm (tolerance : -10%, + not limited)		
	Weight of electrode : 10.6 (Kg.) (Tolerance : ± 10 %)		
	(b) For 2000 mm Electrode		
	Length(L): 1900mm(pipe)+100mm(terminal)=2000mm (Tolerance : -1%, + not limited)		
	Outer Diameter (Ø): 48.3 mm (hollow)((With tolerance : 47.9 mm – 48.8 mm)		
	Thickness (t): 3.2 mm (tolerance : -10%, + not limited)		
	Weight of electrode : 7.1 (Kg.) (Tolerance : ± 10 %)		
2	Galvanized Perforated cage for Earthing :-	The cage should have thickness and holes as specified or better.	Conforms/ Not Conforms
	a) 2880 mm X 150 mm for 3000 mm electrode		
	b) 1880 mm X 150 mm for 2000 mm electrode		
	Circular Hole Size of Net: 3.5 mm Dia. (Tolerance: ±10%)		
	The thickness of Net: 1.5 mm (min.) with hot-dip galvanized		

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

	Center to center distance between two consecutive holes in any direction shall be in the range of 45 mm to 70 mm.		
3	Zinc coating :-	The zinc coating should be Minimum 80 micron for electrode and cage	Conforms/ Not conforms
	Galvanizing on the main electrode (in micron):-		
	Galvanizing on the Perforated cage (in micron):-		
4	Testing of Mixture proportion for Earth enhancement Back Filling Compound Confirming to IEC: 62561-7 with the soil box and standard earth resistance testing meter (during destructive testing of the selected sample as per proposed sampling criteria as mentioned in Cl.5.0(i). Resistivity $\leq 0.2 \Omega\text{-m}$		Conforms/ Not Conforms
	Weight of EEM Per meter of perforated Cage length (in dry condition) : - 15 KG/meter (Tol.: $\pm 5\%$) - Weight of EEM in 2880 mm Perforated cage dimensions: - 43 Kg (Tol.: -5%, +not limited) - Weight of EEM in 1880 mm Perforated cage dimensions: - 28 Kg (Tol.: -5%, +not limited)		
5	Earth pit:-	No manual excavation shall be allowed	Conforms/ Not Conforms
	Method of digging Earth Pit:-Through Bore/auger machine, having Diameter 200-300 mm		
	Earth Pit: 200-300 mm dia. ?		

B. GURANTEED TECHNICAL PARTICULARS FOR OTHER ACCESSORIES OF PiC EARTHING :-

Sr. No.	Technical Particulars	Remarks	Confirm (Yes/No)
1	GI Strip :	Dimension and coating of GI Strip shall be verified.	
	GI Strip of 25mm wide, 3mm thick, having hot-dip galvanized-zinc coating of min. 80 microns, and joints or welding should be avoided as far as possible. (Joints in earthing circuit is not desirable, however if it is technically not possible to lay earthing strip without joint, in that case only, joints should be provided with minimum 2 No.s of nut bolts and it should be solidly welded.		
2	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 be mounted with a suitable mounting stand or bind properly with 4 no.s PVC cable ties (Cable tie dimensions to be added).	Earthing display board as per specification should be provided.	
	(1) Name of Manufacturer/ Trade Name / Supplier (2) PO NO: (3) Feeder Name (4) PiC Earthing Serial No.		

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

	(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		
3	Dimensions of Rigid PVC Pipe (Sunlight protected):- a) Outside Diameter : 40 mm (tolerance:- -0.4 mm) b) Inside Diameter: 34.4 mm (Min.) (Heavy Duty) c) BIS marking of IS 9537 on pipe 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.	PVC Pipe should conform to the requirement of dimensions and BIS marking as mentioned	
4	Verification of test instrument as per specification:- The bidder has to submit a technical catalog of the earth resistivity measurement instrument to be used in the tender for measurement.	Verification of test instrument catalog as per tender norms.	
5	Minimum Dimensions of uPVC Cable Tie (600 mm x 7 mm x 1.3 mm)		
6	Verification of workmanship and material used as per specifications, instructions, and drawing; such as GI nut bolts, connections, etc.		
7	Valid calibration certificate of all the measuring instruments used in the inspection.		

8.0 CHECKLIST OF TESTS CERTIFICATES TO BE SUBMITTED:

- 1) Toxic Content test on Conductive materials (RoHS Certification of non-hazardous material)
- 2) Leachability Test as per clause no. 5.2 of IEC 62561-7
- 3) Short Circuit Withstand Test on Earth electrodes (20 KA rms for 1 sec)
- 4) PH Value Test (pH value of > 7 & < 9)
- 5) Sulphur determination Test as per clause no. 5.3 of IEC 62561-7
- 6) Granular Size of Material (Mesh Size of material at least 150-200 mesh)
- 7) Corrosion Test (as per clause no. 5.5 of IEC 62561-7)
- 8) PVC Pipe tests for the effect of sunlight (Clause no. 8.5 of IS: 13592)
- 9) Test instrument brochure

9.0 GUARANTEE:

The product shall be guaranteed to maintain its property of low resistance without its maintenance for a period of 5 years. **Any defect discovered during the guarantee period of 5 years has to be rectified free of charge**

(PART-B)

TECHNICAL SPECIFICATIONS FOR INSTALLATION, TESTING AND COMMISSIONING OF MAINTENANCE FREE, ECO-FRIENDLY, READY CAPSULE, PIPE-in-CAGE (PiC) TYPE EARTHING WITH ALL RELEVANT ACCESSORIES.

1.0 SCOPE:

This specification covers carting of PiC capsules, GI Strip, etc. from RSO/division/subdivision store to the destination, Installation, Testing and commissioning of maintenance-free, Ready Capsule, Pipe-in-cage type earthing system and other relevant accessories (Like GI Strip, PVC Pipe, Nut-Bolts, Name-plate, etc.) with good standard of workmanship and following guidelines mentioned in IS:3043 and relevant REC standard. The scope also covers to write the measurement reading of testing of earth pit resistance and soil resistivity and other parameters as mentioned on the FRP name plate with non-removable, permanent paint/ UV protected permanent marker for each and every earth pit.

2.0 PROCEDURE FOR INSTALLATION OF PiC EARTHING :

- a) The PiC Earthing needs to be installed **at least 300 mm (30 cm-1ft.) below ground level**, above which the mother soil filling and dumping should be done such that ground level should be maintained as it was before. No parts of earth electrode should be accessible or touchable to the ground level. The connections from the PiC Earth electrode to the parts to which earthing is to be provided should be erected **through the digging of the slot of 1 ft of depth through the soil till the pole/support structure such that the strip should not be easily exposed to the living beings.**
- b) Two different size electrodes are proposed, i.e. 2000 mm and 3000 mm length electrodes. Generally, the electrode having 3000 mm length is preferable. But, wherever digging of 3000 mm pit is not possible, two parallel earthings of electrodes having 2000 mm length are to be used. The earth pits **should be dug with the help of an auger/bore having a size from 200 mm-300 mm.** 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. (Installation Drawing to be added)
- c) 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.
- d) The testing of soil resistivity should be carried out at each location with the Wenner-4 point method. 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.

The measurement of soil resistivity and earth pit resistance should be carried out only through a professional earth testing kit (testing kit with their 30-meter reels, spikes, Test leads, etc.) of

Megger, Chauvin Arnoux or fluke make. The accuracy of 4 Pole earth testing kit should be $\pm 2\%$ or better. The brochure of the test equipment to be used is to be submitted with the bid.

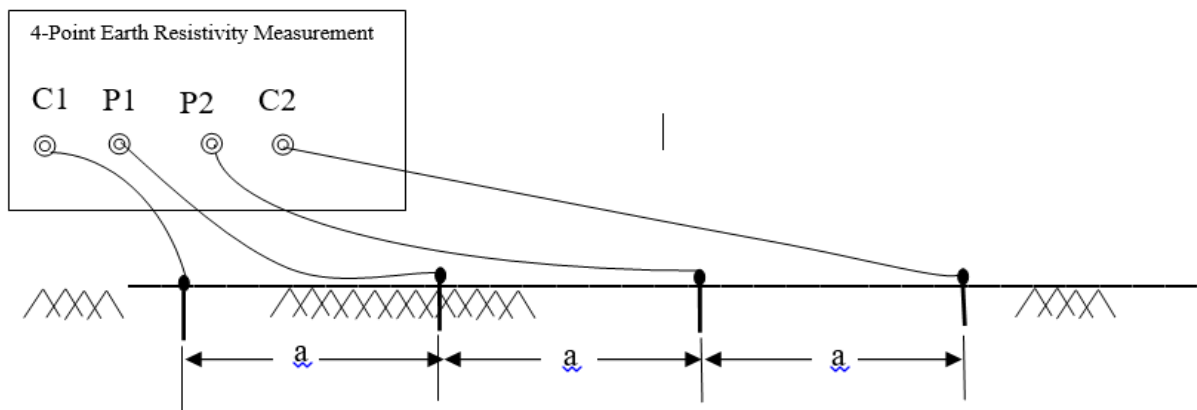
- e) The connection from Earthing Electrode to various network equipment, Transformer body, Transformer Neutral, fabrication of pole and T/C structure, Lightning Arrestors **by way of using mandatorily by 25 x 3 mm GI strip, Nut-bolts and rigid PVC pipe shall be done. Due care shall be taken at the time of connection of GI Strip with earth electrode, so that the insulated enameled paint/PVC cap should not be damaged or torn out.**
- f) To validate the quality of the workmanship, the engineer-in-charge may opt for inspection. If the workmanship quality or material used is found to be deviated from the technical specification, the DISCOM shall take strict action for the same. .
- g) 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.
- (1) Name of Manufacturer/ Trade Name / Supplier
 - (2) PO NO:
 - (3) Feeder Name
 - (4) PiC Serial 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
- h) Before installation, the surface of the earth electrode shall be cleaned properly, **all resistive materials including PVC packing tap shall be removed from the surface.** If PVC packing tap remains on the surface of PiC earthing, it will prevent the smooth dissipation of current in to the earth.
- i) The earth pits should be dug with the help of an auger (200 mm-300 mm dia.). 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 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.

Connections: The scope of work shall cover carting of PiC capsules, GI Strip, etc. from RSO/division/subdivision store to the destination, installation, and Connection of GI Strip of 25mm wide, 3mm thick, having hot-dip galvanized-zinc coating of min. 80 microns without any joints or welding. Joints in earthing circuit is not desirable, however if it is technically not possible to lay earthing strip without joint, in that case only, joints should be provided with

minimum 2 No.s of nut bolts and it should be solidly welded. The connections from the PiC Earth electrode to the parts to which earthing is to be provided should be erected through the digging of the slot of 1 ft of depth through the soil such that the strip should not be easily exposed to the living beings. Also, in the soil, it should be inserted through the PVC pipe, and additionally, up to the minimum height of 2.5 meters from the ground level, it should be erected through the cover of the PVC Pipe supported with a pole by 5 nos of standard make cable ties as per instructions of Engineer-In-Charge. Thus, the whole arrangement should be such that no conducting part shall be exposed to the living being.

3.0 PROCEDURE OF MEASUREMENT/TESTING:-

a) MEASUREMENT OF EARTH RESISTIVITY :



C1-C2 denotes Current Terminal

P1-P2 denotes Potential Terminal

a = the distance between two spikes

For Ex. The calculation of soil resistivity according to Wenner Four electrode method is as below.

Considering distance between spikes (a) = 4 meter

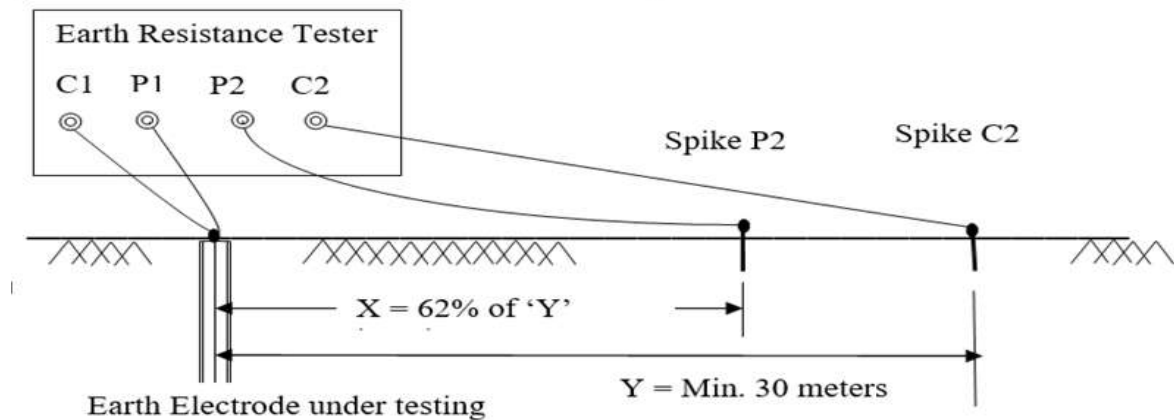
$\rho = 2 \times \pi \times a \times \text{Resistance value shown by earth resistance tester}$

$\rho = 2 \times 3.14 \times 4 \text{ m} \times 2 \Omega$

$\rho = 50.24 \Omega\text{-m}$

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

- b) MEASUREMENT OF EARTH PIT RESISTANCE:** The value of earthing resistance should be measure by the following method of measurement.



The meter will show the value in Ohm

The connecting wire length of the terminal connecting the 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.

4.0 GUARANTEED TECHNICAL PARTICULARS (GTP) :-

Sr. No.	Technical Particulars	Remarks	Details
1	Earth pit:-	No manual excavation shall be allowed	
	Method of digging Earth Pit:-through Bore/auger machine (which machine is available ?)		
	Diameter = 200 – 300 mm dia.		
2	Verification of test instrument as per specification:-	The details of the test instrument should be as per specification and the calibration certification should be verified (Within 1 Year)	
	The bidder has to submit a technical catalog of the earth resistivity measurement instrument to be used in the tender for measurement.		
	Make of instrument		
	4 Pole testing available		
	Professional earth testkit accessories (Company provided : Cable Reels, Spikes, etc.)		

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

Annexure-1

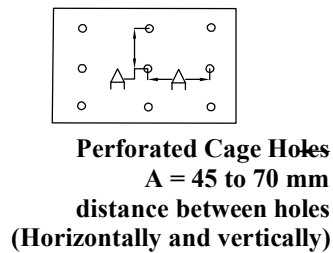
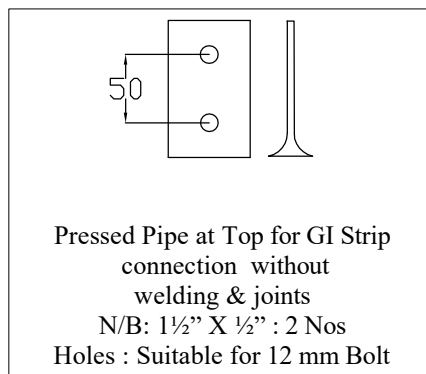
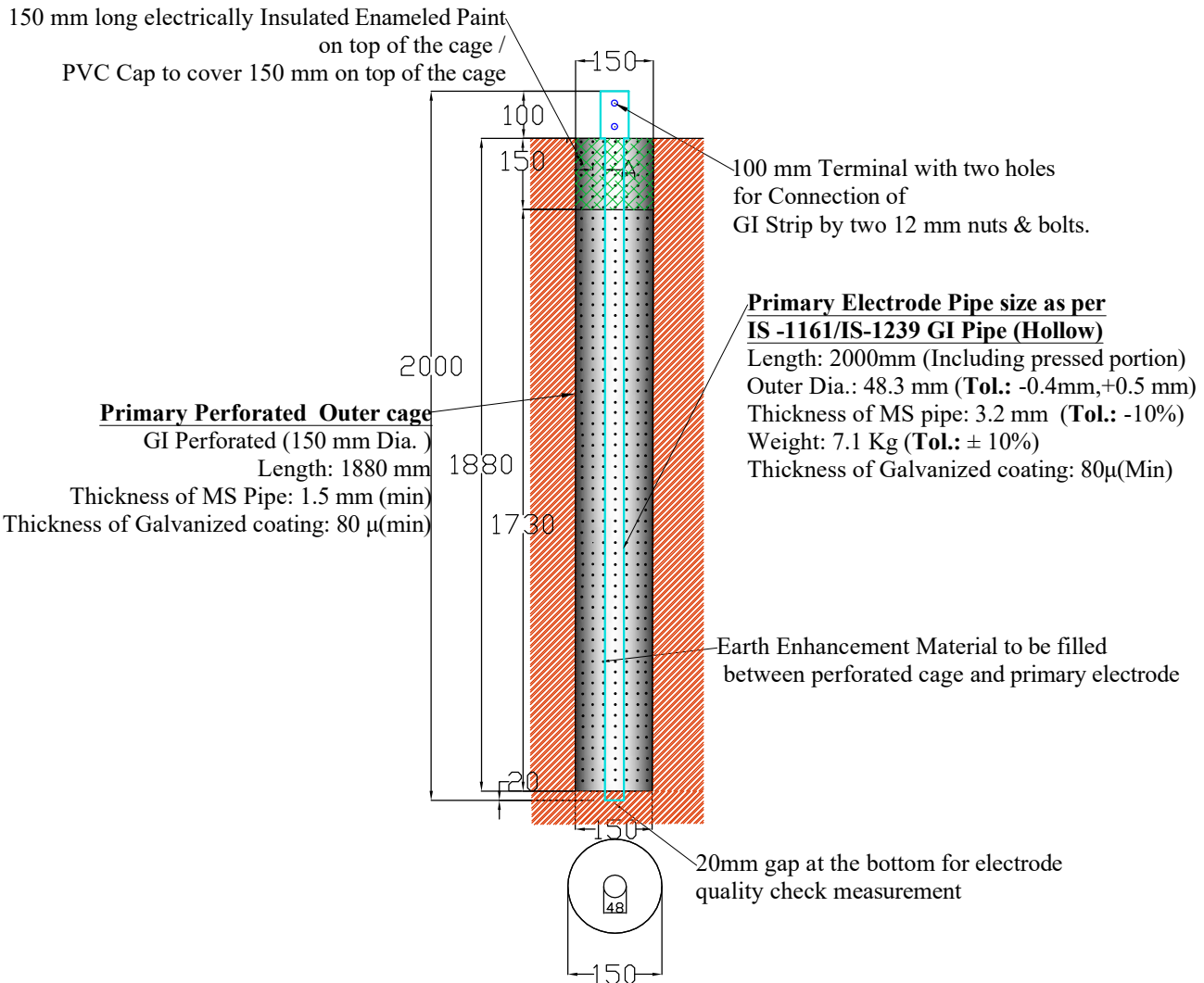
(List of Testing Equipment/Machinery Required from the bidders)

Sr. No.	Name of Equipment	Technical Requirement	Deviation (Yes/No) (Mentioned detail, If any)
1	Soil Box	Designed in compliance with standard ASTM G57	
2	Digital Vernier Calipers*	Range : 0-200mm LCD Resolution : 01mm Accuracy : $\pm 0.02\text{mm}$	
3	Digital Micrometer Screw gauge*	Range : 0-25mm Accuracy : $\pm 2\mu\text{m}$ Type : With ratchet stop	
4	Digital Weighing scale*	Range : 10 g to 100 kg Precision : 10gram Weighing platform : 300x300mm wide	
5	Steel Scale*/ Measuring Tape*	Range : 1 cm-1000cm Precision : 1 cm	
6	Coating thickness tester*	Measuring Ranges: Ferrous/Non-ferrous : 0 ~ 1000um; Guaranteed Tolerance: Ferrous: $\pm 3\% + 1\mu\text{m}$; Non-ferrous: $\pm 3\% + 1.5\mu\text{m}$ Precision: Ferrous/Non-ferrous: 0.1um.	
7	Digital Professional Earth Test Kit*	4-Pole Professional Earth test kit Company provided 30-meter reels, spikes, Test leads, etc. of Megger, Chauvin Arnoux or fluke make. Accuracy : $\pm 2\%$ or better.	

* All instruments having valid Company provided calibration certificate (In case of newly purchased equipment) or NABL accredited calibration certificate of 1 year or later should only be considered valid. Brochure to be provided along with the bid.

Drawing No.: GPRD-16 (Rev.1)

Maintenance Free, Eco-Friendly Ready Capsule - Pipe in Cage type 2000 mm Earthing



Gujarat Power Research & Development Cell, GUVNL, Gandhinagar

Project : Maintenance Free, Eco-Friendly Ready Capsule - Pipe in Cage type 2000 mm Earthing

Prepared By: H.M.Sakariya, JE (R&D)

Date : 09/03/2021

Checked By : D.R.Shah, DE (R&D)

Revision : 1

Approved By : R B Patel, SE (R&D)

Scale: N.T.S.

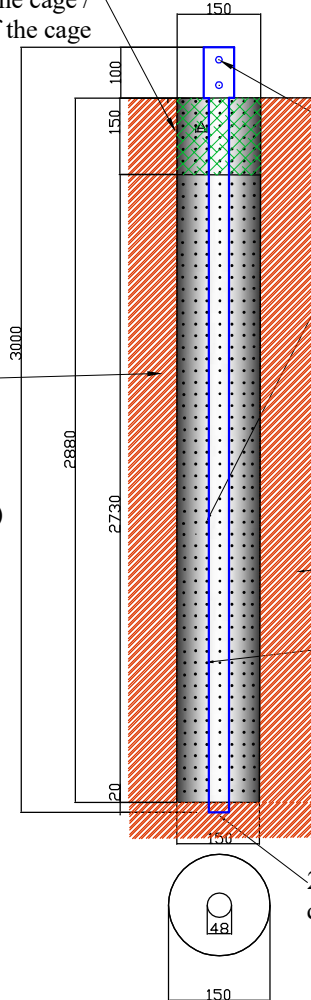
Drawing No.: GPRD-17 (Revision:1)

Maintenance Free, Eco-Friendly Ready Capsule - Pipe in Cage type 3000 mm Earthing

150 mm long electrically Insulated Enameled Paint
on top of the cage /
PVC Cap to cover 150 mm on top of the cage

Perforated Outer cage

GI Perforated (150 mm Dia.)
Length: 2880 mm
Thickness of MS Pipe: 1.5 mm (min)
Thickness of Galvanized coating: 80 µ(min)



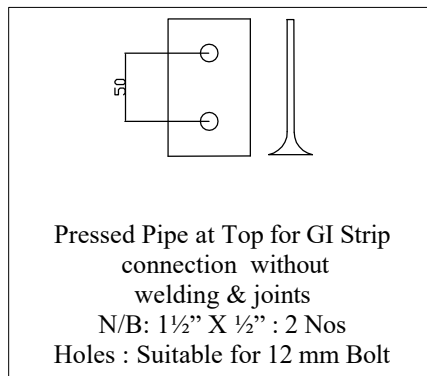
Primary Electrode Pipe size as per IS -1161/IS-1239 GI Pipe (Hollow)

Length: 3000mm (Including pressed portion)
Outer Dia.: 48.3 mm (Tol.: -0.4mm,+0.5 mm)
Thickness of MS pipe: 3.2 mm (Tol.: -10%)
Weight: 10.6 Kg (Tol.: ± 10%)
Thickness of Galvanized coating: 80µ(Min)

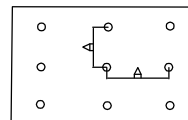
Mother Soil

Earth Enhancement Material to be filled
between perforated cage and primary electrode

20mm gap at the bottom for electrode
quality check measurement



Pressed Pipe at Top for GI Strip
connection without
welding & joints
N/B: 1 1/2" X 1/2" : 2 Nos
Holes : Suitable for 12 mm Bolt



Perforated Cage Holes
A = 45 to 70 mm
distance between holes
(Horizontally and vertically)



Gujarat Power Research & Development Cell, GUVNL, Gandhinagar

Project : Maintenance Free, Eco-Friendly Ready Capsule - Pipe in Cage type 3000 mm Earthing

Prepared By: H.M.Sakariya, JE (R&D)

[Signature]

Date : 09/03/2021

Checked By : D.R.Shah, DE (R&D)

[Signature]

Revision : 1

Approved By : R B Patel, SE (R&D)

[Signature]

Scale: N.T.S.

DGVCL - Proposed changes in all ready approved technical specification for Maintenance free, Ready Capsule, Pipe-in-Cage (PiC) type earthing system

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes	GPRD's Comment
1	Part-A (4-c)	It is proposed in the revised technical specifications that the enameled paint coating should have minimum Dielectric strength-20 KV/mm & minimum 4 coat should be applied to the surface of the electrode.	It is suggested to define thickness of electrically insulated enameled paint in microns	For verification and quality assurance instead of minimum 4 coat for safety aspects.	Incorporated
2	Part-B (e)	The connection from earthing Electrode to various network equipment, transformer body, transformer neutral, fabrication of pole and T/C structure, lightning Arrestors by way of using mandatorily 25x3 mm GI strip, Nut-bolts and rigid PVC pipe shall be done	Generally, the GI strip of 25 mm*3mm available in 6 Meter length, therefore there will be joints in GI strips for connections of earthing electrode to various network. The GI strip is not so flexible compare to PVC/XLPE insulated circular stranded Aluminum cable, therefore it is not convenient to lay GI strip to various network points with bending positions compare to PVC/XLPE insulated circular stranded Aluminum cable.	It is easy to provide PVC/XLPE insulated circular stranded Aluminum cable in rigid PVC pipe of round shape compare to GI strip in rigid pipe.	As per REC drawing, 8 SWG wire is having cross section area of $\sim 52 \text{ mm}^2$ recommended whereas we have proposed 25 x 3 mm GI Strip having cross section area of 75 mm^2 to carry the fault current.

**MGVCL - Proposed changes in all ready approved technical specification for Maintenance free,
Ready Capsule, Pipe-in-Cage (PiC) type earthing system**

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes	GPRD's Comment
1	4.0 Earth Electrode	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.	The outer cage of the GI pipe shall be provided with a maximum of 3.5 mm $\pm 10\%$ dia holes and shall be hot-dip galvanized with a minimum of 80 microns.	Tolerance in hole dia. of outer cage is $\pm 10\%$ as mentioned in revised specification.	Incorporated
2	4.0 (a) Dimensions: Perforated Cage	I. Dimensions:- a) 1880 mm X 150 mm for 2000 mm Electrode b) 2880 mm X 150 mm for 3000 mm Electrode	II. Dimensions:- a) 1880 mm (L) X 150 mm (ϕ) for 2000 mm Electrode b) 2880 mm (L) X 150 mm (ϕ) for 3000 mm Electrode (Tolerance in Length (-1%, + not limited))	Dimensions for cylindrical cage shall be mentioned in terms of Length & Diameter. Tolerance in length of cage shall be specified in line with the tolerance of electrode.	Incorporated
3	6.0 (B) Routine Test	The supplier has to submit following routine test certificate. The routine test certificate is to be provided for each and every sample and is to be submitted along with the submission of sample.	The supplier has to submit following routine test certificate. The routine test certificate is to be provided for each and every sample and is to be submitted along with the submission of sample at the time of lot inspection to the inspector of DISCOM.	Routine test results for each & every unit shall be produced at the time of lot inspection.	Incorporated
4	6.0 (C) Table for Acceptance Test Sr. No. 1	Remarks: All things should be permanently embossed with the clearly visible stamping on the connecting terminal and/or top flat plate of Cage for each sample	Remarks: All things should be permanently embossed / punched with the clearly visible stamping on the connecting terminal and/or top flat plate of Cage for each sample	Embossing/ punching shall be allowed as per Cl. No. 4.0 (f)	Incorporated

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes	GPRD's Comment
5	6.0 (C) Table for Acceptance Test Sr. No. 2B	For 2000 mm Electrode Length (L): 1900 mm (pipe) + 100 mm (terminal)=3000mm (Tolerance : -1%, + not limited)	For 2000 mm Electrode Length (L): 1900 mm (pipe) + 100 mm (terminal)=3000 2000mm (Tolerance : -1%, + not limited)	Typographical error	Incorporated
6	6.0 (C) Table for Acceptance Test Sr. No. 3	I. Galvanized Perforated cage for Earthing :- a) 2880 mm X 150 mm for 3000 mm electrode b) 1880 mm X 150 mm for 2000 mm electrode	I. Galvanized Perforated cage for Earthing :- a) 2880 mm (L) X 150 mm (Ø) (min.) for 3000 mm electrode b) 1880 mm (L) X 150 mm (Ø) (min.) for 2000 mm electrode (Tolerance in Length (-1%, + not limited))	As per above Sr. No. 2	Incorporated
7	6.0 (C) Table for Acceptance Test Sr. No. 3	GI Strip: GI Strip dimensions (L x B x H) in mm GI strip coating (in µ)	GI Strip: 25mm wide, 3mm thick, zinc coating 80-100 microns GI Strip dimensions (L x B x H) in mm GI strip coating (in µ)	To specify the dimensions of GI strip	Incorporated
8	7.0 GTP Sr. No. 2	Galvanized Perforated cage for Earthing :- a) 2880 mm X 150 mm for 3000 mm electrode b) 1880 mm X 150 mm for 2000 mm electrode	Galvanized Perforated cage for Earthing :- a) 2880 mm (L) X 150 mm (Ø) (min.) for 3000 mm electrode b) 1880 mm (L) X 150 mm (Ø) (min.) for 2000 mm electrode (Tolerance in Length (-1%, + not limited))	As per above Sr. No. 2	Incorporated

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes	GPRD's Comment
9	7.0 GTP Sr. No. 3	Zinc Coating on an Electrode Galvanizing on the main electrode (in micron):- Galvanizing on the Perforated cage (in micron):-	Zinc Coating on an Electrode Galvanizing on the main electrode (in micron) 80 microns min.: Galvanizing on the Perforated cage (in micron) 80 microns min.:-	Requirement of Zinc coating must be specified in GTP	Incorporated
10	7.0 GTP Sr. No. 3	Dimensions of Rigid PVC Pipe (Sunlight protected):- a) Outside Diameter : 40 mm (tolerance:- -0.4 mm) b) Inside Diameter: 34.4 mm (Min.) (Heavy Duty)	Dimensions of Rigid PVC Pipe (Sunlight protected):- a) Outside Diameter : 40 mm (tolerance:- -0.4 mm) b) Inside Diameter: 34.4 mm (Min.) (Heavy Duty) c) BIS marking of IS 9537 on pipe	To incorporate requirement BIS marking of PVC rigid pipe	Incorporated
PART-B					

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes	GPRD's Comment
1	1.0 Scope	This specification covers Installation, Testing and commissioning of maintenance-free, Ready Capsule, Pipe-in-cage type earthing system and other relevant accessories (Like GI Strip, PVC Pipe, Nut-Bolts, Name-plate, etc.) with good standard of workmanship and following guidelines mentioned in IS:3043 and relevant REC standard. The scope also covers to write the measurement reading of testing of earth pit resistance and soil resistivity and other parameters as mentioned on the FRP name plate with non-removable, permanent marker for each and every earth pit.	This specification covers carting of PiC capsules, GI strip, etc. from RSO/ Division/ Sub Division Store to the destination, Installation, Testing and commissioning of maintenance-free, Ready Capsule, Pipe-in-cage type earthing system and other relevant accessories (Like GI Strip, PVC Pipe, Nut-Bolts, Name-plate, etc.) with good standard of workmanship and following guidelines mentioned in IS:3043 and relevant REC standard. The scope also covers to write the measurement reading of testing of earth pit resistance and soil resistivity and other parameters as mentioned on the FRP name plate with non-removable, permanent marker for each and every earth pit.	To specify the scope of carting of PiC capsules.	Incorporated

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes	GPRD's Comment
2	2.0 Procedure for installation of PiC Earthing	The connection from Earthing Electrode to various network equipment, Transformer body, Transformer Neutral, fabrication of pole and T/C structure, Lightning Arrestors by way of using mandatorily by 25 x 3 mm GI strip, Nut-bolts and rigid PVC pipe shall be done.	The connection from Earthing Electrode to various network equipment, Transformer body, Transformer Neutral, fabrication of pole and T/C structure, Lightning Arrestors by way of using mandatorily by 25 x 3 mm GI strip, Nut-bolts and rigid PVC pipe shall be done. Due care shall be taken at the time of connection of GI strip with earth electrode, so that the insulated enameled paint/ PVC cap should not damage/ torn out.	To incorporate instruction as a precautionary measures.	Incorporated

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes	GPRD's Comment
3	2.0 Procedure for installation of PiC Earthing (i)	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 without any joints or welding. Joints in earthing circuit is not desirable, however if it is technically not possible to lay earthing strip without joint, in that case only, joints should be provided with minimum 2 No.s of nut bolts and it should be solidly welded. The connections from the PiC Earth electrode to the parts to which earthing is to be provided should be erected through the digging of the slot of 1 ft of depth through the soil such that the strip should not be easily exposed to the living beings. Also, in the soil, it should be inserted through the PVC pipe, and additionally, up to the minimum height of 2.5 meters from the ground level, it should be erected through the cover of the PVC Pipe supported with a pole by 5 nos of standard make cable ties as per instructions of Engineer-In-Charge.	Connections: The scope of work shall cover supply carting of PiC capsules, GI Strips, etc. from RSO/ Division/ Sub Div. Store to site, installation, and Connection of GI Strip of 25mm wide, 3mm thick, having hot-dip galvanized-zinc coating of 80-100 microns without any joints or welding. Joints in earthing circuit is not desirable, however if it is technically not possible to lay earthing strip without joint, in that case only, joints should be provided with minimum 2 No.s of nut bolts and it should be solidly welded. The connections from the PiC Earth electrode to the parts to which earthing is to be provided should be erected through the digging of the slot of 1 ft of depth through the soil such that the strip should not be easily exposed to the living beings. Also, in the soil, it should be inserted through the PVC pipe, and additionally, up to the minimum height of 2.5 meters from the ground level, it should be erected through the cover of the PVC Pipe	To eliminate scope of supply & to specify the scope of carting of PiC capsules & other materials.	Incorporated

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes	GPRD's Comment
4	2.0 Procedure for installation of PiC Earthing (j)	Dimensions of Rigid PVC Pipe (sunlight protected) :- 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.	NIL	The entire clause from PART-B (SCOPE of ERECTION, TESTING & COMMISSIONING) shall be removed and incorporated in PART-A (SCOPE of SUPPLY).	Incorporated
DRAWING					
1	Drawing No. GPRD-16 & 17 (Revision-2)	1. Dist. Between two holes in 100mm terminal= 25mm 2. Dia. of Primary Electrode in top view= 48mm	1. Dist. Between two holes in 100mm terminal= 50 mm 2. Dia. of Primary Electrode in top view= 48.3 mm	Typographical error	Incorporated

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes	GPRD's Comment
2	Drawing No. GPRD-16 (Revision-2)	Perforated Outer cage GI Perforated (150 mm Dia.) Length: 1880 mm Thickness of MS Pipe: 1.5 mm (min) Thickness of Galvanized coating: 80 μ(min	Perforated Outer cage GI Perforated (150 mm Outer Dia.) (min.) Length: 1880 mm(Tolerance (-1%, + not limited)) Thickness of MS Pipe: 1.5 mm (min) Thickness of Galvanized coating: 80 μ(min)	To incorporate tolerances in draw	Incorporated
3	Drawing No. GPRD-17 (Revision-2)	Perforated Outer cage GI Perforated (150 mm Dia.) Length: 2880 mm Thickness of MS Pipe: 1.5 mm (min) Thickness of Galvanized coating: 80 μ(min)	Perforated Outer cage GI Perforated (150 mm Outer Dia.) (min.) Length: 2880 mm(Tolerance (-1%, + not limited)) Thickness of MS Pipe: 1.5 mm (min) Thickness of Galvanized coating: 80 μ(min)	To incorporate tolerances in draw	Incorporated
		PiC Capsule Dimensions 1. Length: 2000 mm 2. Length: 1880 mm 3. Length: 1730 mm	PiC Capsule Dimensions 1. Length: 2000 3000 mm 2. Length: 1880 2880 mm 3. Length: 1730 2730 mm	Typographical error	Incorporated

**PGVCL - Proposed changes in all ready approved technical specification for Maintenance free, Ready Capsule,
Pipe-in-Cage (PiC) type earthing system**

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes	GPRD's Comment
1	7 (Page No-11)	Size of GI strip 25mm wide and 3 mm thick	Size of GI strip should be derived as per IS 3043, 12.22.1. According to IS 3043 the cross section area should be 250 sqmm. Caculation sheet is attached here with.	We have mentioned short circuit level of 20 KA for 1 Sec hence GI strip should be capable to withstand this fault current. After installation, in case of breaking of GI strip, it will be not replaced and costly earthing will be useless.	As per REC drawing, 8 SWG wire is having cross section area of $\sim 52 \text{ mm}^2$ recommended whereas we have proposed 25 x 3 mm GI Strip having cross section area of 75 mm^2 to carry the fault current.
2	7 (Page No-11)	The length of GI strip which supplier has to provide per earthing is not mentioned.	The length of GI strip required per earthing should be decided for TC earthing. The drawing showing PiC earthing provided to TC should be prepared.	It is required to decide amount of work order and to make uniform practise.	The length of GI Strip varies on various electrical apparatus i.e. switch, RMU, TC, Pole, FSP/MSP. Hence, based on requirement DISCOM may decide the suitable length for specific installation.
3	5 (i)	In soil box test, Distance between C1 and C2 is not mentioned and length of lead from meter to soil box is not mentioned.	Distance between C1 to C2 should be mentioned and length of lead should be mentioned.	To avoid confusing during inspection.	Distance between C1-C2 is not mentioned in ASTM G59 standard because it doesn't affect the test result.
4	6 ©	Weight of EEM is not mentioned	Weight of EEM should be mentioned	The most costly item in PiC hence it should be verified	Incorporated
5	4.0 (a)	Thickness of top and bottom plate provided to cage is not mentioned	It should be mentioned that thickness of top and bottom plate should be 1.5 mm.	To avoid confusing during inspection and to make uniform practise.	Thickness of 1.5 mm for outer perforated cage is already mentioned and hence upper and bottom plate are having same thickness.
6	Part (B) 3 (b)	The minimum value of Earth Pit Resistance is not mentioned	After installtion the value of Earth Pit Resistance should be derived from soil resistivity, length & radius of earthing rod as per IEEE 142:1991 OR as per IEEE 80.	After installation it is required to cross verify the value of resistance because after inspection of PiC at supplier's premises, it may be possible to change or remove costly EEM from PiC cage.	As per Electrical inspector letter to CE(Tech), GUVNL vide Ref. No. CEI/INS/GUVNL/2019/1828 dated: 15-05-2019, acceptable ohmic value of earthing cannot be specified in absolute terms.
7	GPRD-17 revised drawing	Drawing of 3000 mm rod and length mentioned is 2000 mm.	it should be as per 3000 mm.	Typographical error.	Incorporated

UGVCL

Uttar Gujarat Vij Company Ltd.

CIN - U40102GJ2003SGC042906

No: UGVCL/R&C/QC Cell /TS/Tech. Specification/PIC Earthing/ 229

Date: 08/02/2022

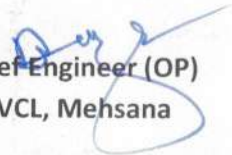
To,
The Supdt. Engineer (R&D)
GPRD Cell,
IIT Gandhinagar Research Park,
Palaj-382355
Dist. Gandhinagar

Sub: - Technical Specification & Drawing for "Maintenance free, Raedy capsule, Pipe-in-cage (PIC) type Earthing for HT/LT Distribution network" prepared by GPRD Cell.

Ref.:- GPRD Cell Letter No. GUVNL/GPRD/RP041/PIC Earthing/Tech Specs/485 Dtd 28.12.2021

With reference to the above cited subject and reference letter received from GPRD Cell under GUVNL for making common Technical Specification & Drawing of **"Maintenance free, Raedy capsule, Pipe-in-cage (PIC) type Earthing for HT/LT Distribution network"** prepared by GPRD Cell for all DISCOMs. We hereby confirm & recommend of the Technical Specification & Draing for **"Maintenance free, Raedy capsule, Pipe-in-cage (PIC) type Earthing for HT/LT Distribution network"** prepared by GPRD Cell vide above reference letters.

This is for your kind information and needful action.


Chief Engineer (OP)
UGVCL, Mehsana

Copy to:

- The Chief Engineer (Tech), GUVNL, Vadodara.
- The Chief Engineer (P), UGVCL, Mehsana.

Regd. & Corporate Office: Visnagar Road, MEHSANA - 384 001 (North Gujarat)

Telephone: (02762) 222080-81

Website: www.ugvcl.com

Fax: (02762) 223574

e-mail: ceop@ugvcl.com

MGVCL

MADHYA GUJARAT VIJ COMPANY LTD.

Regd. Office : Sardar Patel Vidyut Bhavan,
Race Course, Vadodara - 390 007.

Tele: PBX : 2310582 to 86

FAX: 0265 - 2337918/2338164

Email : cetech.mgvcl@gebmil.com/detech4.mgvcl@gebmil.com

CIN No. U40102GJ2003GCO42907



No: MGVCL/Tech/ 1676

Dt. 27-08-2021

Email: guvnlrnd@gprd.in

To,
The Superintending Engineer (R&D)
Gujarat Power Research & Development Cell,
IIT Gandhinagar Research Park, IIT Gandhinagar
Palaj- 382355, Gandhinagar, Gujarat

Sub.: Reviews for amendment of Technical Specification for Maintenance free, Ready capsule, Pipe-in-Cage (PiC) type earthing for HT/LT Distribution network.

Ref.: 1. Review meeting of all DISCOMs held on Dt. 10.08.2021
2. Revised draft Technical Specification & Drawings of Maintenance Free Ready Capsule PiC type earthing received through Email dated 13.08.2021 from GPRD Cell

This has reference to the views/ comments/ suggestions in respect of revised draft Technical Specification and Drawings, prepared based on the meeting held on Dt. 10.08.2021 for amendment in Technical Specification for maintenance Free, Ready Capsule, Pipe-in-cage (PiC) type earthing, asked by GPRD Cell submitted vide above referred email under ref. (2).

Going through the revised draft Specification & drawings, MGVCL hereby confirms the revised Technical Specification & Drawings of Maintenance free, Ready capsule, Pipe-in-Cage (PiC) type earthing subject to some of the views/ suggestions/ comments/ corrections as per "Annexure-A" enclosed herewith to be incorporated in the revised draft Technical Specification & drawings.

This is for your kind information and further needful please.


Chief Engineer (T & O)
MGVCL

Encl. As Above

Copy F.W. Cs to,
1. ETA to MD, Corporate Office, MGVCL
2. CE (Tech), GUVNL, Corporate Office

TO,
Sh. DRS & HMS.

For n-a, R.

 15/09



Changes suggested in proposed modified Technical Specification & Drawing of Maintenance free, Ready Capsule, Pipe-in-cage (PiC) type earthing system

PART-A

Sr. No.	Cl. No.	Clause in revised Technical Specification	Proposed Suggestion/ Comment	Justification
1	4.0 Earth Electrode	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.	The outer cage of the GI pipe shall be provided with a maximum of 3.5 mm $\pm 10\%$ dia holes and shall be hot-dip galvanized with a minimum of 80 microns.	Tolerance in hole dia. of outer cage is $\pm 10\%$ as mentioned in revised specification.
2	4.0 (a) Dimensions: Perforated Cage	I. Dimensions:- a) 1880 mm X 150 mm for 2000 mm Electrode b) 2880 mm X 150 mm for 3000 mm Electrode	II. Dimensions:- a) 1880 mm (L) X 150 mm (ϕ) for 2000 mm Electrode b) 2880 mm (L) X 150 mm (ϕ) for 3000 mm Electrode (Tolerance in Length (-1%, + not limited))	Dimensions for cylindrical cage shall be mentioned in terms of Length & Diameter. Tolerance in length of cage shall be specified in line with the tolerance of electrode.
3	6.0 (B) Routine Test	The supplier has to submit following routine test certificate. The routine test certificate is to be provided for each and every sample and is to be submitted along with the submission of sample.	The supplier has to submit following routine test certificate. The routine test certificate is to be provided for each and every sample and is to be submitted along with the submission of sample at the time of lot inspection to the inspector of DISCOM.	Routine test results for each & every unit shall be produced at the time of lot inspection.
4	6.0 (C) Table for Acceptance Test Sr. No. 1	Remarks: All things should be permanently embossed with the clearly visible stamping on the connecting terminal and/or top flat plate of Cage for each sample	Remarks: All things should be permanently embossed / punched with the clearly visible stamping on the connecting terminal and/or top flat plate of Cage for each sample	Embossing/ punching shall be allowed as per Cl. No. 4.0 (f)
5	6.0 (C) Table for Acceptance Test Sr. No. 2B	For 2000 mm Electrode Length (L): 1900 mm (pipe) + 100 mm (terminal)=3000mm (Tolerance : -1%, + not limited)	For 2000 mm Electrode Length (L): 1900 mm (pipe) + 100 mm (terminal)=3000 2000mm (Tolerance : -1%, + not limited)	Typographical error

6	6.0 (C) Table for Acceptance Test Sr. No. 3	I. Galvanized Perforated cage for Earthing :- a) 2880 mm X 150 mm for 3000 mm electrode b) 1880 mm X 150 mm for 2000 mm electrode	I. Galvanized Perforated cage for Earthing :- a) 2880 mm (L) X 150 mm (Ø) (min.) for 3000 mm electrode b) 1880 mm (L) X 150 mm (Ø) (min.) for 2000 mm electrode (Tolerance in Length (-1%, + not limited)) GI Strip: 25mm wide, 3mm thick, zinc coating 80-100 microns GI Strip dimensions (L x B x H) in mm GI strip coating (in µ) μ_w	To specify the dimensions of GI strip
7	6.0 (C) Table for Acceptance Test Sr. No. 3	GI Strip: GI strip dimensions (L x B x H) in mm GI strip coating (in µ)	Galvanized Perforated cage for Earthing :- a) 2880 mm (L) X 150 mm (Ø) (min.) for 3000 mm electrode b) 1880 mm (L) X 150 mm (Ø) (min.) for 2000 mm electrode (Tolerance in Length (-1%, + not limited)) Zinc Coating on an Electrode Galvanizing on the main electrode (in micron):- Galvanizing on the Perforated cage (in micron) μ_w 80 microns min:-	As per above Sr. No. 2
8	7.0 GTP Sr. No. 2	Galvanized Perforated cage for Earthing :- a) 2880 mm X 150 mm for 3000 mm electrode b) 1880 mm X 150 mm for 2000 mm electrode	Galvanized Perforated cage for Earthing :- a) 2880 mm (L) X 150 mm (Ø) (min.) for 3000 mm electrode b) 1880 mm (L) X 150 mm (Ø) (min.) for 2000 mm electrode (Tolerance in Length (-1%, + not limited)) Zinc Coating on an Electrode Galvanizing on the main electrode (in micron) (in micron) μ_w 80 microns min:- Galvanizing on the Perforated cage (in micron) μ_w 80 microns min:-	Requirement of Zinc coating must be specified in GTP
9	7.0 GTP Sr. No. 3	Zinc Coating on an Electrode Galvanizing on the main electrode (in micron):- Galvanizing on the Perforated cage (in micron):-	Dimensions of Rigid PVC Pipe (Sunlight protected):- a) Outside Diameter : 40 mm (tolerance:- 0.4 mm) b) Inside Diameter: 34.4 mm (Min.) (Heavy Duty)	To incorporate requirement BIS marking of PVC rigid pipe
10	7.0 GTP Sr. No. 3	Dimensions of Rigid PVC Pipe (Sunlight protected):- a) Outside Diameter : 40 mm (tolerance:- 0.4 mm) b) Inside Diameter: 34.4 mm (Min.) (Heavy Duty)	Dimensions of Rigid PVC Pipe (Sunlight protected):- a) Outside Diameter : 40 mm (tolerance:- 0.4 mm) b) Inside Diameter: 34.4 mm (Min.) (Heavy Duty) c) BIS marking of IS 9537 on pipe	
PART-B				
Sr. No.	Cl. No.	Clause in revised Technical Specification	Proposed Suggestion/ Comment	Justification
1	1.0 Scope	This specification covers Installation, Testing and commissioning of maintenance-free, Ready Capsule, Pipe-in-cage type earthing system and other relevant accessories (Like GI Strip, PVC Pipe, Nut-Bolts, Name-plate, etc.) with good standard of	This specification covers carting of PiC capsules, GI strip, etc. from RSO/ Division/ Sub Division Store to the destination, Installation, Testing and commissioning of maintenance-free, Ready Capsule, Pipe-in-	To specify the scope of carting of PiC capsules.

		workmanship and following guidelines mentioned in IS:3043 and relevant REC standard. The scope also covers to write the measurement reading of testing of earth pit resistance and soil resistivity and other parameters as mentioned on the FRP name plate with non-removable, permanent marker for each and every earth pit.	cage type earthing system and other relevant accessories (i.e. GI Strip, PVC Pipe, Nut-Bolts, Name-plate, etc.) with good standard of workmanship and following guidelines mentioned in IS:3043 and relevant REC standard. The scope also covers to write the measurement reading of testing of earth pit resistance and soil resistivity and other parameters as mentioned on the FRP name plate with non-removable, permanent marker for each and every earth pit.	To incorporate instruction as a precautionary measures.
2	2.0 Procedure for installation of PiC Earthing	e) The connection from Earthing Electrode to various network equipment, Transformer body, fabrication of pole and T/C structure, Lightning Arrestors by way of using mandatorily by 25 x 3 mm GI strip, Nut-bolts and rigid PVC pipe shall be done.	e) The connection from Earthing Electrode to various network equipment, Transformer body, Transformer Neutral, fabrication of pole and T/C structure, Lightning Arrestors by way of using mandatorily by 25 x 3 mm GI strip, Nut-bolts and rigid PVC pipe shall be done. Due care shall be taken at the time of connection of GI strip with earth electrode, so that the insulated enameled paint/ PVC cap should not damage/ torn out.	To eliminate scope of supply & to specify the scope of carting of PiC capsules & other materials.
3	2.0 Procedure for installation of PiC Earthing (i)	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 without any joints or welding. Joints in earthing circuit is not desirable, however if it is technically not possible to lay earthing strip without joint, in that case only, joints should be provided with minimum 2 No.s of nut bolts and it should be solidly welded. The connections from the PiC Earth electrode to the parts to which earthing is to	Connections: The scope of work shall cover supply carting of PiC capsules, GI Strips, etc. from RSO/ Division/ Sub Div. Store to site, installation, and Connection of GI Strip of 25mm wide, 3mm thick, having hot-dip galvanized-zinc coating of 80-100 microns without any joints or welding. Joints in earthing circuit is not desirable, however if it is technically not possible to lay earthing strip without joint, in that case only, joints should be provided with minimum 2 No.s of nut bolts and it should be solidly welded. The connections from the PiC Earth electrode to the parts to which earthing is to	

		be provided should be erected through the digging of the slot of 1 ft of depth through the soil such that the strip should not be easily exposed to the living beings. Also, in the soil, it should be inserted through the PVC pipe, and additionally, up to the minimum height of 2.5 meters from the ground level, it should be erected through the cover of the PVC Pipe supported with a pole by 5 nos of standard make cable ties as per instructions of Engineer-In-Charge.	be provided should be erected through the digging of the slot of 1 ft of depth through the soil such that the strip should not be easily exposed to the living beings. Also, in the soil, it should be inserted through the PVC pipe, and additionally, up to the minimum height of 2.5 meters from the ground level, it should be erected through the cover of the PVC Pipe supported with a pole by 5 nos of standard make cable ties as per instructions of Engineer-In-Charge.	The entire clause from PART-B (SCOPE of ERECTION, TESTING & COMMISSIONING) shall be removed and incorporated in PART-A (SCOPE of SUPPLY).
4	2.0 Procedure for installation of PIC Earthing (j)	j) Dimensions of Rigid PVC Pipe (sunlight protected) :- 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.		

DRAWING

Sr. No.	Drg. No.	Dimensions in Revised Drawing	Proposed Suggestion/ Comment	Justification
1	Drawing No. GPRD-16 & 17 (Revision-2)	1. Dist. Between two holes in 100mm terminal= 25mm 2. Dia. of Primary Electrode in top view= 48mm	1. Dist. Between two holes in 100mm terminal= 50 mm 2. Dia. of Primary Electrode in top view= 48.3 mm	Typographical error

2	Drawing No. GPRD-16 (Revision-2)	<u>Perforated Outer cage</u> GI Perforated (150 mm Dia.) Length: 1880 mm Thickness of MS Pipe: 1.5 mm (min) Thickness of Galvanized coating: 80 µ(min)	<u>Perforated Outer cage</u> GI Perforated (150 mm Dia.) (min.) Length: 1880 mm (Tolerance (-1%, + not limited)) Thickness of MS Pipe: 1.5 mm (min) Thickness of Galvanized coating: 80 µ(min)	To incorporate tolerances in drawing
3	Drawing No. GPRD-17 (Revision-2)	<u>Perforated Outer cage</u> GI Perforated (150 mm Dia.) Length: 2880 mm Thickness of MS Pipe: 1.5 mm (min) Thickness of Galvanized coating: 80 µ(min)	<u>Perforated Outer cage</u> GI Perforated (150 mm Dia.) (min.) Length: 2880 mm (Tolerance (-1%, + not limited)) Thickness of MS Pipe: 1.5 mm (min) Thickness of Galvanized coating: 80 µ(min)	To incorporate tolerances in drawing
		<u>PIC Capsule Dimensions</u> 1. Length: 2000 mm 2. Length: 1880 mm 3. Length: 1730 mm	<u>PIC Capsule Dimensions</u> 1. Length: 2000 3000 mm 2. Length: 1880 2880 mm 3. Length: 1730 2730 mm	Typographical error

N.B.:

1. It shall be clarified in the **Cl. No. 4.0 (g)** that, the tests on tender samples will be carried out by DISCOMs at their own committee level or at any NABL/ Govt. approved lab at their own discretion.
2. It is mentioned to conduct destructive test on the samples of PIC capsules selected randomly from the offered lot. However, the accounting of the samples undergone destructive testing must be decided uniformly, i.e. whether such samples would be considered among the offered lot or otherwise to avoid further ambiguities.
3. Requirement of back filling EEM compound composition as per Cl. No. 5.0 (b) shall be incorporated in GTP to make it guaranteed from the bidders.

	MADHYA GUJARAT VIJ COMPANY LTD. Regd. Office : Sardar Patel Vidyut Bhavan, Race Course, Vadodara - 390 007. Tele: PBX : 2310582 to 86 FAX: 0265 - 2337918/2338164 Email : cetech.mgvcl@gebmil.com/detech4.mgvcl@gebmil.com CIN No.U40102GJ2003GCO42907	
---	---	---

No: MGVCL/Tech/ 1191

Dt. 30.07.2021

Email: guvnlrnd@gprd.in

To,
The Superintending Engineer (R&D)
Gujarat Power Research & Development Cell,
IIT Gandhinagar Research Park, IIT Gandhinagar
Palaj- 382355, Gandhinagar, Gujarat

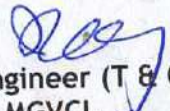
Sub.: Reviews for amendment of Technical Specification for Maintenance free, Ready capsule, Pipe-in-Cage (PiC) type earthing for HT/LT Distribution network.

Ref.: GUVNL/GPRD/PiC Tech Specs/RP-041-Tech Specs/419; Dtd. 16.07.2021

This has reference to the views/ comments/ suggestions and concurrence/ confirmation in respect of modified Technical Specification and Drawings asked by GPRD Cell submitted vide above referred letter.

Going through the various modified clauses and its relevant annexure, MGVCL hereby confirms the modified Technical Specification & Drawings of Maintenance free, Ready capsule, Pipe-in-Cage (PiC) type earthing subject to some of the views/ suggestions/ comments as per "Annexure-A" enclosed herewith to be incorporated in the modified Technical Specification.

This is for your kind information and further needful please.


 Chief Engineer (T & O)
 MGVCL

Encl. As Above

Copy F.W. Cs to,
1. ETA to MD, Corporate Office, MGVCL
2. CE (Tech), GUVNL, Corporate Office

Changes suggested in proposed modified Technical Specification & Drawing of Maintenance free, Ready Capsule, Pipe-in-cage (PiC) type earthing system

Sr. No.	Cl. No.	Clause in modified Technical Specification	Proposed Suggestion/ Comment	Justification
1	1.0 Scope	This specification is prepared keeping in view of turnkey based tender/contract, however, part of this specification may be utilized separately for preparing tender of (1) supply of earthing electrode at store after due inspection and (2) Installation and testing after installation as per guidelines given in the specification.	The Technical Specification for supply part & erection (with testing) part of PiC type earthing shall be prepared/ segregated separately.	To have more clarity about scope of work covered exclusively under supply part & erection part including Guarantee clauses for both and to facilitate DISCOMs to invite tenders for supply and/or erection of PiC type earthing separately as per their requirement in order to attain uniform practice among all DISCOMs.
2	4.0 (a) Dimensions	Primary Electrode: I. Outer Diameter (Ø): 48 mm (hollow) (Minimum) II. Thickness (t): 3.2 mm (Min.) with hot -dip galvanized up to 80 microns III. Weight of electrode: To be followed according to limit specified in IS	Primary Electrode: I. Nominal Bore: 40mm II. Outer Diameter (Ø): 48 mm (hollow) (Minimum) (47.9mm – 48.8mm). III. Thickness (t): 3.2 mm (Min.) (-10%) with hot -dip galvanized up to 80 microns (minimum) IV. Weight of electrode: To be followed according to limit specified in IS	To incorporate uniform tolerances as per the inspection table in Cl. No. 7 and Revised Drawings. Also to mention the designation of steel tube in terms of Nominal Bore to ascertain its various dimensions & tolerances according to IS 1161 & IS 1239.
3	6.0 Procedure of installing Earth Electrode	Perforated Cage: III. Thickness of Perforated Cage: 1.5 mm (min.) with hot-dip galvanized of 80 microns (d) The connection from Earthing Electrode to various network equipment, Transformer body, Transformer Neutral, fabrication of pole and T/C structure, Lightning Arrestors by way of using Nut-bolts and rigid PVC pipe shall be given as per the specification of DISCOMs.	Perforated Cage: III. Thickness of Perforated Cage: 1.5 mm (min.) with hot-dip galvanized of 80 microns (minimum) (d) The connection from Earthing Electrode to various network equipment, Transformer body, Transformer Neutral, fabrication of pole and T/C structure, Lightning Arrestors By way of using GI Strip (25x3mm), Nut-bolts and rigid PVC pipe shall be given as per the specification of DISCOMs.	To have more clarification in the clause.

4	7.0	Inspection	<table><tr><td colspan="2">b. Inspection table: Technical Particular: Electrode Sr. No. 1</td></tr><tr><td><table><tr><td colspan="2">Electrode: (Confirming to IS: 1161-2014/IS 1239)</td></tr><tr><td colspan="2">(a) For 3000 mm Electrode</td></tr><tr><td>Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 10.6 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr><tr><td colspan="2">(b) For 2000 mm Electrode</td></tr><tr><td>Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 7.1 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr></table></td></tr></table>	b. Inspection table: Technical Particular: Electrode Sr. No. 1		<table><tr><td colspan="2">Electrode: (Confirming to IS: 1161-2014/IS 1239)</td></tr><tr><td colspan="2">(a) For 3000 mm Electrode</td></tr><tr><td>Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 10.6 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr><tr><td colspan="2">(b) For 2000 mm Electrode</td></tr><tr><td>Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 7.1 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr></table>	Electrode: (Confirming to IS: 1161-2014/IS 1239)		(a) For 3000 mm Electrode		Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)		Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)		Thickness (t): 3.2 mm (Min) (- 10 %)		Weight of electrode: 10.6 (Kg.) At least (± 10 %)		Cross section Area : 4.53 cm ²		(b) For 2000 mm Electrode		Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)		Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)		Thickness (t): 3.2 mm (Min) (- 10 %)		Weight of electrode: 7.1 (Kg.) At least (± 10 %)		Cross section Area : 4.53 cm ²		<table><tr><td colspan="2">b. Inspection table: Technical Particular: Electrode Sr. No. 1</td></tr><tr><td><table><tr><td colspan="2">Electrode: (Confirming to IS: 1161-2014/IS 1239: NB=40mm)</td></tr><tr><td colspan="2">(a) For 3000 mm Electrode</td></tr><tr><td>Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 10.6 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr><tr><td colspan="2">(b) For 2000 mm Electrode</td></tr><tr><td>Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 7.1 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr></table></td><td></td></tr></table>	b. Inspection table: Technical Particular: Electrode Sr. No. 1		<table><tr><td colspan="2">Electrode: (Confirming to IS: 1161-2014/IS 1239: NB=40mm)</td></tr><tr><td colspan="2">(a) For 3000 mm Electrode</td></tr><tr><td>Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 10.6 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr><tr><td colspan="2">(b) For 2000 mm Electrode</td></tr><tr><td>Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 7.1 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr></table>	Electrode: (Confirming to IS: 1161-2014/IS 1239: NB=40mm)		(a) For 3000 mm Electrode		Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)		Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)		Thickness (t): 3.2 mm (Min) (- 10 %)		Weight of electrode: 10.6 (Kg.) At least (± 10 %)		Cross section Area : 4.53 cm ²		(b) For 2000 mm Electrode		Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)		Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)		Thickness (t): 3.2 mm (Min) (- 10 %)		Weight of electrode: 7.1 (Kg.) At least (± 10 %)		Cross section Area : 4.53 cm ²		
			b. Inspection table: Technical Particular: Electrode Sr. No. 1																																																												
<table><tr><td colspan="2">Electrode: (Confirming to IS: 1161-2014/IS 1239)</td></tr><tr><td colspan="2">(a) For 3000 mm Electrode</td></tr><tr><td>Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 10.6 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr><tr><td colspan="2">(b) For 2000 mm Electrode</td></tr><tr><td>Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 7.1 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr></table>	Electrode: (Confirming to IS: 1161-2014/IS 1239)		(a) For 3000 mm Electrode		Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)		Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)		Thickness (t): 3.2 mm (Min) (- 10 %)		Weight of electrode: 10.6 (Kg.) At least (± 10 %)		Cross section Area : 4.53 cm ²		(b) For 2000 mm Electrode		Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)		Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)		Thickness (t): 3.2 mm (Min) (- 10 %)		Weight of electrode: 7.1 (Kg.) At least (± 10 %)		Cross section Area : 4.53 cm ²																																						
Electrode: (Confirming to IS: 1161-2014/IS 1239)																																																															
(a) For 3000 mm Electrode																																																															
Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)																																																															
Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)																																																															
Thickness (t): 3.2 mm (Min) (- 10 %)																																																															
Weight of electrode: 10.6 (Kg.) At least (± 10 %)																																																															
Cross section Area : 4.53 cm ²																																																															
(b) For 2000 mm Electrode																																																															
Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)																																																															
Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)																																																															
Thickness (t): 3.2 mm (Min) (- 10 %)																																																															
Weight of electrode: 7.1 (Kg.) At least (± 10 %)																																																															
Cross section Area : 4.53 cm ²																																																															
b. Inspection table: Technical Particular: Electrode Sr. No. 1																																																															
<table><tr><td colspan="2">Electrode: (Confirming to IS: 1161-2014/IS 1239: NB=40mm)</td></tr><tr><td colspan="2">(a) For 3000 mm Electrode</td></tr><tr><td>Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 10.6 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr><tr><td colspan="2">(b) For 2000 mm Electrode</td></tr><tr><td>Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)</td><td></td></tr><tr><td>Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)</td><td></td></tr><tr><td>Thickness (t): 3.2 mm (Min) (- 10 %)</td><td></td></tr><tr><td>Weight of electrode: 7.1 (Kg.) At least (± 10 %)</td><td></td></tr><tr><td>Cross section Area : 4.53 cm²</td><td></td></tr></table>	Electrode: (Confirming to IS: 1161-2014/IS 1239: NB=40mm)		(a) For 3000 mm Electrode		Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)		Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)		Thickness (t): 3.2 mm (Min) (- 10 %)		Weight of electrode: 10.6 (Kg.) At least (± 10 %)		Cross section Area : 4.53 cm ²		(b) For 2000 mm Electrode		Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)		Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)		Thickness (t): 3.2 mm (Min) (- 10 %)		Weight of electrode: 7.1 (Kg.) At least (± 10 %)		Cross section Area : 4.53 cm ²																																						
Electrode: (Confirming to IS: 1161-2014/IS 1239: NB=40mm)																																																															
(a) For 3000 mm Electrode																																																															
Length (L): 2900mm(pipe)+100mm(terminal)=3000 mm (Min)																																																															
Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)																																																															
Thickness (t): 3.2 mm (Min) (- 10 %)																																																															
Weight of electrode: 10.6 (Kg.) At least (± 10 %)																																																															
Cross section Area : 4.53 cm ²																																																															
(b) For 2000 mm Electrode																																																															
Length(L): 1900mm(pipe)+100mm(terminal)=2000 mm (Min)																																																															
Outer Diameter (Ø): 48 mm (hollow) (47.9 mm - 48.8 mm)																																																															
Thickness (t): 3.2 mm (Min) (- 10 %)																																																															
Weight of electrode: 7.1 (Kg.) At least (± 10 %)																																																															
Cross section Area : 4.53 cm ²																																																															
			Since the earth electrode shall have ISI marking as per IS:1161-1979/IS:1239 according to cl. No. 4; it must be complied the tolerances mentioned in the respective IS itself.																																																												
			As per Cl. No. 5(i): Soil Box Test- Conductivity test; the resistivity of the Earth enhancement material shall <u>not be higher than 0.20 Ω-m.</u>																																																												
			As per the clarification provided by GPRD Cell vide letter no. GUVNL/GPRD/Earthing/MGVCL Pic Tender/302; Dtd. 28.09.2020. (Copy enclosed)																																																												

		earthing circuit is not desirable, however if it is technically not possible to lay earthing strip without joint, in that case only, joints should be provided with minimum Two numbers of nut bolts and it should be solidly welded).	
5	8.0 Checklist of Test Certificates to be submitted	The bidder is required to submit the test certificates as listed below, along 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) Toxic Content test on Conductive materials (RoHS Certification of non-hazardous material) b) Leachability Test c) Short Circuit Withstand Test on Earth electrodes d) PH Value Test e) Sulphur determination Test f) Granular Size of Material (Mesh Size of material) g) Corrosion Test h) PVC Pipe tests for the effect of sunlight i) Earth testing equipment brochure	To have more clarity for the test reports to be submitted by the bidders and to attain uniform practice for Technical Scrutiny among all DISCOMs and to avoid any ambiguity. To incorporate & assure quality checks for Earth electrode & Earth Enhancement material to be supplied by the bidders.
		The bidder is required to submit the test certificates as listed below, along 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) Toxic Content test on Conductive materials (RoHS Certification of non-hazardous material) b) Leachability Test as per Cl. No. 5.3 of IEC 62561-7 c) Short Circuit Withstand Test on Earth electrodes: It should be capable of withstanding short time current of 20KA (rms) for 1 second. d) PH Value Test e) Sulphur determination Test as per Cl. No. 5.3 of IEC 62561-7 f) Granular Size of Material (Mesh Size of material) g) Corrosion Test (ASTM G59-97 and ASTM G102-89) h) PVC Pipe tests for the effect of sunlight as per Cl. No. 8.5 of IS:13592 i) Earth testing equipment brochure j) Measurement of Zinc coating of Earth electrode	

		k) Earth Enhancement material composition test (As per table 5.0(b) of Specification & IEC 62561-7)	GUIDELINES FOR PROCEDURE OF INSTALLING EARTH ELECTRODE AND EARTH RESISTANCE MEASUREMENT :- 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 without any joints or welding. (joints in earthing circuit is not desirable, however if it is technically not possible to lay earthing strip without joint, in that case only, joints should be provided with minimum Two numbers of nut bolts and it should be solidly welded).	As per the clarification provided by GPRD Cell vide letter no. GUVNL/GPRD/Earthing/MGVCL PIC Tender/302; Dtd. 28.09.2020. (Copy enclosed)
6	11.0	GUIDELINES FOR PROCEDURE OF INSTALLING EARTH ELECTRODE AND EARTH RESISTANCE MEASUREMENT :- 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 without any joints or welding.	GUIDELINES FOR PROCEDURE OF INSTALLING EARTH ELECTRODE AND EARTH RESISTANCE MEASUREMENT :- 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 without any joints or welding. (joints in earthing circuit is not desirable, however if it is technically not possible to lay earthing strip without joint, in that case only, joints should be provided with minimum Two numbers of nut bolts and it should be solidly welded).	Since the earth electrode shall have ISI marking as per IS:1161-1979/IS:1239 according to cl. No. 4; it must be complied the tolerances mentioned in the respective IS itself.
7	Drawing No. GPRD-16 (Rev-1)	Primary Electrode Pipe size as per IS -1161/IS-1239 GI Pipe (Hollow) Length -2000mm (Min) (Including pressed portion) Outer Dia. - 48 mm ($\pm 10\%$) Thickness of MS pipe- 3.2 mm (Min) (+0.4mm, -0.8 mm) Weight- 7.1 Kg ($\pm 10\%$) Thickness of Galvanized coating- 80μ(Min) Perforated Outer cage GI Perforated (150 mm Dia.) Length - 1880 mm Thickness of MS Pipe - 1.5 mm (min) Thickness of Galvanized coating - 80 μ(min) Perforated Cage Holes A = 45 to 70 mm distance between holes (Horizontally and vertically)	Primary Electrode Pipe size as per IS -1161/IS-1239 GI Pipe (Hollow): NB=40mm Length -2000mm (Min) (Including pressed portion) Outer Dia. - 48 mm ($\pm 10\%$) (47.9 mm - 48.8 mm) Thickness of MS pipe- 3.2 mm (Min) (+0.4mm, - 0.8 mm) (- 10 %) Weight- 7.1 Kg ($\pm 10\%$) Thickness of Galvanized coating- 80μ(Min) Perforated Outer cage GI Perforated (150 mm Dia.) (min.) Length - 1880 mm (min.) Thickness of MS Pipe - 1.5 mm (min) Thickness of Galvanized coating - 80 μ(min) Perforated Cage Holes: Dia. 3.5mm or lesser A = 45 to 70 mm distance between holes (Horizontally and vertically)	To incorporate tolerances in various dimensions of perforated cage as mentioned in Specification Cl. No. 4(a). To incorporate tolerances in hole dia. of perforated cage as mentioned in Specification Cl. No. 4(a).

8	<u>Primary Electrode Pipe size as per IS-1161/IS-1239 GI Pipe (Hollow)</u> Length - 3000mm (Min) (Including pressed portion) Outer Dia. - 48 mm (± 10%) Thickness of MS pipe- 3.2 mm (Min) (+0.4mm, -0.8 mm) Weight- 10.6 Kg (± 10%) Thickness of Galvanized coating- 80µ(Min)	<u>Primary Electrode Pipe size as per IS-1161/IS-1239 GI Pipe (Hollow): NB=40mm</u> Length - 3000mm (Min) (Including pressed portion) Outer Dia. - 48 mm (±10%) (47.9 mm - 48.8 mm) Thickness of MS pipe- 3.2 mm (Min) (+0.4mm, - 0.8 mm) (- 10 %) Weight- 10.6 Kg (± 10%) Thickness of Galvanized coating- 80µ(Min)	Since the earth electrode shall have ISI marking as per IS:1161-1979/ IS:1239 according to cl. No. 4; it must be complied the tolerances mentioned in the respective IS itself.
Drawing No. GPRD-17 (Rev-1)	<u>Perforated Outer cage</u> GI Perforated (150 mm Dia.) Length - 2880 mm Thickness of MS Pipe - 1.5 mm (min) Thickness of Galvanized coating - 80 µ(min)	<u>Perforated Outer cage</u> GI Perforated (150 mm Dia.) (min.) Length - 2880 mm (min.) Thickness of MS Pipe - 1.5 mm (min) Thickness of Galvanized coating - 80 µ(min)	To incorporate tolerances in various dimensions of perforated cage as mentioned in Specification Cl. No. 4(a).
	<u>Perforated Cage Holes</u> A = 45 to 70 mm distance between holes (Horizontally and vertically)	<u>Perforated Cage Holes: Dia. 3.5mm or lesser</u> A = 45 to 70 mm distance between holes (Horizontally and vertically)	To incorporate tolerances in hole dia. of perforated cage as mentioned in Specification Cl. No. 4(a).

N.B.:

1. In the submitted **comparison table (Annexure-C), Clause No. 4.0 (a) Dimensions:** it is proposed for Perforated Cage (Circular Hole) dimensions as **3.5mm Dia. (±10%)**. However, the same was not incorporated in respective clauses in the modified specification and left unchanged as **3.5mm Dia. or lesser**. This creates an ambiguity in itself, which may be clarified & corrected accordingly.
2. In the modified Technical Specification Cl. No. 6.0 (e), it is mentioned that, **"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."** However specific tests for same are not clarified. Hence the **specific acceptance tests** required to be carried out during **Proto Inspection & lot inspection** must be incorporated in the modified Specification in order to have uniform practice among all DISCOMs and to avoid any further ambiguities & discrepancies.
3. **GTP** as per older Specification of PiC type earthing shall be incorporated in modified Specification also in order to attain confirmation & assurance from the bidders in respect of various technical parameters relevant to tender Specification.



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



GUVNL/GPRD /EARTHING/ MGVCCL PIC Tender/302

Date: 28.9.20

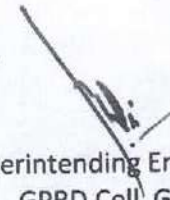
To,
The Chief Engineer (T&O),
Madhya Gujarat Vij Co Ltd.,
Sardar Patel Vidyut Bhavan,
Race Course,
Vadodara 390 007

Subject:	Invitation of tender for Turnkey Based Contract for Supply, Erection, Testing and Commissioning of "Maintenance free ready capsule, Pipe in Cage (PiC) type earthing system" at Transformer centres under Baroda City Circle – GPRD opinion thereof
Reference:	MGVCCL/ Tech/DE-2/3138 dated 25/9/2020

With reference to the above subject, point wise GPRD opinion of your above reference letter is as under

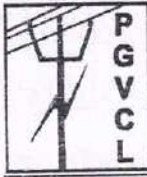
- (1) Joints in earthing circuit is not desirable, however it is technically not possible to lay earthing strip without joint in that case joints should be provided with minimum two numbers of nut bolts and it should be solidly welded.
- (2) For uniform and effective implementation of PiC earthing, it is suggested to fix centre to centre distance between two consecutive holes (horizontal and Vertical) in the range of 45 mm to 70 mm.

This is for your information and necessary action at your end please.


28/9/20
Superintending Engineer (R&D)
GPRD Cell, GUVNL
Gandhinagar

CFWCs:

- (1) The Chief Engineer (Tech), GUVNL, Vadodara



PASCHIM GUJARAT VIJ COMPANY LIMITED

REGD. & CORPORATE OFFICE:- "PASCHIM GUJARAT VIJ SEVA SADAN"
OFF NANA MAVA MAIN ROAD, LAXMINAGAR, RAJKOT-360004

CIN U40102GJ2003SGC042908

Telephone Nos:-0281-2380425/427/2360182
Email:- tech.pg@gebmil.com

Fax No:-0281-2368175
Website:-www.pgvl.com



No. PGVCL/Tech/ 71

Date: 6/1/22

By Post & E-mail : guvnlrnd@gprd.in

To,
✓ I/c. Superintending Engineer (R&D)
✓ Gujarat Power Research & Development Cell,
IIT Gandhinagar, Research Park,
IIT Gandhinagar, Palaj - 382 355,
Gandhinagar, Gujarat.

Sub:- Reviews for amendment of technical specification of "Maintenance free, ready capsule, pipe-in-cage(PiC) type earthing for HT/LT distribution network."

Ref:- Your letter No. GUVNL/GPRD/RP041/PiC Earthing/Tech Specs/485 dated 28.12.2021

With reference to above mentioned subject and subsequent to meeting of DISCOM representatives on dated 10.08.2021 for amendment / suggestion in technical specification of "Maintenance free, ready capsule, pipe-in-cage(PiC) type earthing for HT/LT distribution network."

In response to discussion please find enclosed herewith list of suggestions for further needful at your end.

This if for your information.

Chief Engineer (Tech)
PGVCL, Corporate Office,
Rajkot

Encl. As above.

CFWC's (through e-mail) to :
Chief Engineer (Tech), GUVNL Vadodara



Sh. H.M.S. & J.H.B.

CALCULATION OF CROSS SECTION AREA OF GI STRIP USE IN PIC EARTHING

As per Technical specification clause no 4 (e), the earth electrode shall be capable to withstand a minimum of 20 KA (rms) short time current for 1 sec.

According to above clause, the cross section area of Earthing conductor should be calculated as per IS 3043, 12.22.1 as below.

$$I/S = k \cdot 1/\sqrt{t}$$

Where,

S = Cross section area in square millimeter

I = Value of (ac, rms) fault current = 20 KA

t = Time in second = 1 sec

k = Material constant. = 80 in case of GI material

The Cross Section area of GI strip,

$$S = (I \cdot \sqrt{t})/k = (20000 \cdot 1)/80 = 250 \text{ sq. mm.}$$

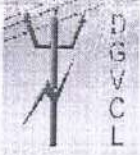
In Technical specification, the dimension of GI strip is 25 mm wide and 3mm thick (i.e. 75 sqmm) which is very less as per above calculation.

50x6 mm mm ⇒ Earth strip (majority)
→ brick suitable on site
→ Within building; substation Earthing
→ Consumer premises, tray ma GIU site
→ GI 50x6 Use sep. or sep. 50x6
→ 84x6 bare wire or sep. 95 mm (can be feasible on 2mm)

MSP / FSP ⇒ 50x6 mm strip
300 mm

Proposed changes in all ready approved technical specification for Maintenance free, Ready Capsule, Pipe-in-Cage (PiC) type earthing system

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes
1	7 (Page No-14)	Size of GI strip 25mm wide and 3 mm thick	Size of GI strip should be derived as per IS 3043, 12.22.1. According to IS 3043 the cross section area should be 250 sqmm. Calculation sheet is attached here with.	We have mentioned short circuit level of 20 KA for 1 Sec hence GI strip should be capable to withstand this fault current. After installation, in case of breaking of GI strip, it will be not replaced and costly earthing will be useless.
2	7 (Page No-14)	The length of GI strip which supplier has to provide per earthing is not mentioned.	The length of GI strip required per earthing should be decided for TC earthing. The drawing showing PIC earthing provided to TC should be prepared.	It is required to decide amount of work order and to make uniform practise.
3	5 (i)	In soil box test, Distance between C1 and C2 is not mentioned and length of lead from meter to soil box is not mentioned.	Distance between C1 to C2 should be mentioned and length of lead should be mentioned.	To avoid confusing during inspection.
4	6 ©	Weight of EEM is not mentioned	Weight of EEM should be mentioned	The most costly item in PiC hence it should be verified
5	4.0 (a)	Thickness of top and bottom plate provided to cage is not mentioned	It should be mentioned that thickness of top and bottom plate should be 1.5 mm.	To avoid confusing during inspection and to make uniform practise.
6	Part (B) 3 (b)	The minimum value of Earth Pit Resistance is not mentioned	After installation the value of Earth Pit Resistance should be derived from soil resistivity, length & radius of earthing rod as per IEEE 142:1991 OR as per IEEE 80, for small distribution transformer its value between 1 to 5 ohms.	After installation it is required to cross verify the value of resistance because after inspection of PiC at supplier's premises, it may be possible to change or remove costly EEM from PiC cage.
7	GPRD-17 revised drawing	Drawing of 3000 mm rod and length mentioned is 2000 mm.	it should be as per 3000 mm.	Typographical error.

	DAKSHIN GUJARAT VIJ COMPANY LIMITED CIN U40102GJ2003SGC042909 Regd. & CORPORATE OFFICE: "Urja Sadan" Nana Varachha Road, Kapodra Char Rasta, SURAT-395006 Telephone: (0261) 2506113/12 Website: www.dgvcl.com -mail: ceom.dgvcl@gebmail.com Fax: (0261) 2572636	
	"Save Energy for Benefit of Self and Nation"	
	Save Energy for Benefit of Self and Nation	
	Save Energy for Benefit of Self and Nation	

DGVCL/C.E.(O&M)/Tech/Earthing-PIC/Tech.Specification/No.

Date: 15 SEP 2021

No 1 5 3 7 5

To,

The I/C Superintending Engineer (R.&D.)
 Gujarat Power R&D Cell, GUVNL,
 214, Academic Block No.3,
 IIT Gandhinagar, Palaj-382355
 Gandhinagar

guvnlrnd@gprd.in

Sub: Review for Amendment of Technical specifications for Maintenance free, Pipe Cage (PiC) type Earthing for HT/LT Distribution network

- Refs. (1) GUVNL/GPRD/Pic/TECH-Specs/RP-041/419 Dtd. 16.07.21
 (2) DGVCL/CE(O&M)/Tech/Earthing-PiC/Tech-Specification/13539 Dtd.09.08.21
 (3) Your E-Mail Dtd.13.08.2021 & 31.08.2021

In captioned to above subject, the input/suggestions for review of amendment of technical specification for Maintenance free, Pipe Cage (PiC) type Earthing for HT/LT Distribution network are as under:

(1) It is proposed in the revised technical specifications that the enameled paint coating should have minimum Dielectric strength -20 KV/mm & minimum 4 coat should be applied to the surface of the electrode.

It is suggested to define thickness of electrically insulated enameled paint in microns for verification and quality assurance instead of minimum 4 coat for safety aspects.

(2) It is suggested to provide PVC/XLPE insulated circular stranded Aluminum cable of appropriate capacity with rigid PVC pipe instead of G.I. strip of 25 mm* 3 mm & PVC rigid pipe for connection from Earthing Electrode to various network, equipment, Transformer body & Neutral, Fabrication of pole & T/C structure, Lightning Arrestors.

Generally, the G.I. strip of 25 mm*3 mm available in 6 Meter length, therefore there will be joints in G.I. strips for connections of earthing electrode to various network.

The G.I. strip is not so flexible compare to PVC/XLPE insulated circular stranded Aluminum cable, therefore it is not convenient to lay G.I. strip to various network points with bending positions compare to PVC/XLPE insulated circular stranded Aluminum cable.

It is easy to provide PVC/XLPE insulated circular stranded Aluminum cable in rigid PVC pipe of round shape compare to G.I. strip in rigid PVC pipe.

(5) It is proposed in the revised technical specifications that the enameled paint coating should have minimum Dielectric strength -20 KV/mm & minimum 4 coat should be applied to the surface of the electrode.

It is suggested to define thickness of electrically insulated enameled paint in microns for verification and quality assurance instead of minimum 4 coat for safety aspects.

You are requested to consider above mentioned suggestions for Amendment of Technical specifications for Maintenance free, Pipe Cage (PiC) type Earthing for HT/LT Distribution network.

R. Par...
I/c Chief Engineer (O&M/GL)
Corporate office, DGVCL, Surat

Copy To:

(1) I/c Chief Engineer (Tech.), GUVNL, Vadodara-390007

(2) A.C.E.(S.D.&P.), Corporate office, DGVCL, Surat

*To,
Sh. DRS.
for consideration.
(Signature)*

**Proposed changes in all ready approved technical specification for Maintenance free, Ready Capsule,
Pipe-in-Cage (PiC) type earthing system**

Sr. No.	Clause No.	Old Clause	Proposed Changes	Reason for proposed changes
1	Part-A (4-c)	It is proposed in the revised technical specifications that the enameled paint coating should have minimum Dielectric strength -20 KV/mm & minimum 4 coat should be applied to the surface of the electrode.	It is suggested to define thickness of electrically insulated enameled paint in microns	For verification and quality assurance instead of minimum 4 coat for safety aspects.
2	Part-B (e)	The connection from earthing Electrode to various network equipment, transformer body, Transformer neutral, fabrication of pole and T/C structure, Lightning Arrestors by way of using mandatorily 25x3 mm GI strip, Nut-bolts and rigid PVC pipe shall be done	Generally, the G.I. strip of 25 mm*3 mm available in 6 Meter length, therefore there will be joints in G.I. strips for connections of earthing electrode to various network. The GI strip is not so flexible compare to PVC/XLPE insulated circular stranded Aluminium cable, therefore it is not convenient to lay GI strip to various network points with bending positions compare to PVC/XLPE insulated circular stranded Aluminium cable.	It is easy to provide PVC/XLPE insulated circular stranded Aluminium cable in rigid PVC pipe of round shape compare to G.I. strip in rigid PVC pipe.