1. Introduction

Object of earthing may be one or more of the following:-

(i) To afford safety to the operating and maintenance personnel against electric shock.
(ii) To ensure reliable and safe operation of the equipment by limiting or eliminating the induced voltages in signal and Block circuits.
(iii) To protect the equipment against build up of unduly high, voltages which can cause dielectric (Insulation) breakdown.

2. Earthing of Signalling Equipment

Earthing of following signalling equipments is essential:

- Signal Posts along with iron screen if provided.
- The lever frames and other metallic parts of the cabin in contact with the lever frame.
- Metallic sheath and armouring of underground Cable. The earthing shall be provided at every location box where cables terminate.
- Block instruments working on earth return circuits through the respective Block filters.

3.Earthing of Telecom Equipment

It is necessary to earth all telecom. Equipments inclusive of transmitters, receivers and associated equipments, Sheath of Telecom cable for the following reason.

- To prevent or to reduce the risk of cross talk.

- To complete earth return signalling circuits.
- To avoid risk of shock.
- To provide direct connection to the earth for lightening protection.

The total resistance of an "Earth" is the sum of :-

(i) The resistance of the conductor joining the earth electrode to the installations;
(ii) The contact resistance between the surface of the earth electrode and the soil and
(iii) The resistance of the body of the soil surrounding the earth electrodes.

Normally, the first two resistances are negligibly small compared to the third, so the resistance of an Earth" as primarily determined by the nature of the soil and not by the electrode itself.

4.Location of Earth

The following are the preferred locations for efficient earth:

i) Wet marshy grounds or grounds containing vegetation or refuge, such as cinder, ashes and brine waste.
ii) Clay, loamy soil, arable land, clayey soil or loam mixed with small quantities of sand.
iii) Clay and loam mixed with various proportions of sand, gravel and stone.
iv) Damp and wet send pits.

5.Treatment of Soil

To reduce the resistivity of soil, it is necessary to dissolve in the moisture normally contained in the soil some substance which is highly conductive in its water solution. The most commonly used substances are sodium chloride (common salt), calcium chloride, sodium carbonate, copper sulphate, salt and soft coke and salt and charcoal in suitable proportions.

6.Limits of Earth Resistance

Maximum values of earth resistances specified for earthing of Signalling and Telecommunication equipments are as under:

Sr No.	Descriptions	Max. Earth Resistance
1	Telegraph and Block Instrument using earth return circuit	10 Ω
2	Earths for surge arrestors/ lightening dischargers	10 Ω
3	Earthing of Signalling equipment	10 Ω
4	Earthing of signalling cable screen in AC electrified areas	10 Ω
5	Earthing of Telephone Exchange	5 Ω
6	Earthing of aluminum sheathed telecom cable in AC electrified area.	1 Ω
7	Earthing of equipment in VF repeater stations and cable huts.	5 Ω
8.	Axle counter cable screened in ac electrified area	1 Ω

7.Earth Lead Wires:

The lead wires connecting the installation and the earth electrode shall ordinarily be of stranded copper wire of 29 sq.mrn. (19 strand wires of 1.4 min dia). Copper wire has been specified because G.I.wire is usually subject to greater corrosion. However, in areas where copper wire may be subject to frequent loss by theft, ACSR -wires of size 64 sq.mm. (19 strands of 2.11 mm dia) or G.I. wires of negligible resistance may be used.

8.Earth Electrodes:

The material required for a standard electrode system should be corrosion resistant. Under ordinary conditions of soil, use of G.I. or M.S. electrode is recommended. In areas where corrosions are likely to be excessive, it is preferable to use either copper or copper clad electrodes. The electrodes shall be free from paint, enamel or grease.

Earthing arrangement shall normally consist of one or more galvanised iron pipes of not less than 38 mm internal diameter and not less than 2.5 metre in length with spike at one end and a lug at the other for connecting the earth lead wire.

Alternately, G.I. Steel rods of not less than 16 mm dia or copper rods of not less than 12.5 mm dia, not less than 2.5 metre in length can be used.

9.Installation of Earth Electrode System

Earth Electrode shall be installed as per Fig.1. When a rocky soil is encountered at a depth of less than 2 metres of the length of

the electrode, the electrode may be buried inclined to the vertical, not more than 30 degree from the vertical.

10.Measurement of Earth resistance

Earth can be tested by means of a Wheatstone Bridge or a GPO Detector or a Megger Earth Tester. To test an earth, arrangement is to be made as shown in Fig. 2.

The iron bars are used as temporary Earths and driven in the ground for 1 metre, 0.25 metre. Salted water is poured to ensure that the bars make a good connection with the earth

Let, R1 is the resistance measured between A&B
R2 is the resistance measured between A&C
R3 is the resistance measured between B&C

Therefore the resistance of A can be calculated by following formula:

Resistance of earth. $A = \frac{R1 + R2 - R3}{2}$

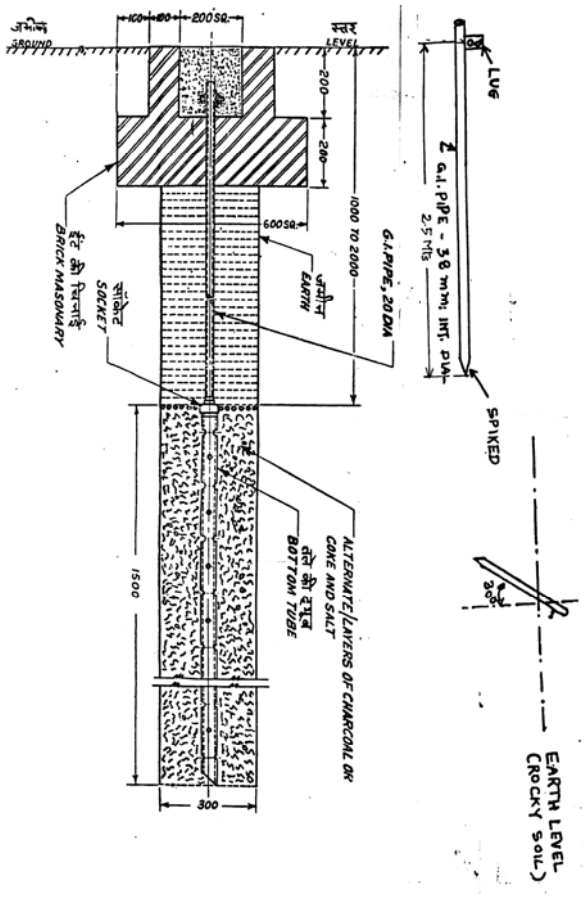

Fig.1:Installation of Earth Electrode

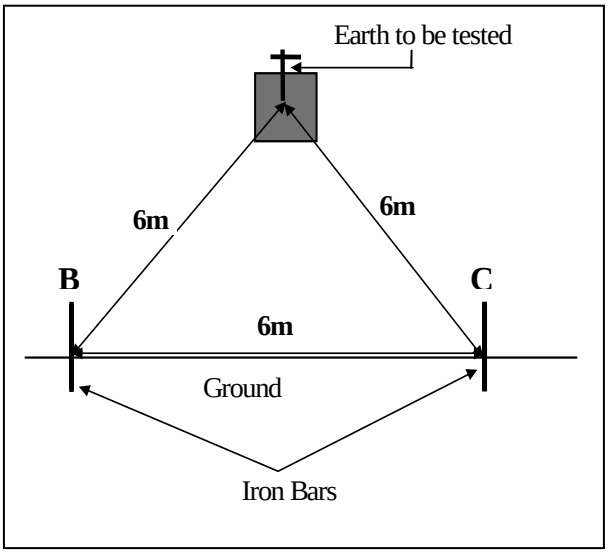

Fig 2: Measurement of earth

11.Precautions

- Where more than one earthing arrangements are employed, the distance between earthing electrodeds shall not be less than 3 meters.
- The clearance of equipment earths from system earths provided by the electrical department either of the Railways or any other administration shall not be less than 20 meters.

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(For official use only)

EARTHING ARRANGEMENT

CAMTECH/ S /2007/EA/1.0
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Centre
for
Advanced
Maintenance
TECHnology *Excellence in Maintenance*

Maharajpur, Gwalior – 474020
E-mail –dirstcamt@sancharnet.in