ISIS Practice
For BT people

EPT/ANS/A055

Issue 13, 21-May-2020
Use until 20-May-2021

Published by Technical Documentation Team

Privacy- Internal

FTTC Earthing Manual

Planning and Installation Practices

About this document ...

Author

The author of this document may be contacted at:

Chief Engineer's Office Technical Documentation team

Openreach (BOD)
Post Point Darlington ATE
Barnard Street
Darlington
Co. Durham

DL3 7DT

Telephone:
Fax:
Email: aei.doc.control@bt.com

Content approval

This is the Issue 13 of this document.
The information contained in this document was approved on 21-May-2020 by Desmond Silvera, Senior Technical Power Manager

Version History

Version No.	Date	Author	Comments
Issue 13	21-May-2020	Chief Engineer's Office Technical Documentation team	Table 6.2 added with sidepod power load figures.
Issue 12	19-Mar-2020	Chief Engineer's Office Technical Documentation team	Table 6.1 updated for earth electrodes.
Issue 11	06-Dec-2019	Chief Engineer's Office Technical Documentation team	Section 7.1.2 updated to show that the installation must be re-tested on the day of the installation.
Issue 10	17-May-2019	Chief Engineer's Office Technical Documentation team	Section 7.1.2 updated with new method statement for retro fit earths v2.2
Issue 9	07-May-2019	Chief Engineer's Office Technical Documentation team	Section 7.1.2 updated with new method statement for retro fit earths v2.1
Issue 8	11-Mar-2019	Chief Engineer's Office Technical Documentation team	Section 7.1.2 updated with new method statement.
Issue 7	01-Jan-2019	Chief Engineer's Office Technical Documentation team	Combined all earth rod electrode installation process in to section 6. Section 7 conductive concrete.
Issue 6	11-Dec-2018	Chief Engineer's Office Technical Documentation team	Reinstatement, review date extended
Issue 6	11-Dec-2017	Chief Engineer's Office Technical Documentation team	Earth A55 form updated in Appendix B: Earth Electrical Resistance form.
Issue 5	25-Aug-2017	Chief Engineer's Office Technical Documentation team	Section 6.5.2 and 6.5.3 updated
Issue 4	04-Jul-2017	Chief Engineer's Office Technical Documentation team	Section 6.4 & 6.5 updated
Issue 3	10-Mar-2016	Chief Engineer's Office Technical Documentation team	Approver change
Issue 2	14-Jan-2016	Chief Engineer's Office Technical Documentation team	Change of approver
Issue 1	27-Oct-2015	Chief Engineer's Office Technical Documentation team	New Document (Information extracted from EPT/PPS/B025)

Table of Content

1 SCOPE ---------- 5

2 GENERAL SAFETY REQUIREMENTS ---------- 5

3 REFERENCES ---------- 5

4 THE NEED FOR A CONNECTION TO EARTH ---------- 6

5 EARTHING SYSTEMS FOR FTTC ---------- 7

5.1 Initial measurement of Earth Electrode Resistance ---------- 7
5.2 Routine Measurement of Earth Electrode Resistance ---------- 8

6 PLANNING AN EARTH ELECTRODE SYSTEM ---------- 9

6.1 General ---------- 9
6.2 Earth Electrode System ---------- 9
6.3 Vertical Earth Rods ---------- 10
6.4 Earth Rod Protection ---------- 18
6.5 Suggested Stores List ---------- 18

7 CONDUCTIVE CONCRETE (PREFERRED METHOD FOR EARTH ELECTRODES). ---------- 19

7.1 Earth Requirements for FTTC Cabinets ---------- 19

8 ENQUIRIES ---------- 23

9 APPENDIX A: SAFETY RISK ASSESSMENT ---------- 23

10 APPENDIX B: EARTH ELECTRODE RESISTANCE FORM ---------- 23

1 Scope

This document replaces ISIS EPT/ANS/B025 on how to earth FTTC and other NGA street furniture. It should be read in conjunction with EPT/ANS/A036 when electrically certifying a cabinet. Reference to EPT/PPS/B025 may still be required.

This document explains the need for earthing systems for NGA and describes how to plan and install an earth electrode system at a FTTC street cabinet.

2 General Safety Requirements

- The work and working practices described in this document must only be carried out in strict accordance with the safety standards detailed in the Health and Safety Handbook.
- Cease work during local thunderstorms.
- A safety risk assessment should be carried out when providing an earth. A Safety Task Statement is provided in the Appendix to this document to help in the assessment of perceived risks in obtaining a connection to earth.

> **Warning:** Safe digging practices as described in ISIS document SFY/HSH/D057 must be observed.

3 References

The following documents give further information about earthing requirements:

ISIS BES/ESV/A010	Electrical installation – Policy for Design, Installation, Inspection & Testing
ISIS EPT/UGP/B033	Duct Description, Repair & Sealing
ISIS AEI/AEC/B257	Conductive Concrete Earthing Solution
BS 7430	Code of practice for earthing
BS 7671	The requirements for electrical installations (The IET Wiring Regulations).
BS 951	Electrical Earthing Clamps
IET GN3	IET Guidance Note 3 – for BS 7671
ENA ER G12-4	ENA Engineering Recommendation G12-4

All referenced documents refer to the most current edition

4 The Need for a Connection to Earth

A connection to earth is required for the following purposes:

- Protective earthing
  - to protect against the risk of fire and electric shock from mains power operated equipment
- Disconnected DNO neutral
  - The DNO requires a local earth on mains powered metallic street furniture of a maximum value dependent of the maximum load when power is supplied as a TN-C-S system and an earth value exceeding this maximum means the power supply needs to be made TT. The earth value for various cabinet loads is detailed in Section 6.5, Table 6.1. See ENA ER-G12-4 for rationale and power industry earth limits.
  - The reason for this additional earth requirement is that due to the equipment being Class 1 and in a metal cabinet, that in the event the DNO has a neutral disconnection the cabinet metalwork should not rise more than about 100V and so limit the potential for fatal electric shock. The secondary earthing of the TN-C-S will prevent this.
- EMC & Surge Protection
  - An earth of a maximum value may be required by some equipment vendors to satisfy EMC and surge protection requirements. FTTC cabinets are not generally considered to be in exposed positions for lightning and so would not have any special measures applied to them for surge protection. Unless a vendor specifies a particular maximum earth value, then no special measures will be taken.
- Other metallic components in the ground
  - The cabinet earth must not be influenced by other metallic components in the vicinity and clearance from them maintained at all times. This is most important when in the proximity of power cables or power earthing, especially HV power.
  - No connection must be made to other metallic components that do not belong to Openreach or permission has been given for the connection.
  - If another metallic system was to influence the earth value (make it lower than it really is) and this other system was to be removed or changed, then the cabinet earth may then be above the safe limit.

The requirements for protective earthing are given in BS 7671; see also ISIS document BES/ESV/A010.

5 *Earthing Systems for FTTC*

The earthing requirements for the cabinet will be dependent on the power configuration of the cabinet i.e. TN-C-S, TN-S or TT power systems may be deployed. In mainland UK it is generally TN-C-S or TT. In Northern Ireland it will generally be TN-S or TT.

The primary earth for a TN-C-S will be derived from the incoming neutral at the DNO cut-out, for TN-S from the separate DNO provided earth and for TT from a local earth (e.g. rod or conductive concrete).

For TN-C-S and TN-S it is required, by the DNO, due to the nature and construction of the cabinets that secondary earth also be provided at the cabinet. When the earth value of this secondary earth is too high for the predicted maximum cabinet load, then the system is made TT earthing system and this secondary earth then becomes the primary earth. Equally, if Ze is too high for a TN-C-S or TN-S system then the system is made TT earthing system and the secondary earth becomes the primary earth.

5.1 Initial measurement of Earth Electrode Resistance

When the cabinet or pillar plinth is initially installed, there will not be any power available to measure the earth resistance as described in section 5.2. The method described below must therefore be used.

If an earth rod is used to form the earth connection, then a 3 terminal measurement may be used as described in section 5.1.1 to gauge a value of the earth achieved so far.

If conductive concrete is used to form the earth, then it is not possible to take a reliable measurement of the earth resistance at the time of plinth install as it can take 14 – 28 days for the conductive compound to cure. It is agreed that no measurement is performed at this stage for conductive concrete.

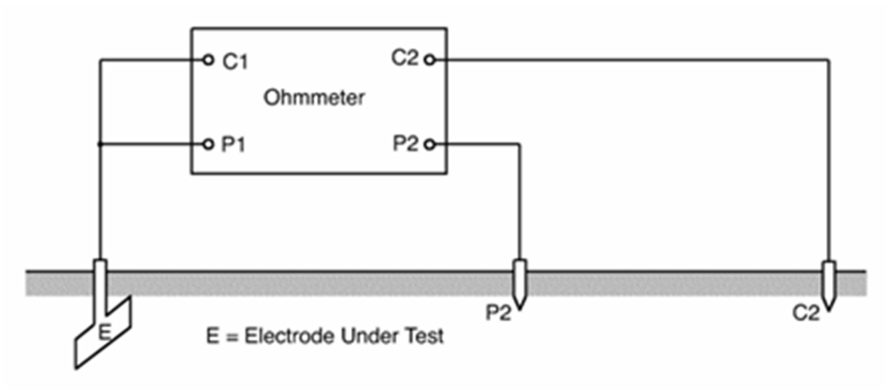
When measuring the resistance care should be taken in the measurements and it should be proven to be a stable value at a minimum of three probe measurement positions (See Guidance Note 3 to BS 7671, section 2.6.14, Test method 1). When a measurement is required to prove compliance to BS 7671 (Wiring Regulations), then all test equipment must be calibrated.

Note: When needing to meet a maximum value, try and make the measurement under ‘normal’ weather and water table conditions. The ‘normal value’ target value should always be aimed to be at least 10% below the maximum allowed value so as to account for very dry conditions. If the ground conditions are very wet then the normal value should be reduced to account for the greater conductivity of the soil, possibly by 10% e.g. maximum value (target) = 20 Ohms, ‘Normal’ value = 17 Ohms, Wet value = 15 Ohms.

5.1.1 Using an Earth Resistance Meter

Making use of the equipment instructions, connect the earth electrode to be measured to the correct terminal of the meter. Push the two test spikes into the ground to form the temporary electrodes, in the positions suggested in the user instructions (e.g. 25m and 50m). Use lengths of cable to connect the spike electrodes to the meter terminals as appropriate.

Figure 5.1 - Discrete Method of Measuring Earth Resistance.



Take three readings; the first with the voltage spike electrode (P2) approximately midway between the current spike electrode (C2) and the electrode under test; the second with it 3m nearer the current electrode and the third 3m nearer the electrode under test.

If the difference between the minimum and maximum readings is not greater than 5% of the average of the three readings, the average reading may be taken as the earth electrode resistance. If the readings are outside this limit, move the spike electrodes to a greater distance from the electrode under test and repeat the test until agreement within 5% is reached.

Further detail of how to measure earth electrodes is given in ISIS EPT/PPS/B025.

5.2 Routine Measurement of Earth Electrode Resistance

5.2.1 Initial and Routine Testing

The measurement of the earth electrode resistance will be carried out as part of initial electrical certification and also as part of the routine electrical test and inspection program for the cabinet or pillar (as detailed in ISIS EPT/ANS/A036).

5.2.2 Method of Measurement

The preferred method of measurement is the Earth Fault Loop Impedance method using an IET Wiring Regs tester using the electricity supply to the cabinet or pillar.

6 *Planning an Earth Electrode System*

Note: Section 6 will only be used as references material as of January 2019. This due to the removal of earth electrodes rods installation from Openreach rate card and all electrodes rods removed from BT stores. Earth electrodes installation has be replaced with the conductive concrete installation process for both new installations and retrofit.

6.1 General

As the earth electrode system is being installed as part of a mains power protection system, the Wiring Regulations, BS 7671 stipulate that all mechanical connections associated with the earth system must to be able to be inspected at any time. This may involve the fitting of earth inspection pits at each electrode. Consideration to the layout of the system should be taken and any impact it may have on 3rd parties (e.g. highways, etc.)

Where site conditions dictate it, a horizontally laid earth electrode system may be a preferable solution than a vertically rod or conductive concrete system. On rare occasions a mix of methods may give the best results. See Risk Assessment in Appendix A.

A conductive concrete, encasing a copper ring electrode is able to provide a long lasting low resistance earth electrode. The final value still depends on the earth resistivity, moisture conditions and surface area of the concrete. Please contact the document author for any other earthing methods.

6.2 Earth Electrode System

The site of the earth electrode system should be chosen so as to obtain a minimum clearance of ideally 0.6m or more from telecommunication cables, electricity cables, gas or water pipes, as other metallic services may contribute to the measured earth value of the rod. The value cannot be guaranteed long term if the other services are disconnected or removed. Care must be taken to avoid damage to drainpipes and sewers. Insulated cables from the earth electrode can be as close as 50mm to other services.

6.3 Vertical Earth Rods

Spikes Earth 3 or copper clad earth rods should be used. When fitting an earth rod, the ground must be checked for other services. It is imperative that the ground is checked a number of times during the excavation. The ground should be fully dug for the length of the rod. Under no circumstances must a connection be made to any other services in the ground. A rod must be at least 150mm away from any other service, especially metallic ones.

When excavating the ground and another service is detected, then the rod position must be moved to the side and the excavation opened further to check for other services as in Figure 6.1.

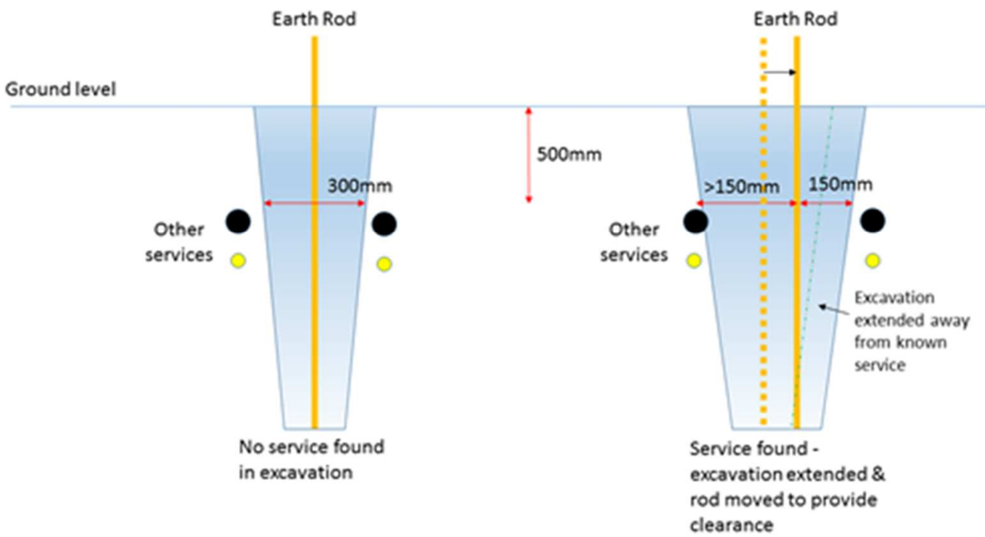


Figure 6.1: Earth rod placement near other services

In the diagram, the rod on the right has had to be moved to the right to maintain 150mm clearance to another service. It may be necessary to totally re-locate the cabinet if other services cannot be avoided.

6.3.1 Spike Earth 3

The standard BT earth rod is the Spike Earth 3 (see Figure 6.2). The components of Spike Earth 3 are available from BT Stores.

The electrode system consists of Rods Earth 3 which are un-galvanized mild-steel rods 1.5m (5ft) by 16mm (5/8in) threaded at both ends, which can be screwed together to form a long continuous rod. The continuous rod, together with a hardened tip and two hexagonal nuts for securing the earthing lead, is known as a Spike Earth 3. The driving head is not used for FTTC applications, though it can be used as a nut for cable fastening. The tip is not normally required for FTTC as the rod should be fully dug and not driven in.

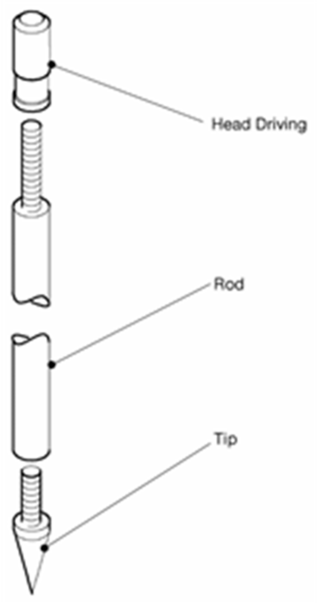


Figure 6.2: Spike Earth 3.

If horizontal rods are required, Spike Earth 3 may be laid horizontally at the base of the telecom duct trench, under the duct. It is advisable to use three rods screwed together, with the first rod bent 90' at the mid-point to come up in the plinth earth duct. The depth of the rods must be greater than 500mm depth of cover.

In poor soil areas a reduction in the earth value can be obtained by encasing the rod in Marconite or similar conductive compound. A 50% mix of the compound and soil will give good results. It is important that such compounds do not form a bridge to other services and that the 150mm spacing from the edge of the compound is maintained.

6.3.2 Rod Earthing

Caution: Only to be used if signed off by the Power Lead within CEO for every site.

If alternative methods of earthing, i.e. earth rods, are used, then to help achieve the correct earth value with the minimum amount of earth rods and excavation a measurement of the earth resistivity is recommended (see ISIS EPT/PPS/B025). Using this method will only achieve a minimum earth resistive reading no lower than 5Ω. Any reading below this level should be investigated for illicit earth installations.

In exceptional circumstances, when the earth electrode value has drifted outside that of the specification after being installed, there is a need to retrospectively correct the installation to meet the requirements of BS7671 and that of the DNO. A process to achieve this is described in this

Appendix

In areas of poor soil/high resistivity, it is preferable to use conductive concrete. If more than 3 rods are identified as being required to achieve the target value, then conductive concrete must be used under the plinth.

All backfill must be compacted hard around the earth rods to gain maximum benefit in decreasing the earth resistance. Avoid stone backfill around the rod.

The use of Marconite, Bentonite or other conductive backfill materials should only be used on the authority of the local project manager. When conductive backfill is used, it should be mixed to a concentration of no more than 50% of the backfill soil and be well compacted around the rod. No water should be added to Marconite backfill. If Bentonite backfill is used, then if may be added as a slurry around the rod, but it should be allowed to settle before a resistance reading is taken (this could be 1 to 2 days for moisture levels to stabilise). The percentage decrease in earth electrode resistance is only likely to be between a few percent and 30%, and not easily determined beforehand as it depends on the soil resistivity. It must not form part of the concrete or stone sub-base under the plinth, but can be used beneath the stone sub-base, but must not be within 150mm of any other services. It needs to be more than 500mm below the surface if it is to contribute to reducing the earth electrode resistance.

Note: As of 1st July 2017 this is the **default** method for installing retrofit earth electrodes.

6.3.3 Cabling from the Earth Rod Electrode

Conductive concrete ring electrodes come complete with a 16mm2 green/yellow tail and only need to be suitably terminated and labelled on the bus-bar.

All cable connections from an earth rod electrode or for joining multiple rod electrodes shall be in a minimum of 16sq.mm green/yellow cable, using crimped eyelets matching the bolt fixings (e.g. 16 mm2 x 10 mm for Earth Rod 3).

The top of the Earth Rod shall be accessible, including the cable connection, within the cabinet and any earth pit and not embedded in duct sealing resin:-

> Rods should be a minimum of 45mm above the duct and a maximum of no more than 50mm below the top of the root i.e. sufficient space to allow easy termination or inspection and not impact other items in the cabinet.

When rods are in an earth pit or buried, the top connection of the rod shall be protected with Tape Sealing 3, 50mm or Denso tape.

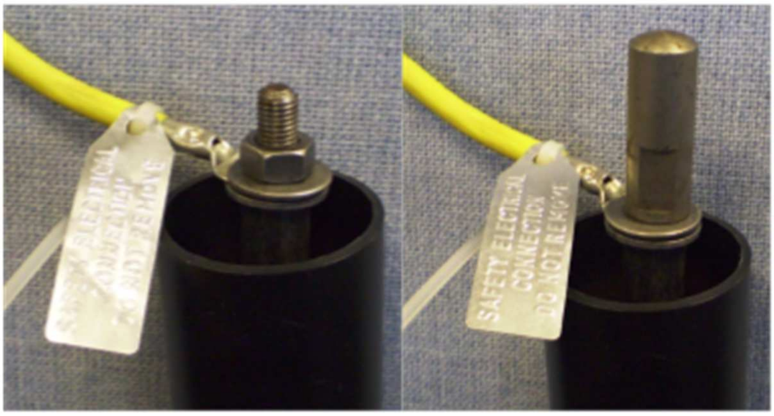
For the Earth Rod 3, washers shall be used either side of the eyelet when clamping to the rod. If a washer is not used, then there is the possibility that it is not possible to tighten the nuts correctly on the rod (threads may not be cut fully to the shoulder of the rod).

Figure 6.3 – Washers & Nuts for Earth Rod 3

3/8” BSF Nut and appropriate washers

A nut or driving head may be used to clamp the 2 washers and crimp eyelet assembly to the rod. The photographs in Figure 6.4 show the cable clamped via the threaded portion of the earth electrode (preferred method).

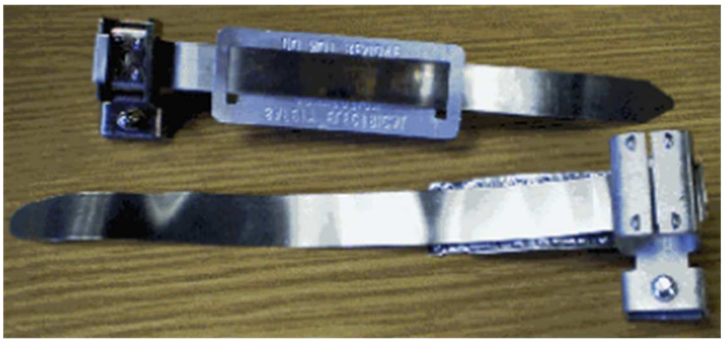
Figure 6.4– Securing the Earth Cable Directly to the Earth Rod 3



When a rod needs to be cut short within a cabinet, e.g. due to a length limitation such as rock, or is from an alternative supplier, then an earthing clamp conforming to BS 951 should be used. It is imperative that a clamp of the correct rating is used (**type E for 16sq.mm cable**); again a crimped eyelet shall be used to connect the cable to the strap type clamp.

The photograph in Figure 6.5 shows a type A-D clamp (smaller of the two, and NOT to be used for 16mm2 cable) and a type A-E clamp (suitable for up to 16mm2 cables). The surface area of the A-E clamp for both the strap and clamp face is much larger.

Figure 6.5 – Type A-D (upper) and A-E (lower) Earth Straps

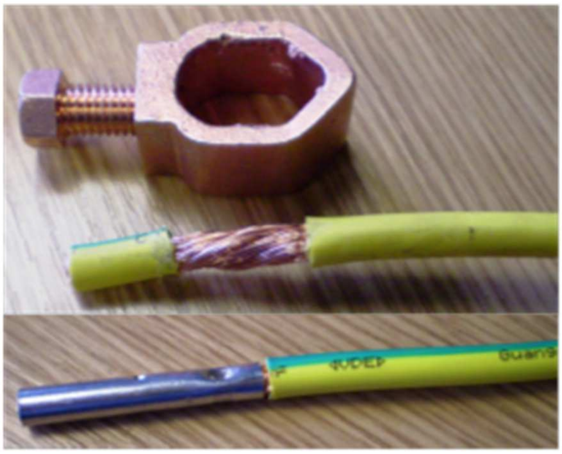


Safety labels are mandatory (BS 7671) at the point of cable connection to the earth electrode. Examples are as in the selection shown in Figure 6.6. Most of the strap type clamps come with labels provided, if not they will need to be locally purchased. Conductive concrete earthing cables shall have a label attached close to the point it terminates on the earth bus-bar.

Figure 6.6 – Earthing Safety Labels

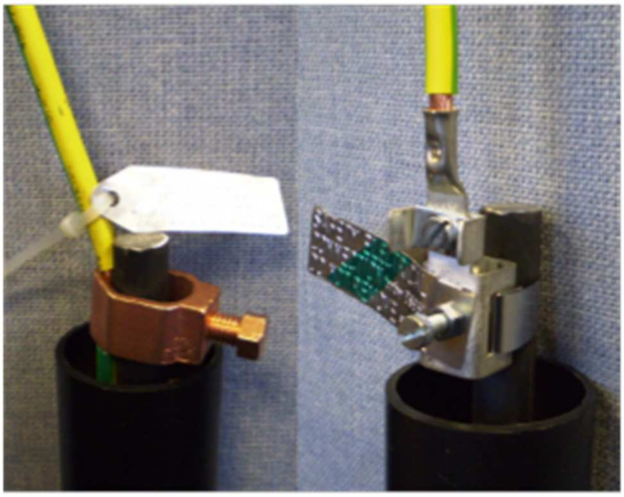
Two common clamp types may be used when there has been a need to cut the earth rod – they should not be used as the norm for connecting the earth cables. One uses a stainless steel band and cabled with a crimp connector (16 x 6), as in Figure 6.5, and the other is a phosphor-bronze ring casting (Figure 6.7). A safety label will need to be attached to the cable close to the clamp.

Figure 6.7– Ring Clamp and Termination Options



Examples of these terminated to the earth electrode are shown in Figure 6.8. It is suggested that only a portion of the insulation is removed from the cable when using the ring clamp to avoid the wires spreading out and giving a poor connection (as shown in Figure 6.7) or an inline crimp used to give the cable rigidity.

Figure 6.8 – Securing Earth Cable via Strap or Ring Clamp



Protection of the connections within the earthing system shall be as shown in section 6.6.

6.3.4 Earth Electrode Value Greater than Load Defined Limits in Cabinet

For conductive concrete earthing, when the earth value, as defined in Table 6.1, has not been reached, it is possible to extend the earthing into the telecom and power trenches if it is above target value, though a further 2 -4 weeks curing time will be required for this to become effective.

For earth rod electrode earthing, the following shall be used when it has not proven possible to achieve the required earth electrode resistance, defined in Table 6.1, with the vertical earth rod within the cabinet, then additional earthing measures need to be employed. This will involve extending the earth electrode out to the side away from the plinth and use the earthing methods described in the earlier parts of section 6, including taping and sealing of the earth cable to the buried electrodes. The connecting cable from this extended earth electrode system must be securely fastened to the earth electrode within the plinth such that the whole form the earth electrode system.

The photographs in Figure 6.9 show possible options of how to couple the cables from the external earthing system to the rod in the area of the plinth and onwards to the main earth terminal (MET) of the cabinet. Safety labels and duct have been left off for clarity. The cable going downwards would enter the duct and go to the external earthing system; the upper cable would go to the MET in the passive side of the cabinet. When a long enough piece of cable is available from the external earthing system to go to the MET and a ring clamp is being used on the plinth electrode, then a portion of the cable insulation need only be stripped back and positioned under the ring clamp as per Figure 6.9(d). If the cable from the external earthing system to the rod is too short to connect, then it may be extended by using either an inline crimp or by bolting together two eyelet crimps as shown in Figure 6.10. The length of the cable from the continuous cable connection to the MET via the rod will depend on the timing of the FTTC plinth and cabinet installation.

Figure 6.9 – Possible Options for Securing Earth Cable from External Electrodes and Onwards to MET on Cabinet Shell

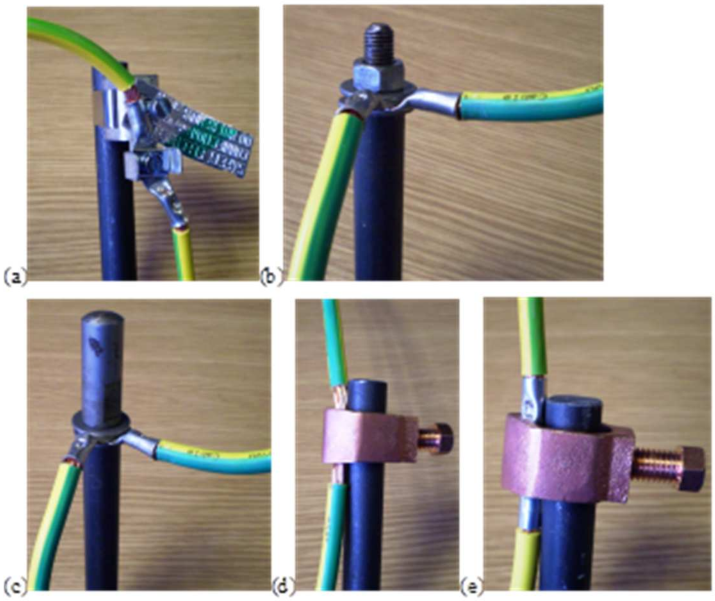
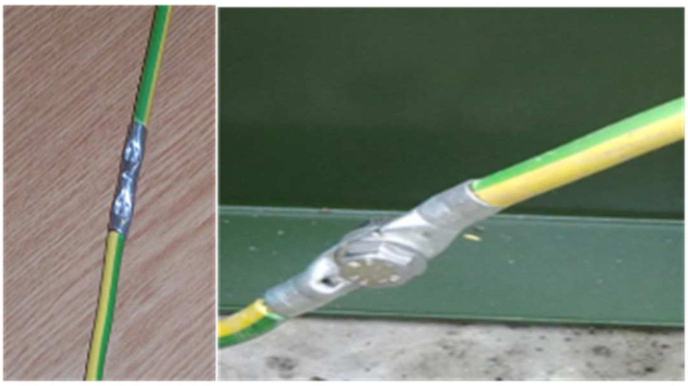


Figure 6.10 – Means of Extending the Earth Cable



When rod electrodes are used, the earth electrode installation pecking order will be as follows:-

- One earth rod under the passive side of the FTTC Cabinet. If this results in an earth electrode reading of less than 130 Ohm (300mA RCD) or 180 Ohm (30mA RCD), then target is achieved; else
- Install a further two earth rods. If this results in an earth electrode reading of less than the above values, then target is achieved; else
- Refer the issue back to the regional programme / project manager for resolution.

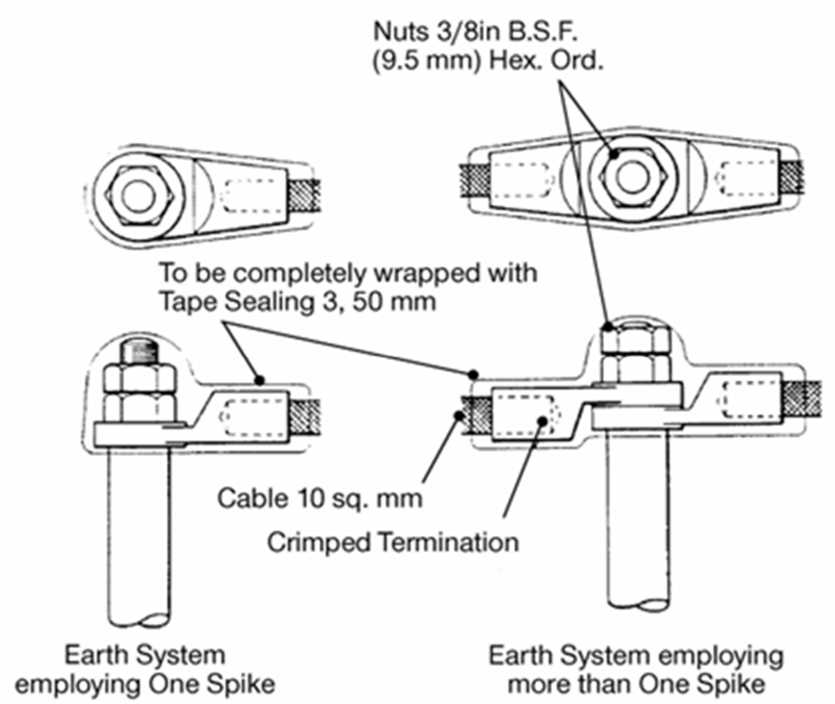
Note: 130 Ohm or 180 Ohm refers to the maximum value at the plinth build stage when using earth rods. 150 Ohm or 200 Ohm applies at the electrical certification stage for 300mA and 30mA RCD respectively.

It is important to make sure the earth cable joining rods is protected, e.g. placed a side of ducts, etc. and cannot be damaged when other utilise dig the area. Suitable marking tape should be used to highlight the cable below.

6.4 Earth Rod Protection

The top connections of the earth rods are most liable to corrosion and should be well wrapped with Tape Sealing 3, 50mm or Denso Tape. Fill in all excavations and make good the surface.

Figure 6.11 - Terminating Earth Wire to Spike Earth 3



Note: Note: drawing has washers omitted. One nut minimum required

A similar method shall be employed when using copper clad rods and cable clamps.

6.5 Suggested Stores List

Item	**Item Code**	**Remarks**
Tape Sealing 3 (50mm)	071305	Denso type tape
Washers	Locally Purchase	for Rod Earth 3
Nut 3/8" BSF	013350	for Rod Earth 3

Heads Driving	012201	for Rod Earth 3
Spike Tip	015951	for Rod Earth 3
Rod Earth 3	014450	-
Earth Clip, Type E or A-E	Locally Purchased	For use with 16mm2 cable
Earth Clamp	Locally Purchased	For use with 16mm2 cable
Safety Labels	Locally Purchased	For installation to conform with BS 7671

7 Conductive Concrete (Preferred method for earth electrodes).

Conductive concrete is a cement based product, which can encase a copper electrode and provide a means of earthing. The method to use this product is described in section 6.5.1.

Note: For new installations Conductive Concrete does not necessarily give an instant earth electrode of acceptable value. It takes time for the compound to cure and become effective (possibly up to 28 days after installation). It is recommended that a minimum of 2 weeks from date of installation is given before measurements or electrical work is carried out.

7.1 Earth Requirements for FTTC Cabinets

The power supply offered by the DNO in mainland UK will normally be TN-C-S, or exceptionally TT, and has the added requirement of a supplementary earth electrode having to be fitted to limit touch voltage in the event of a DNO fault to ~100V (as per ENA ER G12-4 and BS 7671, Guidance Note 5, Section 14.5, table 14.1).

UK Main land:

- TN-C-S system = Ze 0.35 to 0.5 Ohm max
- TN-S system = Ze 0.8 Ohm max
- TT system = 150 Ohm max (300mA RCD)
- TT system = 200 Ohm max (30mA smartRCD)

WPD region (UMS) will use Ze as per metered supplies. SSE and NPG cannot confirm if they are able to meet the Ze limit of 0.35 Ohm for unmetered supplies on all occasions.

If the value of Ze is within limits, then the power system can remain TN-C-S or TN-S (as appropriate to the power delivery status from the DNO). Similarly, if Ze is too high a value and the DNO are not able to reduce Ze any further, the system must be converting to TT earthing system and an Auto RCD installed.

In Northern Ireland only the DNO will normally only supply a TN-S or a TT system depending on their local electrical network. In the event of a disconnected neutral the system should remain safe with return current going via the earth conductor (S of the TN-S) or the earth electrode (value must not exceed 100 Ohm). In the event of a vehicle impact the same precautions to approach and touch the cabinet shall be used as for any other FTTC cabinet. If a supplementary earth is fitted, then it should be to the same requirements as mainland UK FTTC cabinets.

Northern Ireland, (un-metered):

- TN-S system = Ze 0.8 Ohm max (100 Ohm max for the earth electrode)
- TT system = 150 Ohm max (300mA RCD)
- TT system = 200 Ohm max (30mA smartRCD)

If the value of Ze is within limits, then the power system can remain TN-C-S or TN-S (as appropriate to the power delivery status from the DNO). Similarly, if Ze is too high a value and the DNO are not able to reduce Ze any further, the system must be converting to TT earthing system and an Auto RCD installed.

In the event of two or more mains powered cabinets being installed in close proximity and needing the earth extended outside of the plinth area, then they must not share the earthing metalwork in any way, i.e. each to be individually earthed. In such cases, both cabinets should be configured TT.

The current requirement for the value of the earth electrode/system is a maximum , as detailed in Table 6.1, when measured at the end of a 1m length of 16mm2 cable (i.e. a correctly terminated length of cable on an earth rod or similar means of earthing, e.g. conductive concrete earth tail) at the time of electrical certification. When the plinth is being built, the limit is less that than at certification to allow for settlement of soil for earth rods. Conductive concrete cannot be measured at the plinth build stage. The maximum value of 130 Ohm at the plinth build stage in difficult soils allows for settlement and a final value of below 150 Ohm at the electrical certification stage (for a 300mA RCD). When a 30mA smartRCD is used, then a plinth build value of 180 Ohm maximum to result in a final value of less than 200 Ohm maximum at electrical certification.

The earth electrode resistance value required depends on the power loading of the cabinet as per the table below.

Table 6.1 Earthing Values Based on Maximum Cabinet Load (England, Scotland and Wales) ***ENA ER G12-4 document section 6.2.15.***

Connection.	Maximum 1-ph Load or, for 3-phase, maximum overall load unbalance.	Maximum consumer earth electrode resistance bonded to main earth terminal.	Predicted Maximum Load for NGA Street Cabinets.
1-phase or unbalanced 3-phase	≤500W	100Ω	Huawei All-in One (500W)
	≤1kW	60Ω	Huawei 96/128 (600W), Power Pillar used for FFTRN (600W), ECI 128,256 and All-in-one (1000W).
	≤2kW	20Ω	Huawei 288 (1400W)
	≤3kW	14Ω	N/A
	≤4kW	11Ω	N/A
	≤5kW	9Ω	N/A

Note: ***≤ means less than or equal to.***

When calculating the Maximum Load of the installation use the maximum load of the DSLAM cabinet add the load of the PCP side pod and or AC forwarding DSLAM load (if installed).

Table 6.2 Maximum Side Pod load.

PCP Side Pod Type	**"Absolute Maximum" Power consumption (W)** Excludes Max. Hybrid cable loss (43W)
Huawei **MA5818 Gfast** PCP side pod	**426.5 W** (Includes 68 W for side pod's HEX door)
Nokia **MX-6 Gfast** PCP side pod	**361 W** (Includes 11 W for Side pod's roof Fan)
Huawei **MA5818 VDSL** PCP side pod	**405 W** (Includes 68 W for side pod's HEX door)
Nokia **DF-16 SHE*2** PCP side pod	**307 W** (Includes 7 W for Side pod's roof Fan)
Huawei **X2 SHE** PCP side pod (currently in design phase)	**319.5 W** (Includes 68 W for side pod's HEX door)

Earth resistance values above those in table 6.1 will require the cabinet power being made a TT earthing system and the fitting of an RCD when electrically certified. The maximum earth resistance value when fitting an RCD is still 150 Ohm or 200 Ohm depending on the RCD rating being used.

The earth rod or cables exiting ducts within the cabinets must be gas sealed and fed in the correct duct (i.e. not power duct). Note, do not cover the cable connection on an earth rod with resin – it needs to be fully accessible for testing and inspection purposes.

As the NGA programme expands to cover other ways of deploying Broadband, then the loads on cabinets may change if extra equipment is added. This will affect the earth resistance value and it may be necessary to adjust the table above to allow for this.

7.1.1 Conducive Concrete Earthing

As of August 2015 conductive concrete will be the <u>default</u> earthing solution for New FTTC builds.

The installation process for conductive concrete and plinth build is described in the method statement below. The process MUST be rigidly followed. The resistance of the earth is taken at the end of the 16mm2 cable from the ring electrode within the conductive concrete once it has cured. Make sure all details are noted on the earthing certificate.

In situations where the distance from the NGA cabinet base to the BT/Openreach duct chamber is limited, then the base of the supplementary trenches may be used. These trenches extend 1000mm centrally from the base of the cabinet excavation, conductive concrete will be placed in the base of these trenches, the 16mm² bare cable from the earth ring will be placed on top with a further covering of conductive concrete placed on the top. The trenches will be partially reinstated with native soil which will be firmly tamped before installing the cable ducts. This is fully documented in the

method statement

and also in Engineering Memo AEI/AEC/B257 in the ISIS library and CANDID.

7.1.2 Conductive Concrete earthing method for existing NGA FTTC installation.

This method statement covers the retrospective installation of an earth electrode/s using Conductive Concrete for existing NGA cabinets. This method requires the Conductive concrete to be mixed with water and an accelerator that will enable the installer to reinstate the pavement on the same day (minimum curing period of 2 hours but must ensure firmness of the concrete first). Expected earth resistive readings using this method could be as low as 2Ω but only if the attached method statement is followed to the letter. The earth electrode cables supplied in the retrofit kit has been cut to a prescribed length for extract resistive calculation. Installing earth electrode cables that have not been supplied as part of the retrofit kit by the supplier Cubis will in-valid the warranty and the installer will be answerable for their actions. Once the new conductive concrete earth has been installed and cured (minimum of 2 hours and firm) the whole installation must be re-electrically tested as described in ISIS EPT/ANS/A036 on the day of the installation.

Openreach Method
Statement for Retro I

8 *Enquiries*

Technical Enquiries may be directed to the document author.

9 *Appendix A: Safety Risk Assessment*

The attached document is the risk assessment provided by BT Safety Services. Click here for document 'RN V9 Tasl

Also available is the Stay wire risk assessment

10 *Appendix B: Earth Electrode Resistance Form*

Link to a form for engineers or contractors to fill in (if required) when having to provide proof of an earth electrode resistance at a FTTC cabinet.

Earthing A55 form issue 7 07.12.2017.d

END OF DOCUMENT