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Lightning Protection Handbook

Planning and Installation Practices

About this document ...

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Table of Content

1 SCOPE ---- 6

2 GENERAL SAFETY REQUIREMENTS ---- 6

3 REFERENCES ---- 7

4 INTRODUCTION ---- 7

4.1 BACKGROUND ---- 7
4.2 GUIDELINES ---- 7

5 SUMMARY OF LIGHTNING PROTECTION POLICY ---- 8

5.1 RULES OF APPLICATION ---- 8
5.2 LOCATION OF LIGHTNING PROTECTION DEVICES ---- 12
5.3 LIGHTNING RETARDING LOOPS/COILS ---- 13

6 TESTING ON LINES FITTED WITH PROTECTORS ---- 15

7 PSTN MASTER SOCKET ---- 15

8 LIGHTNING PROTECTION AT EXCHANGES ---- 15

9 SELECTING THE TYPE OF EARTH ELECTRODE FOR EXTERNAL NETWORK APPLICATIONS ---- 18

9.1 SUPPLEMENTARY PROVISION OF A LIGHTNING PROTECTION EARTHING SYSTEM ---- 18
9.2 COST EFFECTIVE PROVISION OF EARTH ELECTRODES WHEN POLES ARE PROVIDED/RENEWED ---- 18
9.3 METHOD OF CONNECTING TO A STAY FOR EARTH POINT USAGE ---- 19
9.4 AERIAL CABLE SUSPENSION WIRE EARTH BONDING ---- 23
9.5 DROPWIRE CONNECTION TO AN EARTH CABLE ---- 26
9.6 UNDERGROUND, OVERHEAD & EXTERNAL DPS ---- 27
9.7 INTERNAL DPS ---- 33

10 LIGHTNING PROTECTION ON ROUTE ---- 35

10.1 INSTALLING IN-LINE LIGHTNING PROTECTION AT UNDERGROUND JOINTS ---- 36
10.2 LIGHTNING PROTECTION FROM MAINS BORNE SURGES ---- 39
10.3 EARTH CONNECTION AT CUSTOMER PREMISES ---- 41

11 LIGHTNING PROTECTION OF CABLES SERVING EXPOSED TRANSMITTER SITES ---- 43

11.1 PROTECTION POLICY ---- 43
11.2 METHODS OF PROTECTION ---- 46
11.3 PRECAUTIONARY MEASURES ---- 47
11.4 RECORDS ---- 48

12 LIGHTNING PROTECTION TO AERIAL CABLES ---- 49

12.1 PROTECTION AT THE JUNCTION OF OVERHEAD AND UNDERGROUND OPTICAL CABLE ---- 50

13 STORES LIST OF PROTECTIVE DEVICES ---- 51

14 STORES LIST OF ANCILLIARY LP PARTS ---- 52

15 RECORDS & REPORTS ---- 54

15.1 RECORDS ---- 54
15.2 REPORTS ---- 55

16 ENQUIRIES---------- 55

1 *Scope*

These instructions are for the guidance of staff on the measures to be taken to protect customers, staff and equipment from the effects of surges induced into BT plant. Mandatory paragraphs are marked thus *.

Note: Following a review in 2006 of the lightning protection policy, installation practice/equipment, a briefing (

) has been issued to compliment this document. The briefing will be attached for reference only. It does not change the content or practice indicated within this ISIS.

A new series of documents has been created which details the specification/performance requirements for building the Access Network. The index can be found in ISIS document EPT/ANS/A001. This document (EPT/PPS/B055) should be read in conjunction with the Lightning Protection Specification ISIS document EPT/ANS/A020.

This document covers policy, planning and installation practices for lightning protection (LP) at:

- Telephone exchanges
- The external cable network
- Distribution points
- Final pole/customer premises
- Exposed transmitter sites.

The method of providing Earth Electrodes, Measuring earth resistivity and Measuring resistance of an earth electrode is covered in The Earthing Manual ISIS - EPT/PPS/B025 & the Specification for Lightning Protection - EPT/ANS/A020.

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 & Safety Handbook.

Safe digging practices as described in ISIS document SFY/ESP/C026 must be observed.

Cease work on overhead or underground lines and radio stations during local thunderstorms. If aloft, descend to ground level. *

3 References

Health & Safety Handbook
ISIS SFY/ESP/C026 Safe Digging Practices
ISIS EPT/UGP/B097 Drilling Holes into Jointing Chambers
ISIS EPT/OAM/B010 External Line Plant Symbols
ISIS EPT/PPS/B025 Earthing Manual
Information Video Lightning – Protecting BT's Network from it's Power
ISIS EPT/ANS/A001 Access Network Specification Index and Scope
ISIS EPT/ANS/A020 Specification for Lightning protection

4 Introduction

4.1 Background

Lightning is a cause of electrical surges in the network that occur as a result of either direct strikes to line plant or induction into lines in the vicinity of lightning activity. Any strike within 50 metres of an object is regarded as a direct strike. Strikes from 50 and up to 200 metres are regarded as proximity strikes giving rise to induced surges. With the protection methods described here the effects of induced surges can usually be nullified. Direct strikes, however, are much more damaging and it would not be economical to attempt to prevent damage from occurring to the network under these conditions, fortunately direct strikes occur much less frequently than proximity strikes. Further information on the protection of plant and risk assessment is given in Section 5.

The protection described here is designed to protect the most vulnerable parts of BT's infrastructure. Equipment is far more sensitive to overvoltages than is cable. Polyethylene cable is capable of withstanding lightning surges in excess of 10kV whereas certain types of equipment may be damaged by a few tens of volts. Experience shows that where cable damage occurs this is usually a result of a direct strike. For this reason the protection provided is primarily at the terminal points, that is, the Distribution Point (DP) and the exchange.

4.2 Guidelines

In order to discharge lightning energy you need to dissipate the energy using an earth electrode. Every attempt should be made to obtain a low resistance earth connection.

The earthing practices have been divided into two categories: those in areas of normal earth resistivity (less than 1000 ohms) and those in areas of high resistivity (1000 ohms and greater)

The earth resistivity is shown in the spreadsheet at *Figure 4.1* although local knowledge of variations in earth resistivity if known should be taken into account (*see Figure 4.1*).

For Operational buildings, the resistance of the earth electrode should not exceed 8 ohms. It will be necessary to measure this on installation, and periodically, as per the Earthing Manual ISIS EPT/PPS/B025

For all other network Applications, (DP's / Joints etc) it is no longer normally necessary to measure earth electrode resistance. The Lightning Protection Risk assessment tool will determine the need for protection, and the spreadsheet at figure 4.1 may be used to determine whether the exchange area has Normal or High Earth resistivity.

For Exchange areas with Normal Earth resistivity, any required Earth Electrodes should be better than 50 ohms resistance *

For exchange areas with High Earth resistivity, any required earth Electrodes should be better than 200 ohms resistance.*

* These values may be achieved by using standard earth electrode provision methods described in section 2 of ISIS EPT/ANS/A020

Figure 4.1

5 *Summary of Lightning Protection Policy*

5.1 Rules of Application

Lightning protection based on a risk assessment of the routing ;-

- At DPs or joints for lines which have a history of lightning damage.
- At DPs and/or other points in the network identified at risk of lightning damage when using the Lightning Risk Assessment planning tool.

All pairs at the exchange end should be protected on the MDF irrespective of the route taken, that is city, urban or rural, and irrespective of any overhead exposure or terrain on the route.

Protection should, generally, be provided at the DP if the Risk Assessment tool shows that protection is needed on the route, irrespective of it being UG or OH. **All reference to overhead cable includes dropwire, open wire, and covered wire**.

Where the Risk Assessment tool indicates protection is required further on towards the customer from the DP, then additional further protection should be fitted at the last pole/joint that is accessible.

The need for protection when using the Risk Assessment tool is quite different to the assessment methods used within BT in the past. Some exchange areas may prove to need a lot more protection units fitted, whilst others may need a lot less. *There are no empirical rules to be used (4 span rule does not apply), as the Risk Assessment method will be particular to every route based on earth resistivity, lightning activity, environment and the cable routing.*

5.1.1 Exchange MDF Protection

This section of the ISIS is applicable to both Openreach and BT (and other CPs), with either party agreeing to devolve the fitting of protection to the other as a business arrangement. The decision to protect the terminating equipment is the responsibility of the CP. Openreach will not normally fit protection unless part of the business arrangement.

- It is recommended that lightning protection be provided on all lines at exchanges (100% coverage). This will ultimately be a decision of the CP who owns the terminating equipment for the particular lines. By fully protecting 100% of circuits, it avoids the need to calculate the risk due to the routing of the lines in the network.
- In most cases lightning protection will be fitted on the internal equipment side of the MDF. Exceptions to this will be on Modular frames and the few frames that have line side only protection. It will still be the CP responsibility to provide protection
- Dispensation has been given for some types of Openreach owned exchange side equipment to be fitted without lightning protection such as:-
    1. Exchange side MDF blocks, where EvoTAM tie cables are terminated, no longer need lightning protection fitted.
    2. A risk assessment has taken place and been approved by the Chief Engineer, Service Provision and Service Delivery, which also aligns with LLU-TAM tie cable installation practice.
    3. Retrospective action is not required.
- Where protection is fitted on the internal side of the MDF, then this practice should continue.
- If it is agreed that protection is not fitted to CP services terminating on the MDF by Openreach, it is then the responsibility of the CP to fit protection on the HDF as they require, or the MDF termination point if HDF protection facility is not available.
- UXD5 8/40 line-cards MUST be protected to minimise a fire risk. It is important that the correct design of protector is used to correct the design

fault of these line-cards. Consult with the UXD5 service team for more information.

- Openreach will not provide protection modules for MDFs to protect CP circuits. It is the responsibility of the CP to provide protection. On MDF Jack Test blocks, Openreach will provide the dummy link (module 1A or 1B) unless the CP provides protection for Openreach to fit.

  However, in a number of exchanges (believed to be less than 20% of frames, and mostly on modular frames) protection on the internal side has not been provided and is therefore required to be fitted using appropriate Jacks Test and Protector Modules on the line side.

  For clarification purposes, the following policy must be applied on all M-side schemes where new cable is terminated on the MDF:

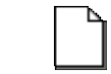
- Work originator to obtain confirmation of protection requirement, i.e. internal or line side

- Where confirmed as line side, cable to be terminated on suitable Jacks Test incorporating protection facility - normally JT 45/ series (ISIS NWK/LNK/C319 has more detail on this)

  Legacy PSTN circuits (Systems X & Y) are currently protected either at the block associated with the PSTN circuit or at the DSL block associated with the circuit (SMPF), sometimes at both blocks. (with modular frames also at the interconnect field panel).

  Some frames will only have line side protection (generally all modular frames and a small proportion of traditional frames using Jack test 4x). On these frames we may need to still provide protection as we cannot easily determine which is legacy and which is MPF/SMPF.

  Exception to this rule is that UDX5 exchanges will need protection at all times on 8/40 line cards using the Protection Module 9C as these cards, under certain line conditions without protection can pose a fire risk. Liaise with the UXD5 team to make sure that the necessary protection is always fitted to



  these line cards. (svce007_lightning for UXD5.doc) from the UXD5 team details what protection should be fitted to the line-card types. If in doubt, contact Barry Saltmarsh (BT TSO).

  All modular frames are fully protected (CODS, CAMS, COSMIC & AUGAT) as a protection module is required to give continuity. CAM frames use the single pin device, so could use the dummy 1A/B modules. If a dummy module is used on CAM frames, then care must be taken to select the correct circuit in the protector field. It may be more cost effective to always fit protected modules.

  Table of when/where to fit protection on Jack Test 40 series MDFs:-

Service	Protector Module
BT PSTN only	Any, except 1A or 1B (note 2)
PSTN & ADSL (not MPF or SMPF)	Module 6C or 6D (note 2)
ISDN	Any, except 1A or 1B
CWSS	Any, except 1A or 1B
DACS	Any, except 1A or 1B (note 2)
Kilo-stream	Any, except 1A or 1B
MPF	Dummy Module 1A or 1B
SMPF	Dummy Module 1A or 1B (note 2)
Any service, If protection is line-side of MDF	Module 6C or 6D (note 2)
Private Circuits	As required

Notes:-

1. Any existing protection is still valid for the service being provided and does not necessarily need to be upgraded to the latest protection module.
2. Exceptions to this table are UXD5 exchanges where special measures must be adopted, e.g. use of Protector Module 9C.
3. Local decisions, due to prevalence of lightning activity or risk of power contact may mean that protection should always be fitted to all MDF ports.

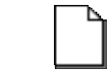
5.1.2 Customer and Route Environment

As part of the process in using the Risk Assessment tool, an assessment of the environment the DP/customer is located in needs to be determined. The environment class for the exchange has already been assessed and is included within the tool.

The environment options are as follows:-

(i) 0 - Urban/City location near tall buildings (above 6 floors). Typical city areas with large & tall buildings surrounding the DP or customer premises
(ii) 0.1 - Urban/City location near medium height buildings (between 3 to 6 floors). City or large Town areas with reasonably tall buildings surrounding the DP or customer premises
(iii) 0.5 - Rural/Suburban area surrounded by other nearby houses (1 or 2 floors).Typical town or large village area, with buildings covering at least 90% of the available construction space near to the DP or customer premises

(iv) 0.75 - Rural/Suburban area partly surrounded by other nearby houses (1 or 2 floors) small town or village, sparsely populated with buildings (50%) or DP or customer premises on edge of a town/village with good population density
(v) 1 - Rural area without any nearby constructions (flat ground) Remotely located DP or customer premises outside of population area



The Lightning Risk Assessment tool is together with the instructions on loading it, etc. Open the ZIP file and then open the Instructions.pdf document.

Note: You will need to secure “Admin Rights” to load the software on a BT PC/Laptop.

5.2 Location of Lightning Protection Devices

Within the BT infrastructure, equipment is far more sensitive to overvoltages than is cable. Protection is therefore provided at the terminal points, that is, the Distribution Point (DP) and the Exchange. Different types and versions of LP devices are available to suit the varying requirements of different installations. For example, plug-in protection modules may be used in exchanges and at overhead DPs whilst wired-in protectors are used in underground joints (see *Figure 5.2*).

Factory assembled lightning protected joints are available, alternatively protectors may be fitted in straight through joints on site as described in Section 10. The earth terminals of the protectors are commoned together and connected to an earth electrode when installed.

The various options on what protector to fit and the earthing methods are details in sections 2 and 3 of ISIS EPT/ANS/A020

For internal DPs the earth connection may be derived internally using the Customers' Main Earthing Terminal (CMET), or Protective Earth Source Adapter 1A (PESA 1A). Not all CMET’s are safely accessible, and may need a Qualified electrician to terminate the earth, the use of the PESA 1A avoids this.

Some protectors are designed not to operate to mains voltage; That is, the firing voltage is set above mains. In these cases it is permissible to connect the earth terminal of the protector to a local power protective earth. [Reason being that in the event of a fault on the protective earth sytem, and it becomes live, then the protector won’t trigger via the telephone line and put people at risk, e.g. at MDF] . For further details of earthing in customers' premises, see Section 10 (and *Figure 10.5*).

For demonstrations of the various Protectors, their use, and providing earths, see the DVD / Video “Lightning – Protecting BT’s Network From It’s Power” – (See ‘Enquiries’, section 16 for details)

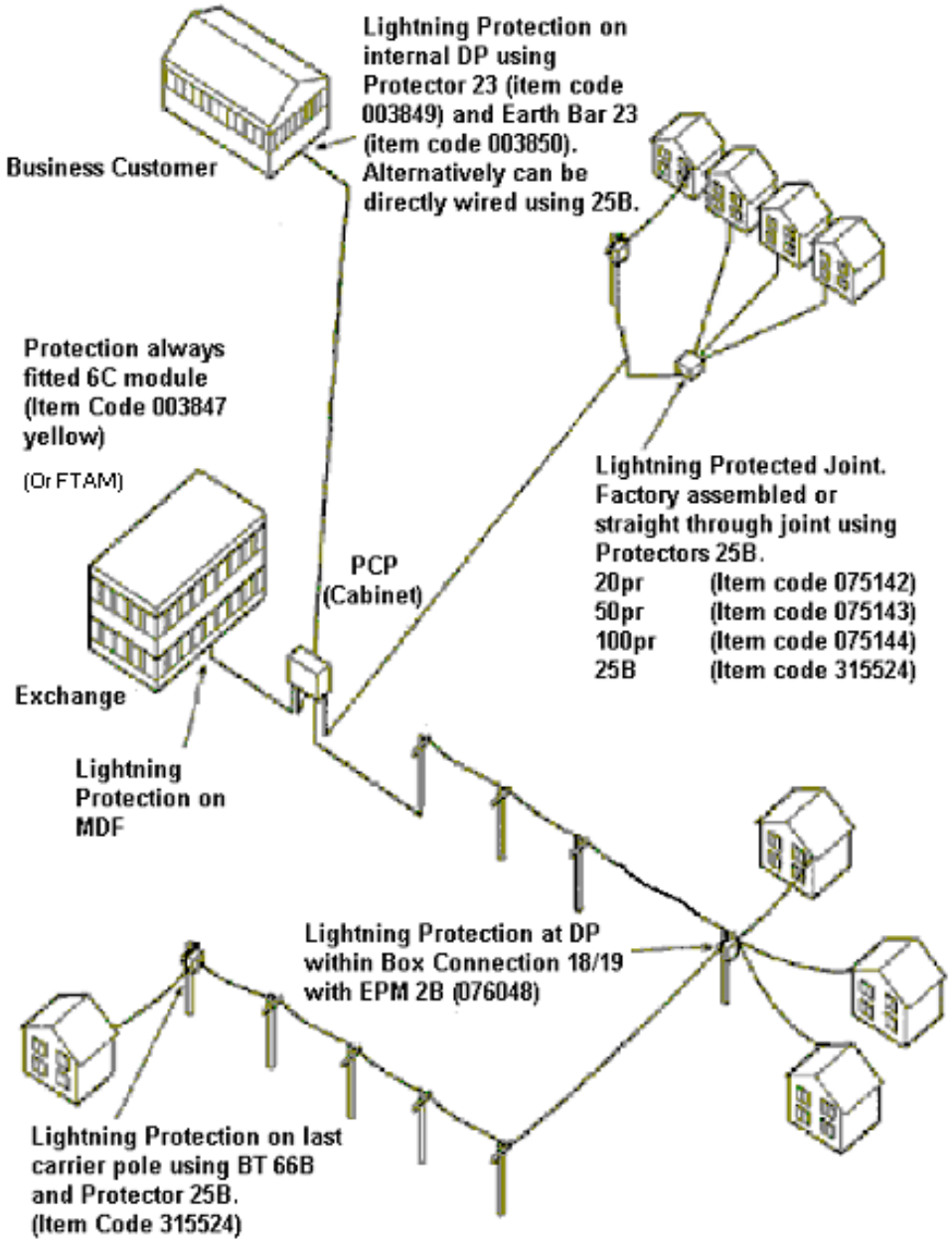


Figure 5.2: Location of Lightning Protection Devices in the Network

5.3 Lightning Retarding Loops/Coils

Whilst we do not actively attempt to protect the network from direct lightning strikes, there may be occasions where it is beneficial to limit the extent of damage to a long route in a remote exposed area.

Lightning retarding loops are not a new idea and where used in the network many years ago. They work by presenting a small common mode inductance to the line when a common mode surge (e.g. lightning) is present. This inductance acts like a high Ohmic resistor and effectively blocks the passage of the surge, but as the current flow it is retarding is potentially very high it can cause the loop to fracture the cable (i.e. it is sacrificial) at the entry point to the loop and so prevent the passage of the surge further along the route.

Lightning retarding loops will not stop damage (as described above), but can limit how far a surge travels and can, for instance, limit the damage to a section between two poles. As with all lightning protection, especially that for direct strikes, it is not a forgone conclusion the method will work in all circumstances.

When using such loops, remember to take into account the affects this will have on the customer, as each loop location can add a few of metres in line length and hence increase loss. Also, if locating a fault on a line with these loops it will affect the location distance, so again account for the extra line length when measuring the route.

The loop is formed from the aerial cable/dropwire used for the route and consists of 3 – 6 turns of cable approximately 30cm - 50cm in diameter. This is similar to a drip loop at a customer premises, but with a few turns instead of one. It should be positioned between the cable clamps and the pole (i.e. not stressed by the aerial route). The loops should be lightly cable tied together at 3 or 4 points around the circumference, and fastened to the pole to avoid stress on the cable in windy conditions. All practices relating to pole access and safety must be adhered to at all times.

6 *Testing on Lines Fitted With Protectors*

The minimum d.c. limiting voltage of Protectors suitable for use in the external network is 140V d.c. as measured between line terminal and earth or between line terminals.

> **Caution:** The use of test voltages above 120V d.c. will likely give false insulation resistance (IR) readings due to the protector operating. It will not damage the protector if a higher test voltage is used.

7 *PSTN Master Socket*

The Network Terminating Point (NTE) contained a 2 terminal protection device until 2012 and it has now been removed. This device was not suitable for providing lightning protection because it did not have a discharge path to earth. It was fitted to reduce spurious clicks on the line due to electro-mechanical switching at the exchange – no longer required since the network has evolved to being solid-state.

If the line meets the criteria for lightning protection to be provided then 3 terminal devices should be fitted at the DP, etc. as described in this document.

8 *Lightning Protection at Exchanges*

In most cases lightning protection has been fitted on the internal equipment side of the MDF. This occurred at the time of exchange modernisation when the Jack Test 44 to 49 range of MDF blocks were introduced and used to terminate the, then new, System X/Y Switches onto the internal side of the MDF. Older MDF blocks on the external side of the MDF will not take the modern protector modules. Where protection is fitted on the internal side of the MDF, then this practice should continue unless instructed otherwise, e.g. EvoTAM (see 5.1.1). Frames that have been replaced in recent years may have modern Jacks Test fitted on the external side, in which case protection should continue to be fitted there. (For details on the provision of the Exchange Earth – see Earthing Manual ISIS EPT/PPS/B025)

In general, it is not proposed that retrospective action will be taken in respect of protection at Exchanges. However, where there is a history of lightning damage, the following action should be taken:

See section 5.1.1 for other information regarding exchange end protection.

Protector Modules should be replaced when existing modules are removed for maintenance or new provision/change of service.

Jacks Test	Protection Module
45 or 47	Replace 1A and 2A with 6x (or FTAM) x = A,B,C or D
39 or 40	Replace 14A/21A with 22C*
Any Other MDF Block	
Upgrade to Jacks Test 45 or 47	As above

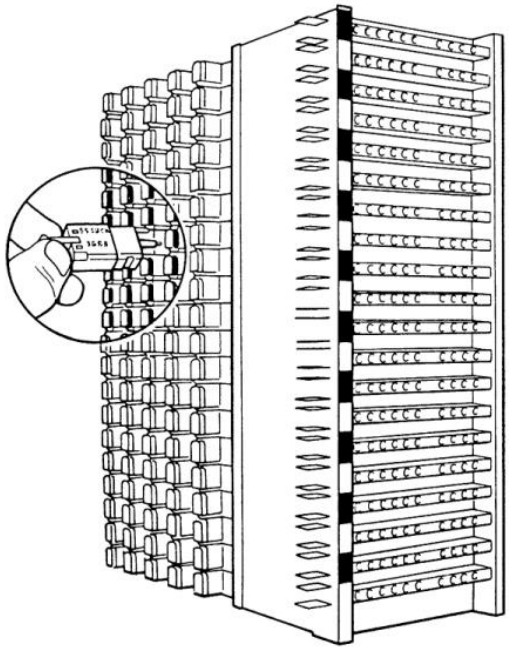
** There is no contract cover on this item – due to very low volumes – if required these can be obtained from Littelfuse at Swindon. (Paul Turner)*

UXD5s

Caution: UXD5 exchanges fitted with Jack Test 45 - 47 should be fitted with Protector 9B or 9C which supersedes the 4A (coloured yellow) and PM 9A, and contains series fuses required for the 8/40 linecard. *(Refer to UXD5 Support Group service notes).* The UXD5 Support group has very comprehensive documentation on which protectror is suitable for which line card. Failure to observe the correct protector can result in a linecard fire in the event of a power contact fault on the network. These devices **MUST NOT** be used on non-UXD5 switches.

Refer to Section 5.1.1 for full details of what protection components to fit at the MDF.

Figure 8.1 Protection Modules at Exchange



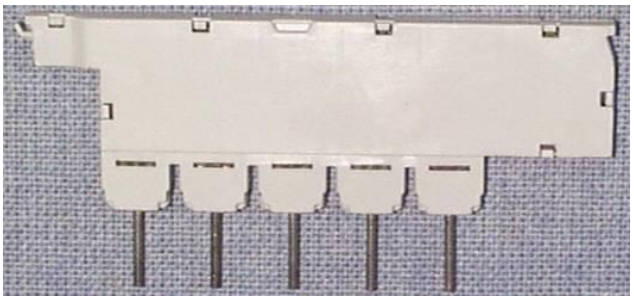
EvoTAM Protection

Exchange side MDF blocks where EvoTAM tie cables are terminated no longer need lightning protection fitted. A risk assessment has taken place and been approved by the Chief Engineer, Service Provision and Service Delivery, this also aligns with LLUTAM tie cable installation practice. Retrospective action is not required.

FTAM Protection Cartridge

In line with Recent ADSL provision, a new test access product has been introduced, which mounts on the protection ports of the Porta MDF Block, replacing all the existing protectors. This is called the Frame Test Access Module (FTAM) and offers Test access, whilst maintaining protection equivalent to a protector 6C/D. *(See Figure 8.2)*

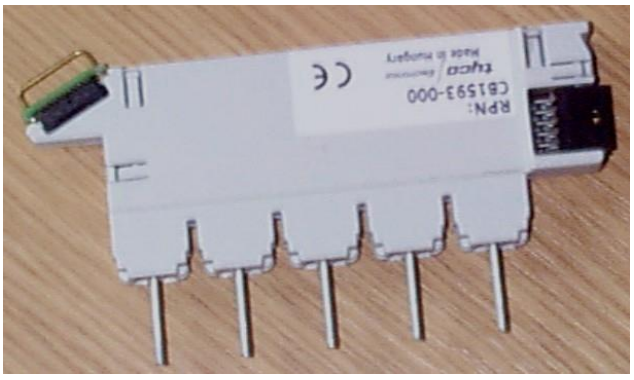
Figure 8.2 – The FTAM Protection Cartridge



Transfer Engineer Shoe

As part of the move to 21CN, a method of migrating from the old network to the new is being implemented of some frames. This involves the fitting of a protection device, similar to the FTAM module, but without any TAM facility. The protection components are equivalent to a 6C/D module. A cable attaches to the rear of the shoe to go to the 21CN switch and a plug on the front can be removed to disable the old 20C network. *(See Figure 8.3)*

Figure 8.3 - The TCP Shoe



9 *Selecting the Type of Earth Electrode for External Network Applications*

Equipment connected within the network is far more susceptible to damage than is the cable itself. Protection is therefore provided at the DPs and at the exchange. Section 9.1 indicates the various options available to provide a reliable Earth Electrode. The work originator will choose the most efficient & cost effective method for providing a reliable earth electrode, bearing in mind local conditions and concurrent works. (For details on provision methods, see Access Network Specification ISIS EPT/ANS/A020)

*At points where lightning protection is provided all pairs within the closure must be connected to earth via the protectors. All other continuous metallic components such as armouring and suspension strands must be bonded to the same earth as the protector. *

See also Lightning Protection from Mains-borne surges, Section 10.2.

9.1 Supplementary Provision of a Lightning Protection Earthing System

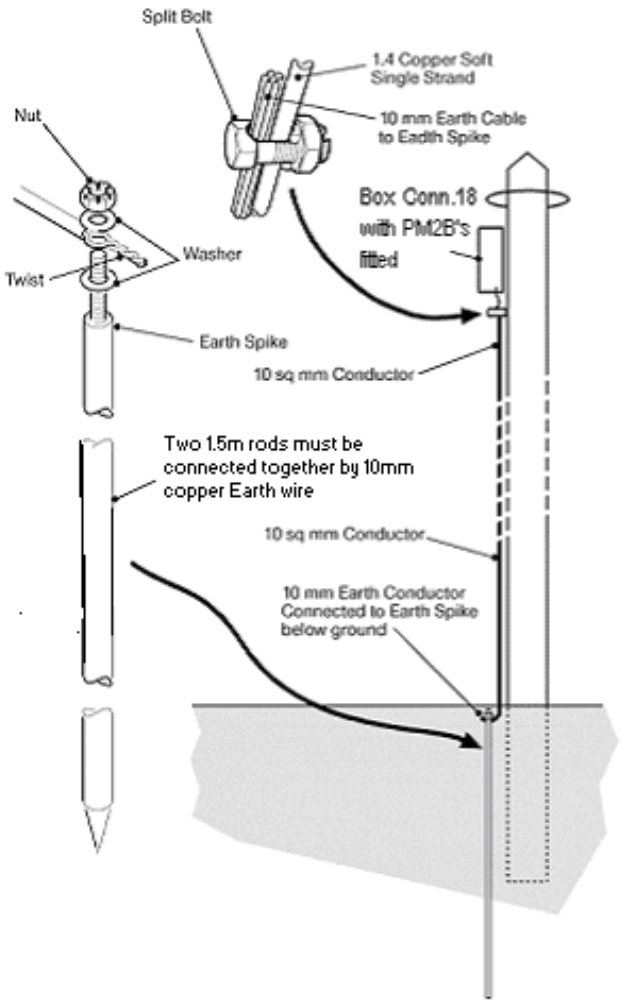
This section describes alternative earthing methods that could be used to compliment those described in ISIS EPT/ANS/A020

Under no circumstances should a supplier provide an earth bond that compromises the effect of insulators in suspension wires.

9.2 Cost Effective Provision of Earth Electrodes when Poles are Provided/Renewed

When a decayed pole, low wire pole provision or new build pole provision that has been identified as requiring lightning protection, is renewed / provided then lightning protection should be fitted at that time. This will avoid the need for a special visit and allow the earth electrode to be provided cost effectively. Any of the methods shown in section ISIS EPT/ANS/A020 may be used to achieve a cost effective solution.

Figure 9.3 Example of provision of earth electrode at overhead DP at the time the pole is provided/renewed (One of the earth rods may be placed in the pole hole)



Note: **SAFE DIGGING PRACTICES MUST BE FOLLOWED (ISIS REF. SFY/ESP/C026)**

Two Earth Rods should be provided except where the presence of other services prevent this in which case Copper Tape under the pole should be employed.

If the existing DP is not a Box Conn 18/19 and it does not need changing then the Earth Cable should be left just below the DP in the Split Bolt such that it can be connected to the Box Conn when it is replaced.

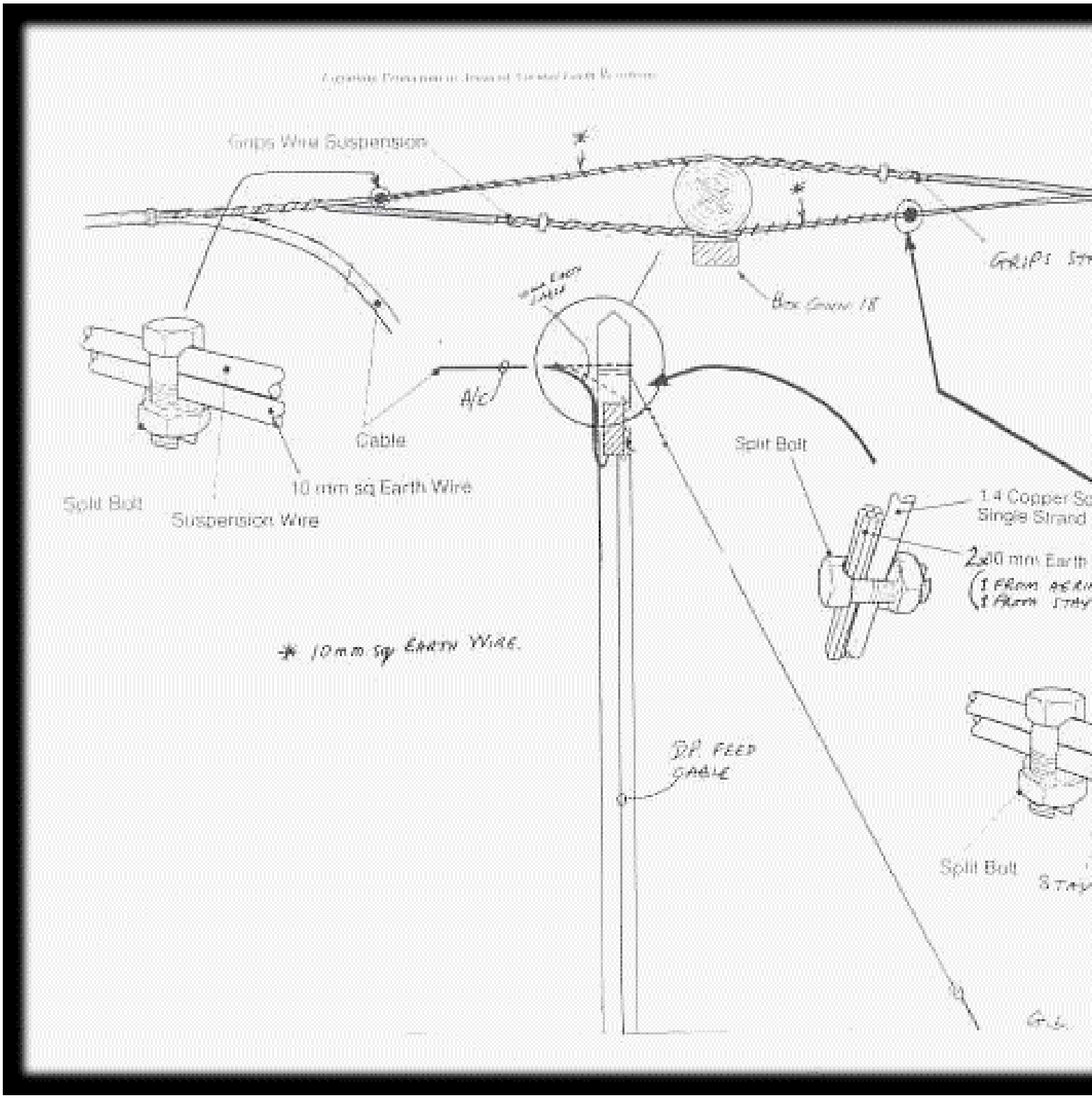
9.3 Method of Connecting to a Stay for Earth Point Usage

This method of obtaining an earth connection may be used where it is not possible to provide earth rods.

This method provides a solution for pole routes that need to be protected retrospectively where it may not be possible to fit a spike due to localised ground services such as gas, electric, water mains etc.

The method described here is to be used where lightning protection is required at an existing pole which does not require replacing in an area of normal earth resistivity. If the existing pole being protected does not have an existing stay but requires one to ensure route stability then this method may also be used.

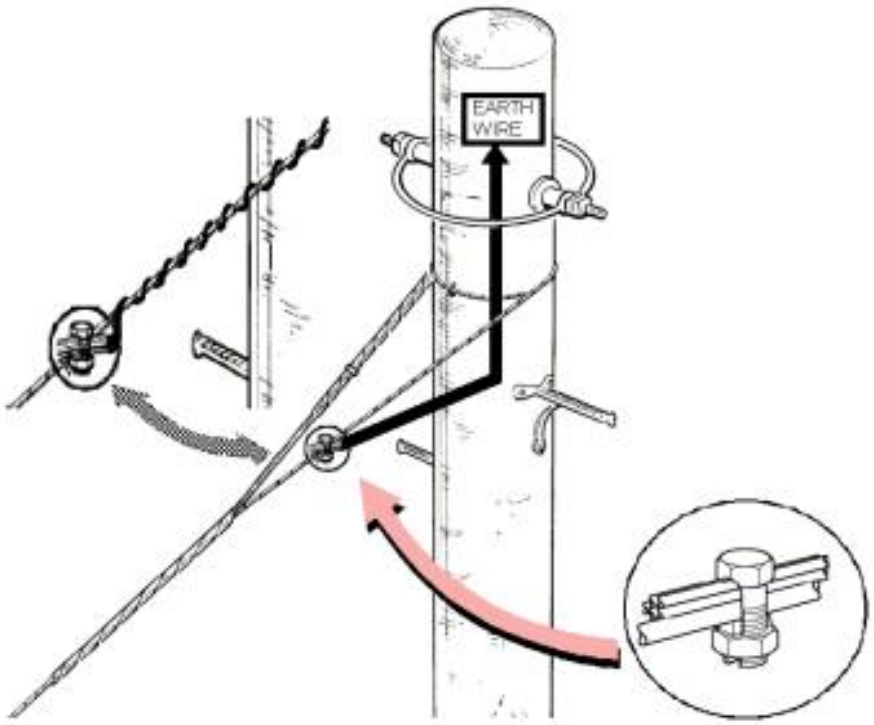
Note: When making a connection to an earth rod or using a split bolt then over tape connection with tape


Grips Wire Suspension
Cable
A/C
Split Bolt
10 mm sq Earth Wire
Split Bolt
Suspension Wire
Split Bolt
* 10mm sq EARTH WIRE.
DP FEED CABLE
Split Bolt

9.3.1 Method of Connection

Measure and cut a length of 10sqmm Earthing Cable (sufficient to link from the end of the stay grip (nearest the ground level) to a connection point on the side of the pole next to the block terminal or joint. Allowing for the cable to be bound onto, or twisted around the stay wire back up to the pole). Add approx 200mm extra allowance onto the length. Then strip 25mm insulation from both ends of the earth wire. Fit the earth wire into place on the stay wire and pole down to the connection point by the block terminal or joint position.

At the end of the stay wire (within the termination at the pole top) fit the stay wire into the slot of a Split Bolt. Then fit the stripped end of the pre-measured earth cable into the same slot on the spilt bolt and tighten the locking nut of the split bolt to ensure a solid connection.



9.3.2 In-line Joint Connection

If a Lightning protection in-line joint has been constructed on the pole then measure the 10sqmm earth wire cable from the joint to the connection point, cut to length and strip 25mm of insulation from the free end. Fit the stripped free end of the earth cable from joint into the slot of a split bolt, then add into the same slot the stripped end of the earth cable from the stay wire and

tighten the locking nut of the split bolt to ensure a solid connection. Fix to pole with Straps12A.

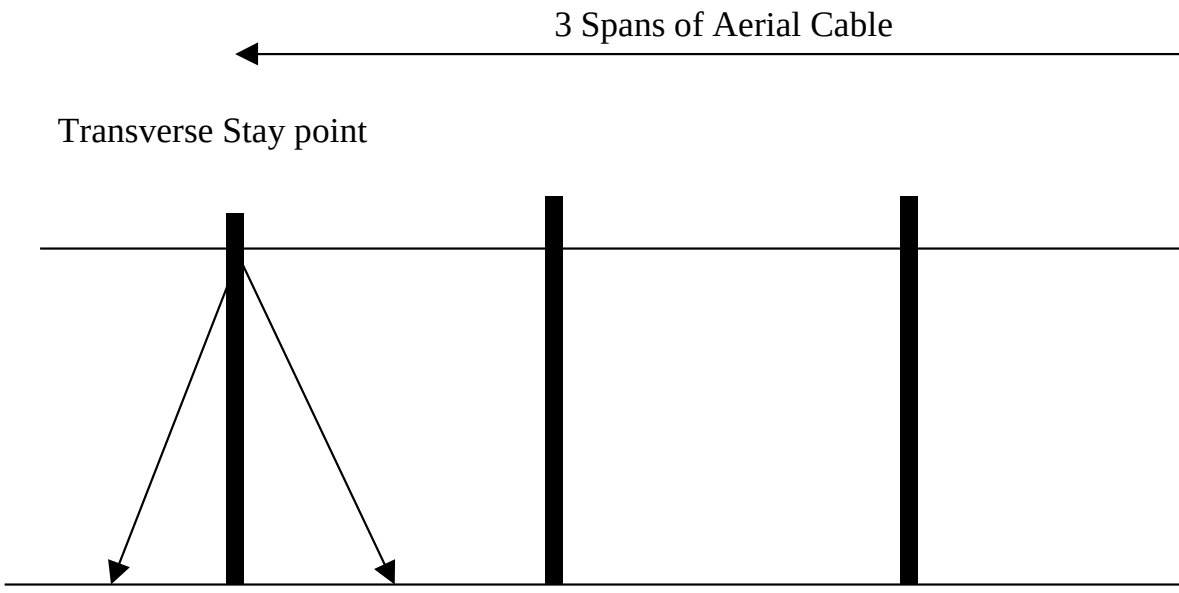
9.3.3 Block Terminal/Box Connection

If Block Terminal/Box Connection is being used to provide lightning protection then measure (either 10mm earth wire or 1.4 mm copper soft) length from the block terminal earth bar screw connection to the connection point. Cut to length (and if earth cable used, strip 25mm insulation off the connection point end). Fit stripped end of earth cable or wire copper soft from block terminal into the slot of a split bolt. Then add into the same split bolt slot the stripped end of the earth cable from the stay wire and tighten the locking nut of the split bolt to ensure a solid connection. Fix to pole with Straps12A.

9.4 Aerial Cable Suspension Wire Earth Bonding

Additional earth protection to the aerial cable section can be gained by bonding the aerial cable suspension wire to the stay earth connection. This can only be done if power attachments (joint use etc) have been isolated correctly from the earthed section of the suspension wire. Plus it is only effective if additional stays along the route are no more than 3 spans away and are similarly bonded to the suspension wire.

Note: If insulators exist within the additional stay construction then bonding will not be effective.



Caution: Do not cut into a straight through section of aerial cable suspension wire to make a bonding point. True bonding connections can ONLY be achieved at a full termination of the aerial cable or using the Telenco Earthing & Bonding Clamp (EC13)

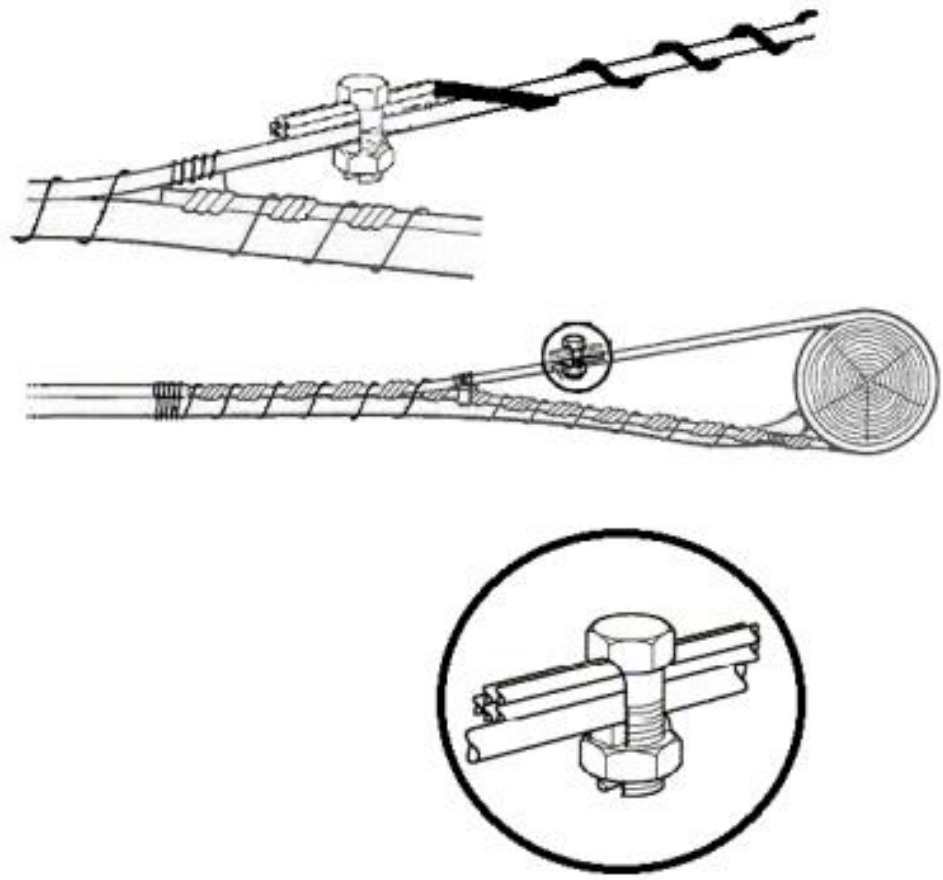
9.4.1 Method of Connection

9.4.1.1 (Using Split bolt on Bared Aerial Cable suspension Wire)

Measure and cut a length of 10sqmm Earthing Wire (sufficient to link from the bare end of the suspension wire (furthest from the pole) to a connection point on the side of the pole next to the block terminal or joint. Allowing for the cable to be bound onto the suspension wire back to the pole). Add approx 200mm extra allowance onto the length. Then strip 25mm of insulation from both ends of the earth wire.

At the open/bare end of the suspension wire (within the termination at the pole top) fit the suspension wire into the slot of a Split Bolt. Then fit into the same slot in the split bolt the stripped end of the pre-measured earth cable and tighten the locking nut of the split bolt to ensure a solid connection. Bind the earth cable to the stay wire and secure to the pole down to the connection point by the block terminal or joint position.

Then connect to the earth cable from the stay as described in section 9.3 above



9.4.2 Method of Connection

9.4.2.1 (Using Telenco Earthing & Bonding Clamp (EC13) onto Unbared Aerial Cable Suspension Wire)

The method used similar to the split bolt method (section 9.4.1 above), except that the Telenco Earthing and bonding clamp does not require the removal of the sheath from either the Aerial cable Suspension wire, or the 10sqmm earthing wire, but displaces the sheathing on tightening the bolt. *(See figure 9.4)*

Then connect to the earth cable from the stay as described in section 9.3 above.

Figure 9.4 – Connecting 10sqmm Earthing wire to "Unbared" Aerial Cable Suspension wire.

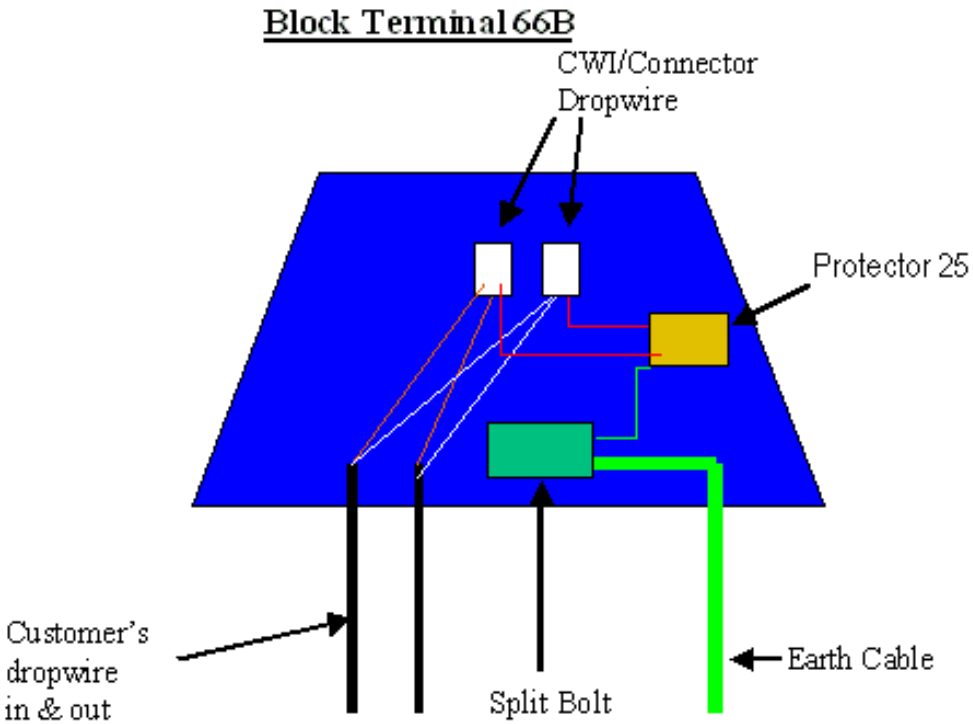
9.5 Dropwire Connection to an Earth Cable

To fit lightning protection on a customers line in the dropwire a joint must be made at the correct location (worksite).

9.5.1 Method

Whether the earth point is to be a spike in the ground, stay wire or any other type of fixing, connect up and run the earth cable from the earth point. Pre-prepare the 10mm earth wire to the proposed jointing position in the BT66B and strip approx. 25mm of insulation from the earth wire.

If dropwire existing, confirm location of required lightning protection and as part of this ensure that sufficient slack for a joint exists. Fit BT 66B to pole at required joint position. Using a tee type connector (either CWI8B or an appropriate connector dropwire for the dropwire type) tee in the red wires from the protector 25 to either leg (A & B) of the customers line. Then strip 25mm of insulation from the protector 25's green wire (This wire to be cut back as short as possible and NOT left with Surplus coiled up, as this could compromise the protection due to the inductive effect of this coiled wire with lightning surges) and fit the bared wire into the slot of a split bolt connector. Finally fit the stripped end of the pre-measured earth cable into the slot of the same split bolt connector and tighten the locking nut of the split bolt to ensure a solid connection.



9.6 Underground, Overhead & External dps

9.6.1 Protected Joints

Protection is provided using protectors housed in factory assembled lightning protected joint. The protected joint is connected to the network using a teed joint. The teed joint will be made in an appropriate Cap-Ended or In-Line Joint Closure. The protected joint must not be used as a flexibility or testing point.

Type of Joint	No. of Pair	Sleeve	Item Code	CWIs	Cable	Cable ELP 6491 10mm GN/Y
	20	Sleeve 30P	075142	Supplied	Supplied	Supplied
Pre-assembled	50	Sleeve 31P	075143	Supplied	Supplied	Supplied

Joint	100	Sleeve 32P	075144	Supplied	Supplied	Supplied

Table 9.1 Stores List for Preassembled Protected Joints

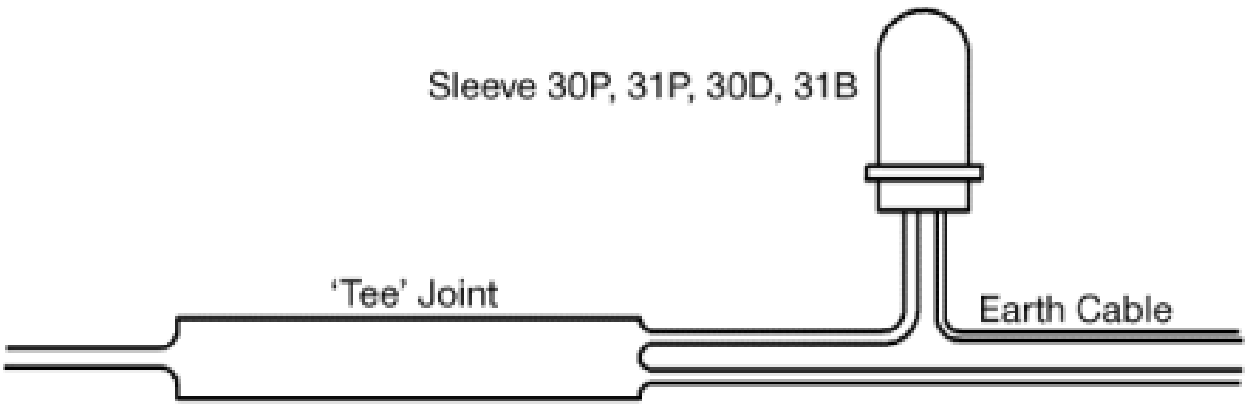
Installing the Pre-assembled Tee Joint

Tee the pre-assembled protected sleeve into the cable to be protected. Construct the tee joint using an appropriate Cap-Ended or In-Line Kit Joint Closures. Normal jointing and closure methods apply. The cable should be short as is practically possible and should not have any sharp bends or loops. Cut off any surplus, *see Figure 9.6*

Replacement of Protectors

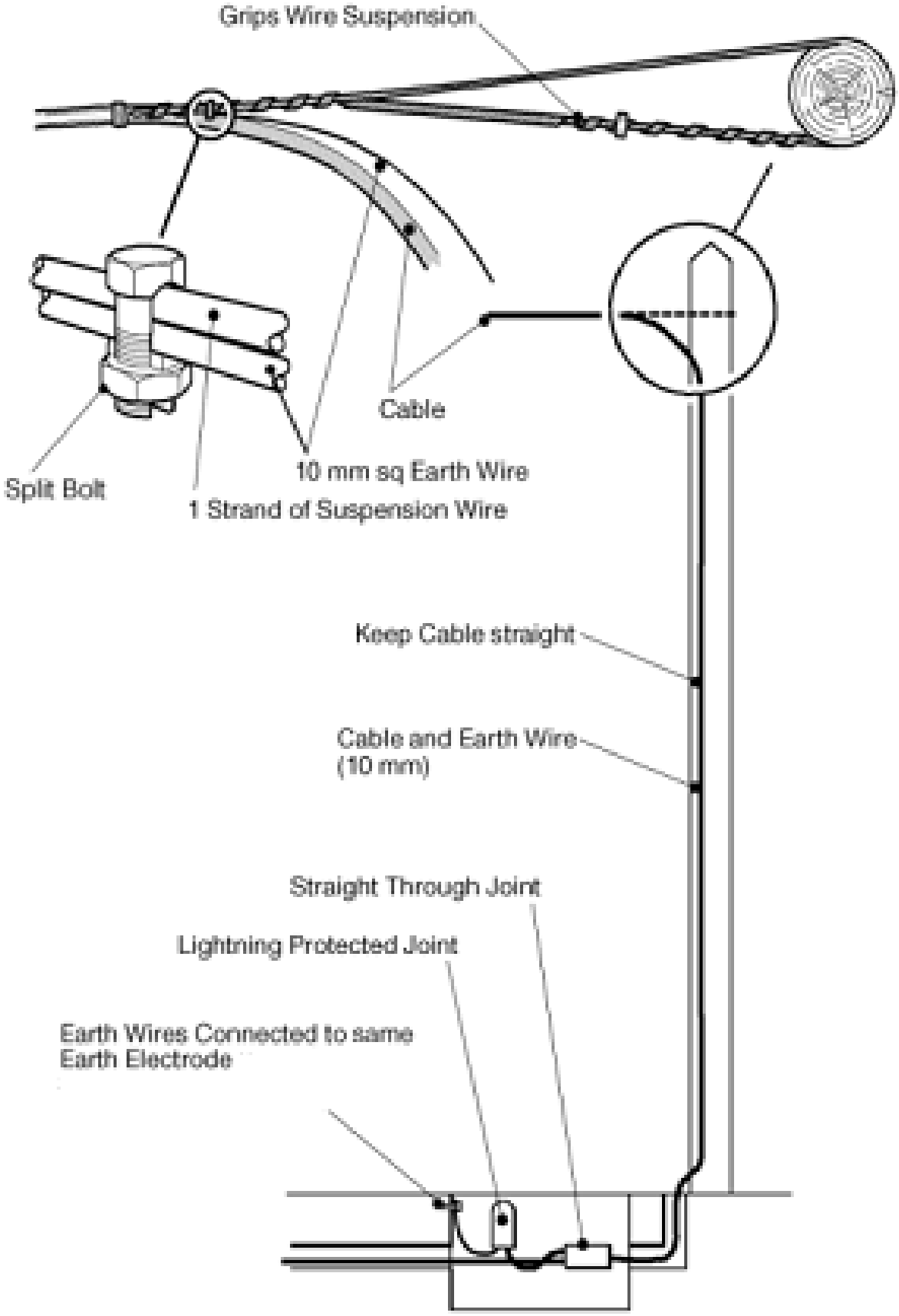
If a protector within a protected joint is found to be faulty the 1024 procedure should be used to replace the whole joint. Protector 25B can be used to restore service as a temporary measure.

Figure 9.5 Protected Joints



'Tee' Joint with Remote Protection

Figure 9.6 Example of Protection in UG DP at the end of Aerial Cable Route


Grips Wire Suspension
Cable
10 mm sq Earth Wire
Split Bolt
1 Strand of Suspension Wire
Keep Cable straight
Cable and Earth Wire
(10 mm)
Straight Through Joint
Lightning Protected Joint
Earth Wires Connected to same
Earth Electrode

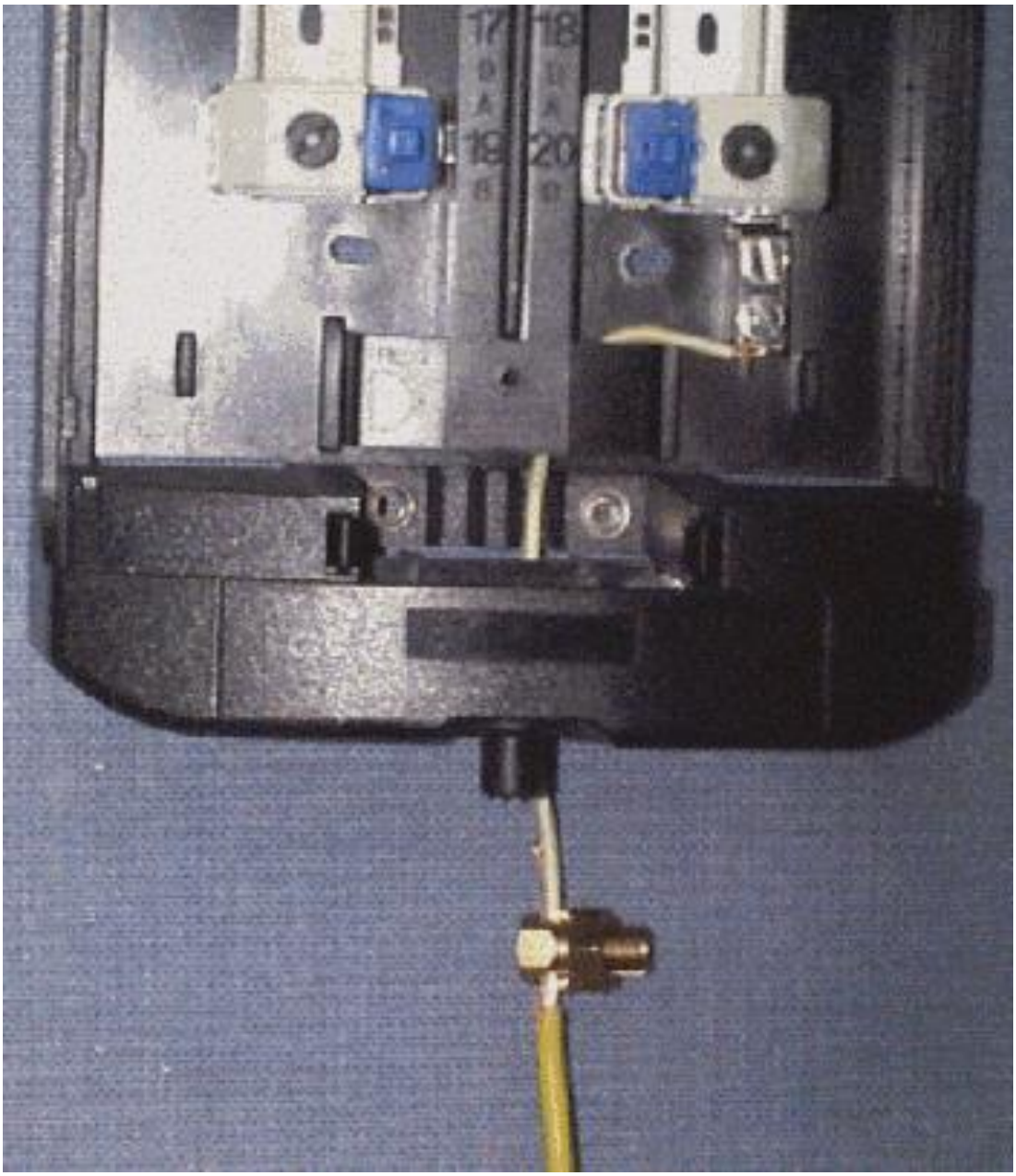
Where lightning protection is provided in underground DP at end of aerial cable route suspension strand should also be connected to the earth electrode. (see Sections 9.4.1 & 9.4.2 for connection to Aerial cable suspension wire using Split bolt or Telenco Earthing & Bonding Clamp)

9.6.2 Protected Box Connection on Pole Tops or Walls

The Modular Box Connection 18A / 19A with lightning protection in the form of a plug-in module (see *Figure 9.7*) is to be used.

The Modular Box Connection has been designed as a modular system. It consists of a Box Connection 18A (box) and up to 20 External Connection Modules, or a Box Connection 19A (box) and up to 10 External Connection Modules. There are two types of Protector module available (to fit into the connection module) they are, the External Protector Module 1A (dummy modules) and if protection is required the External Protector Module 2B (protectors).

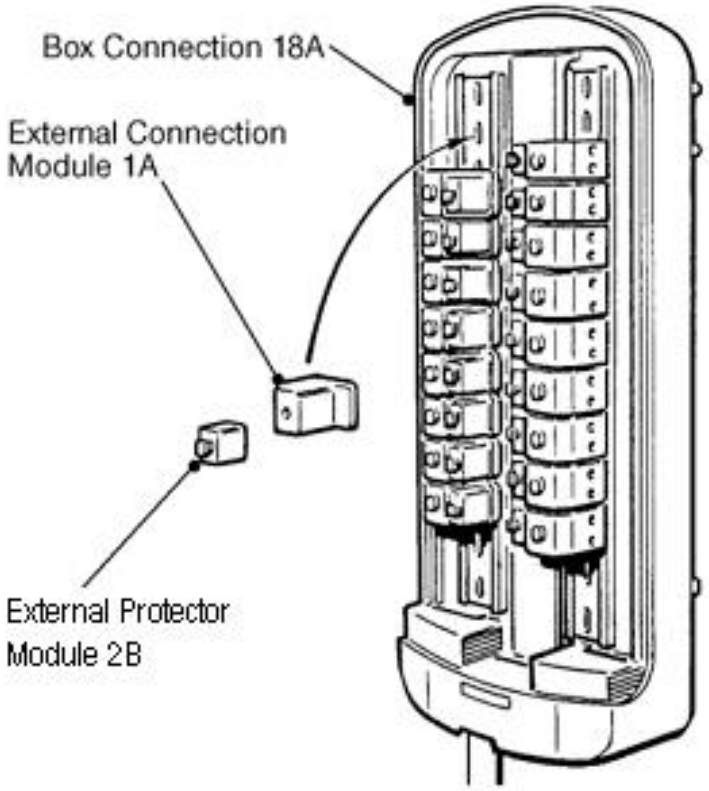
All such DPs require a connection to earth to allow the protectors to function.



Connect 1.4 Copper Soft Single Strand to 10 mm earth cable using split bolt

Note: It is possible (if no copper soft or spare split bolt held) to connect the earth wire directly into the Box Connection using 2 strands of the earth wire connected under the earth screw connection and bending back the excess wire left taping it to the cable sheath (for reasons of safety).

Figure 9.7 Protector Module and Box connection 18A



9.6.3 Protection in Hollow Poles

Lightning protection must be either fitted in the joint box next/prior to pole using through joint or preassembled joint, or may be installed on the BT 71A within the hollow pole. (The earth may also be derived from within the pole itself – see ISIS EPT/ANS/A020)

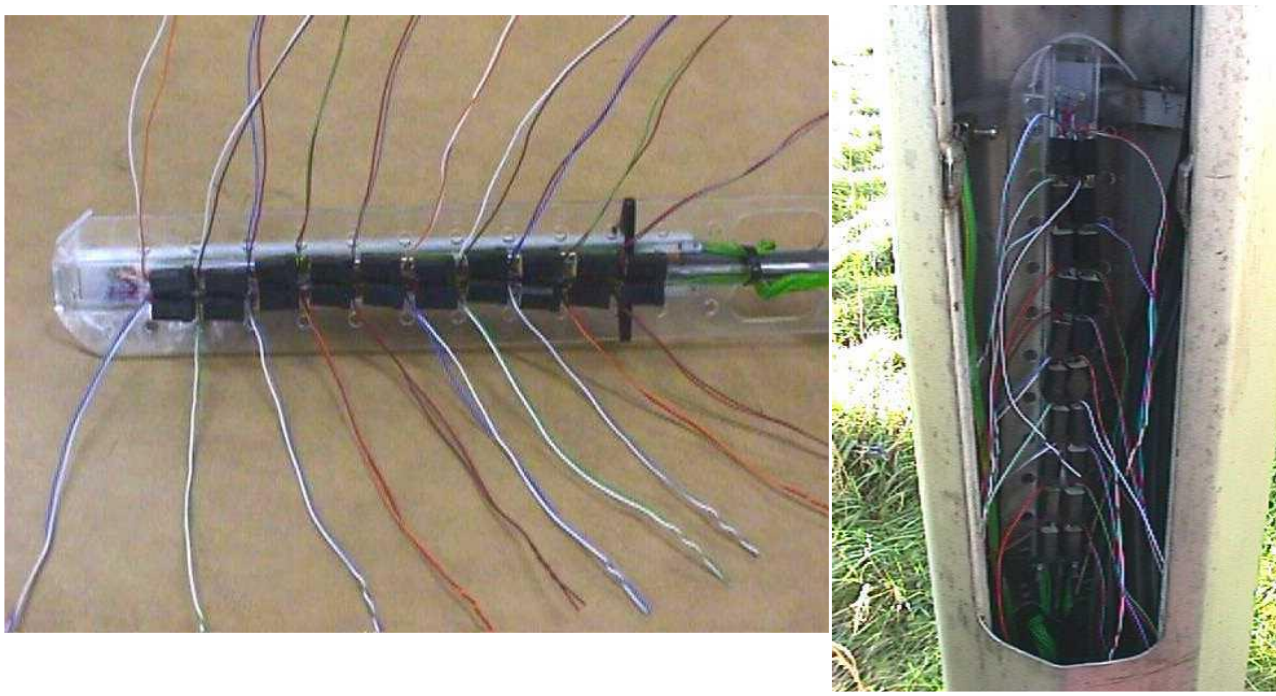


Figure 9.8 – LP fitted to BT 71A

9.7 Internal dps

Facilities exist for fitting lightning protection to internal DPs. When the DP cable is terminated on Krone 237A modules, Protector 23B or 23C (003849 or 033270) and Earth Bar 23 (003850) should be used as shown. If Jack Test 44 to 49 exist at customers premises, then fit Protector 6C or 6D (as used on MDF). Where neither of these methods can be used, crimp wire end protector 25B to the pairs as required.

For some installations (eg remote MOLO sites) Internal Lightning Protection is to be standard for all “at Risk” Services. (See Service specific Installation Policy Documents – eg CWSS & ASDH/HDSL).

At some installations, (eg Remote MOLO sites), space will be at a premium, and “Box Conn 220A – Swivel 20 Pair” (item code no 015621) has been introduced. This allows the provision of a Krone 237A module, earth bar 23, and protectors 23, onto a hinged mounting, Giving an overall “reduced headroom” requirement. *(See figure 9.11)*

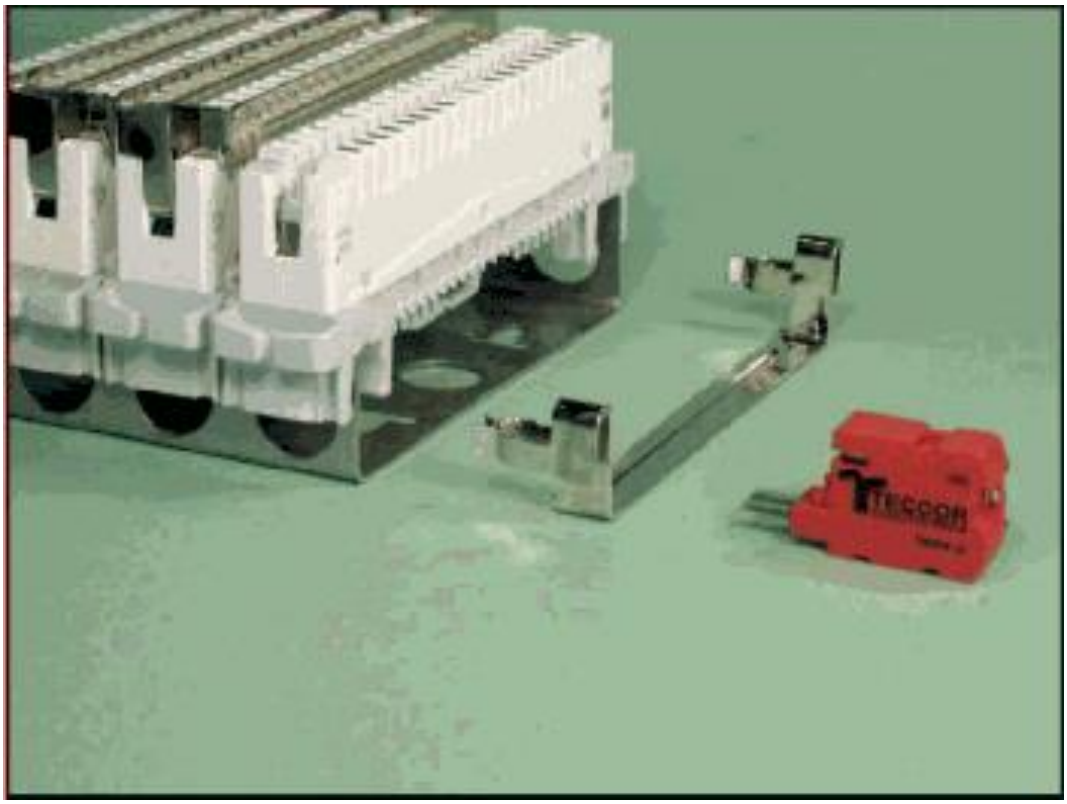


Figure 9.9 Protector 23 and Earth Bar 23

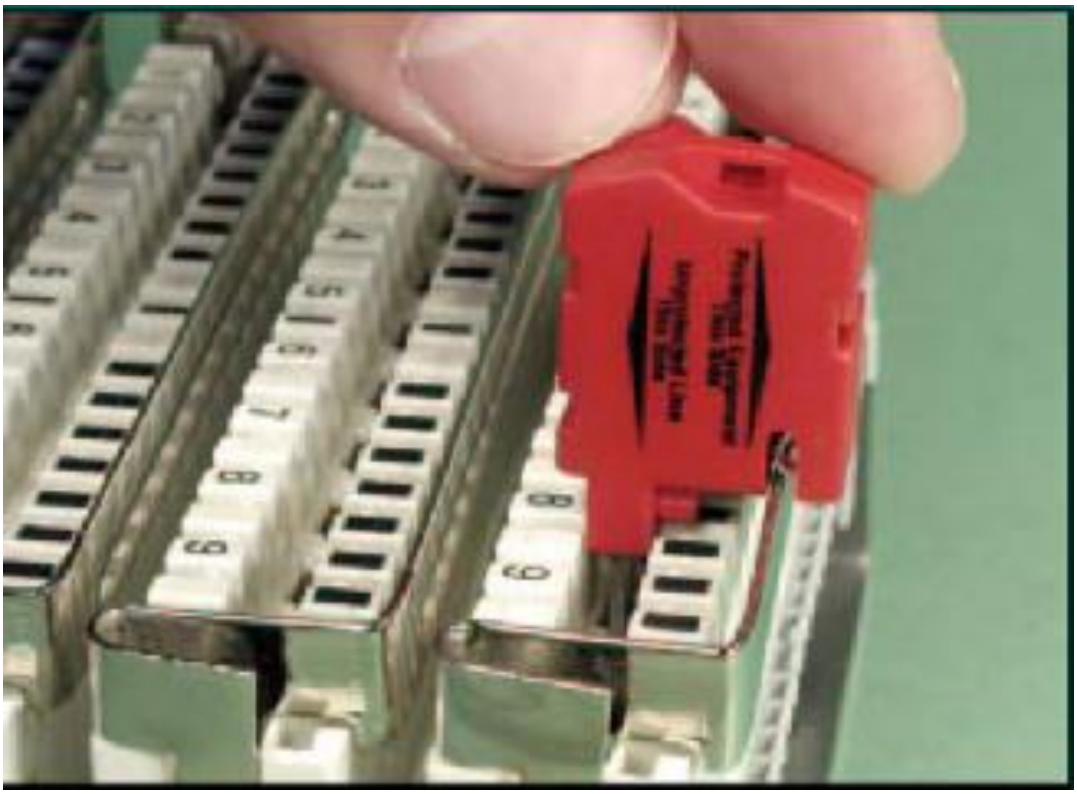
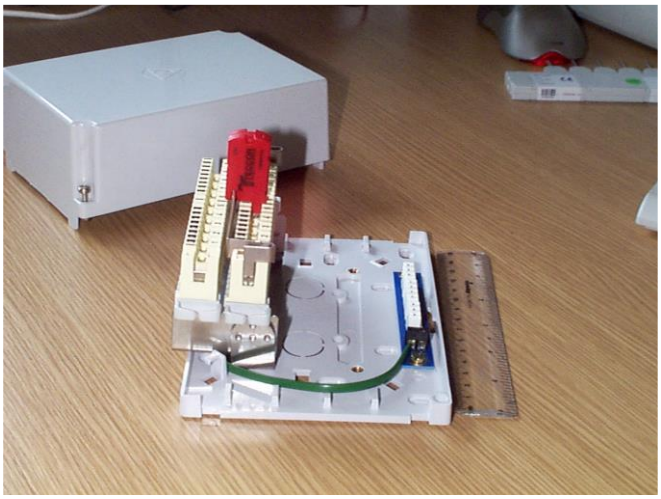


Figure 9.10 Inserting Protector 23 into Krone 237A modules



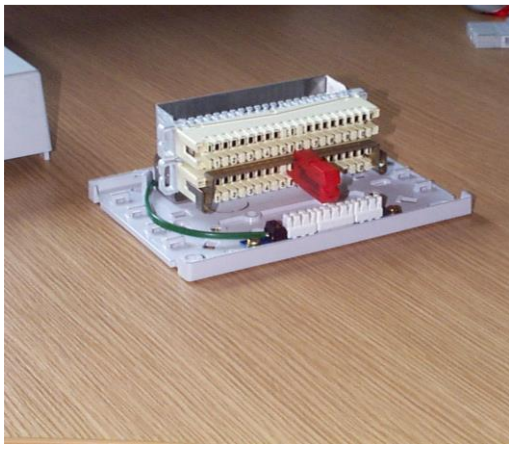


Figure 9.11 – Box Conn 220A - Swivel 20 pair

10 *Lightning Protection on Route*

This document defines minimum levels of lightning protection. In areas where there is a history of lightning damage, local managers may feel a higher level of protection is justified, for example on route protection in addition to protection at the DP.

Where sections of plant are frequently damaged by lightning surges, install protected joints either side of the vulnerable section so that induced surges are contained and discharged to earth. This will restrict damage to starter cable sections or even eliminate damage altogether.

Lightning protection on route may be provided in one of the following ways:

For non-pressurised distribution cables:

- Pre-assembled Tee Joint (see Section 9.6.1)
- In-Line Joint (see Section 10.1.1).

For pressurised cables:

- In-Line Joint (see Section 10.1.1)

For transverse screen cables:

- In-Line Joint (see Section 10.1.1).

For aerial optical fibre cables:

- Constructed Tee Joint (see Section 12).
- Whilst protection at cabinets is not normal practice it can be considered. The best means is to tee in at a nearby joint. Make sure that the glover barrier (where present) is also earthed.

10.1 Installing In-line Lightning Protection at Underground Joints

This practice is suitable for Junction cables up to 104 pairs and distribution cables up to 100 pairs.

Details for installing protection on modular joints will be supplied with the appropriate kit.

* All pairs within the closure must be connected to earth via the protectors. All other continuous metallic components such as armouring, moisture barrier and suspension strands must be bonded to the same earth as the protector.

* To stop water penetrating into the joint, the earth cable should be blocked by removing 50mm of it's sheath, at a distance of 100mm from the cable end. Twist the cable to separate the conductors, and install a piece of 28-6mm tubing heatshrinkable over the bared conductors. This provides a water block.

10.1.1 Preparing for Jointing

Using *Table 10.1* as a guide, select the required sheath closure for the joint.

Follow normal joint preparation practices.

Cable Type and Size	**Protector 25B (Quantity)**	**Tubing H-S 28-6mm**	**Sheath Closure**	**Cable ELP 6491 10mm GN/Y**
14 pair PEQ No. 6	15	1	KJC 4S	As required
28 pair PEQ No. 6	29	1	KJC 4S	As required
60 pair PEQ No. 6	61	1	KJC 4A	As required
104 pair PEQ No. 6	105	1	KJC 4A	As required
20 pair PET	20	1	In Line Mechanical Closure Large (Item 021086)	As required
50 pair PET	50	1	In Line Mechanical Closure Large	As required
100 pair PET	100	1	In Line	As required

			Mechanical Closure Large	
20 pair TVS	21	1	In Line Mechanical Closure Large	As required
40 pair TVS	41	1	In Line Mechanical Closure Large	As required
80 pair TVS	81	1	In Line Mechanical Closure Large	As required

Table 10.1 Stores List for Lightning Protection within In-line Joints

10.1.2 Cable Jointing

Cut the red leads of the required number of Protectors 25B to 90mm lengths.

Take the first pair to be jointed from each side of the joint and separate the ‘A’ and ‘B’ legs. At a point 40mm from one end of the jointing gap twist the two ‘A’ legs together and cut the ends of the twisted wires to a length of approximately 30mm.

Position one red lead from a Protector 25B alongside and level with the end of the twisted wires. Place a Connector Wire Insulated (CWI) No. 8B over the end of the three wires. Push the connector over the wires until they butt against the inner end of the connector. Crimp the connector using Pliers Crimping No. 8B. Repeat for the ‘B’ wire using the other red lead of the same protector (see *Figure 10.1*).

Joint screened conductors using the “twist and solder” method.

Repeat this operation with subsequent pairs at intervals of 30mm across the jointing gap finishing at a point 40mm from the other end of the jointing gap (see *Figure 10.2*).

Joint the screening tapes of a Transverse Screen cable using standard methods. Joint the two red leads of a Protector 25B to the jointed Transverse Screen tape using Connectors Screen 1A and Pliers Crimping No. 10A. Use one connector for each wire.

Joint the two red leads of a Protector 25B to the moisture barrier, if present. The connections should be made using a single Kits 267A and a Riveter 1A.

Lay the connectors or soldered nibs along the joint in a direction towards the earth cable end of the joint. Lay the protectors in the opposite direction to the connectors (away from the earth cable end of the joint).

Note: Do not coil wires.

Figure 10.1 Positioning Protector 25B

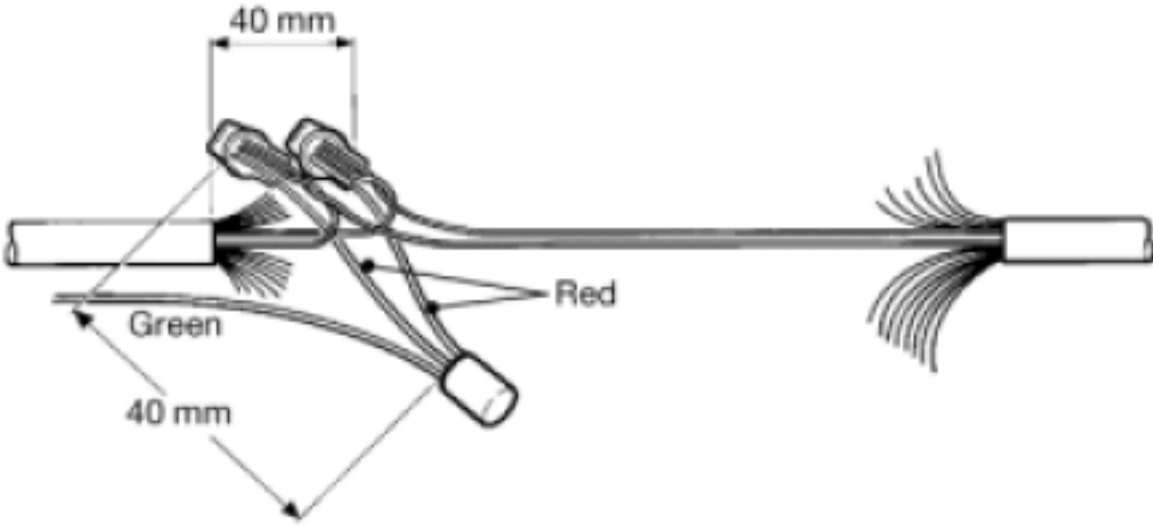
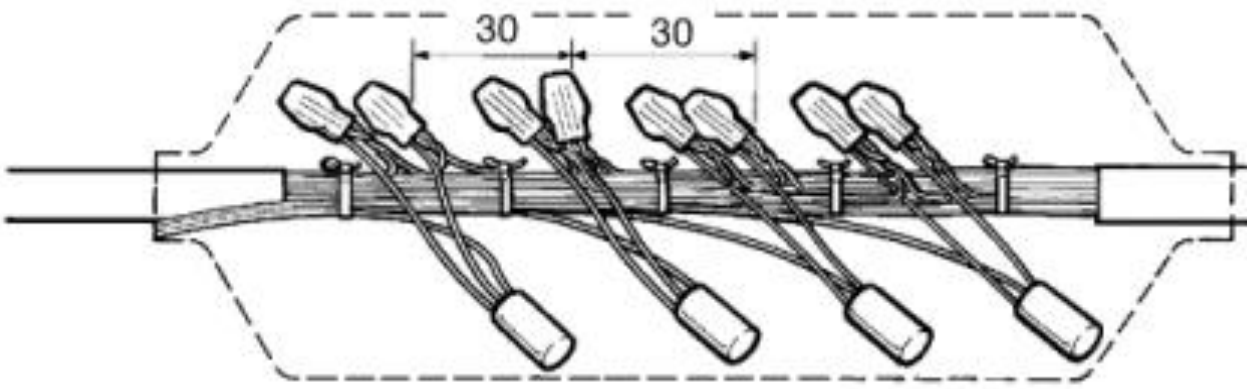


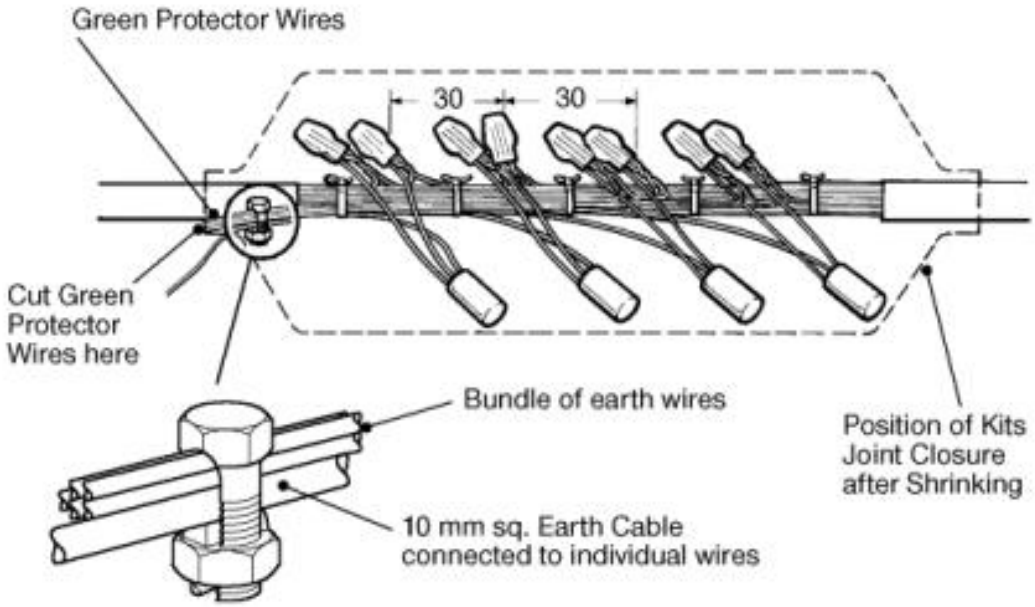
Figure 10.2 Spacing for Protectors



Lay the green protector wires and the earth wires connected to the moisture barrier (and transverse screen, if present) along the joint towards the earth cable end of the joint. Bunch the green protector wires and cut at a point in accordance with *Figure 10.3*. The green protector wires from the far end of the joint should be extended with scrap green protector wire using Connectors Wire Insulated No. 8A.

Tie Tape 11A around the completed joint between each bank of connectors.

Figure 10.3 Completed Joint



10.1.3 Closing the Joint

Remove 25mm of insulation from the end of each of the green protector wires. Place into split bolt together with 10sq.mm of earth cable and tighten.

Wrap the whole joint with Paper Insulating 50mm.

Insert desiccant packs into the joint and tie with Tape 11A.

Close the joint following the manufacturer's instructions.

10.2 Lightning Protection from Mains Borne Surges

Lightning activity may cause surges and transients on mains supply cables, which are just as susceptible to induced voltages as is BT's network. Damage tends to occur more frequently to mains powered telecoms equipment which carries a protective earth terminal. It is likely the damage occurs due to arcing between the live and earth terminals during surges. It is therefore recommended that where lightning protection is fitted at the DP (where BT owns / maintains the customer switch / equipment) you should also fit mains protection.

If there is a history of lightning damage in the area, fit the more expensive Protector Mains 4B/10; otherwise fit a Protector Mains 2A. Double insulated equipment (for example most plug-top power supplies and equipment without an earth connection) should not normally require mains protection.

Where customers have purchased their own equipment or have a rental agreement with another company, make the customer aware of the possibility of damage to equipment from mains-borne surges. The customer can then

choose whether or not to make their own arrangements for mains protection. *Figure 10.4* gives guidance on when and where to fit mains power protection to customer equipment.

Figure 10.4 Guidance on Fitting Mans Protection

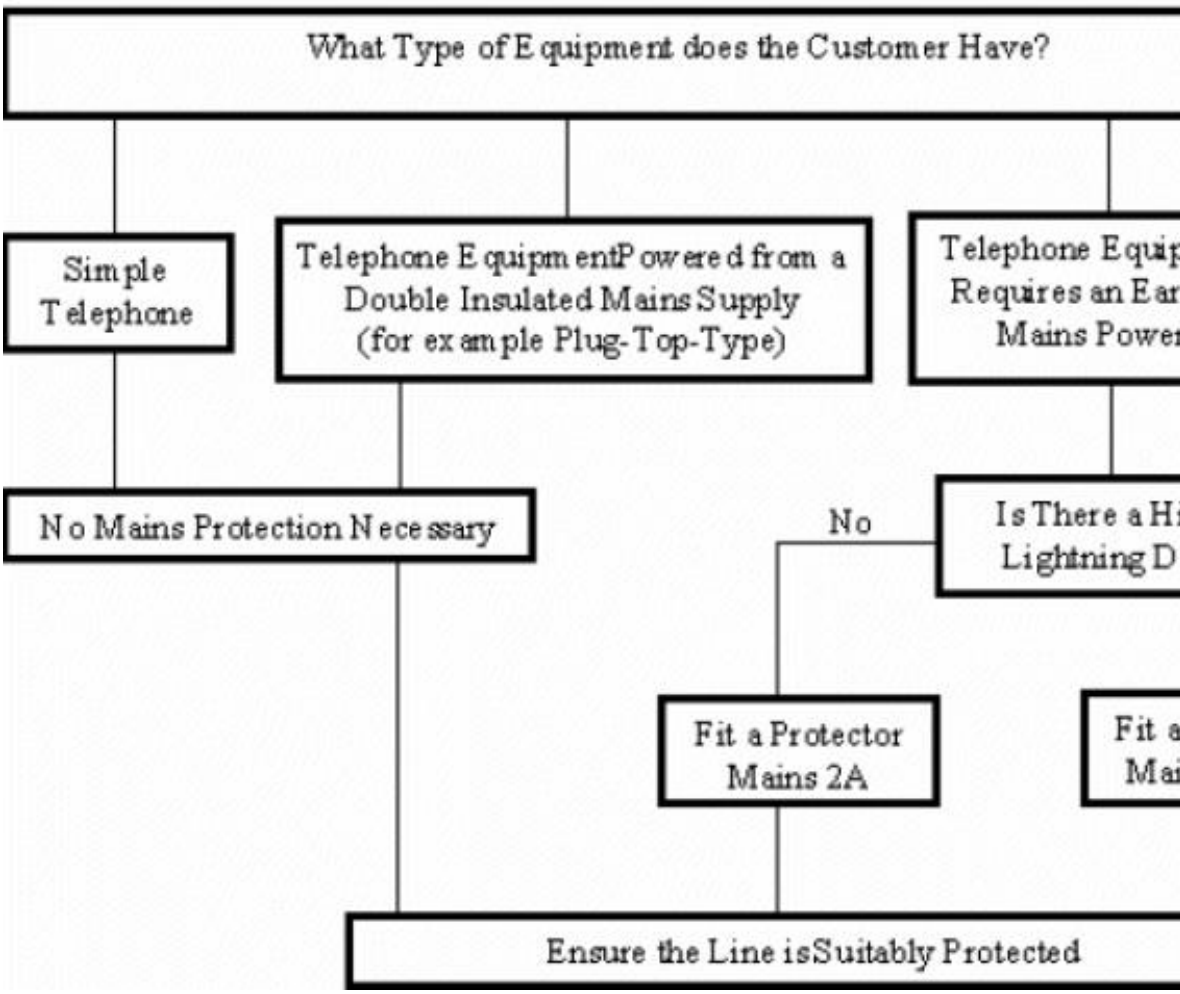
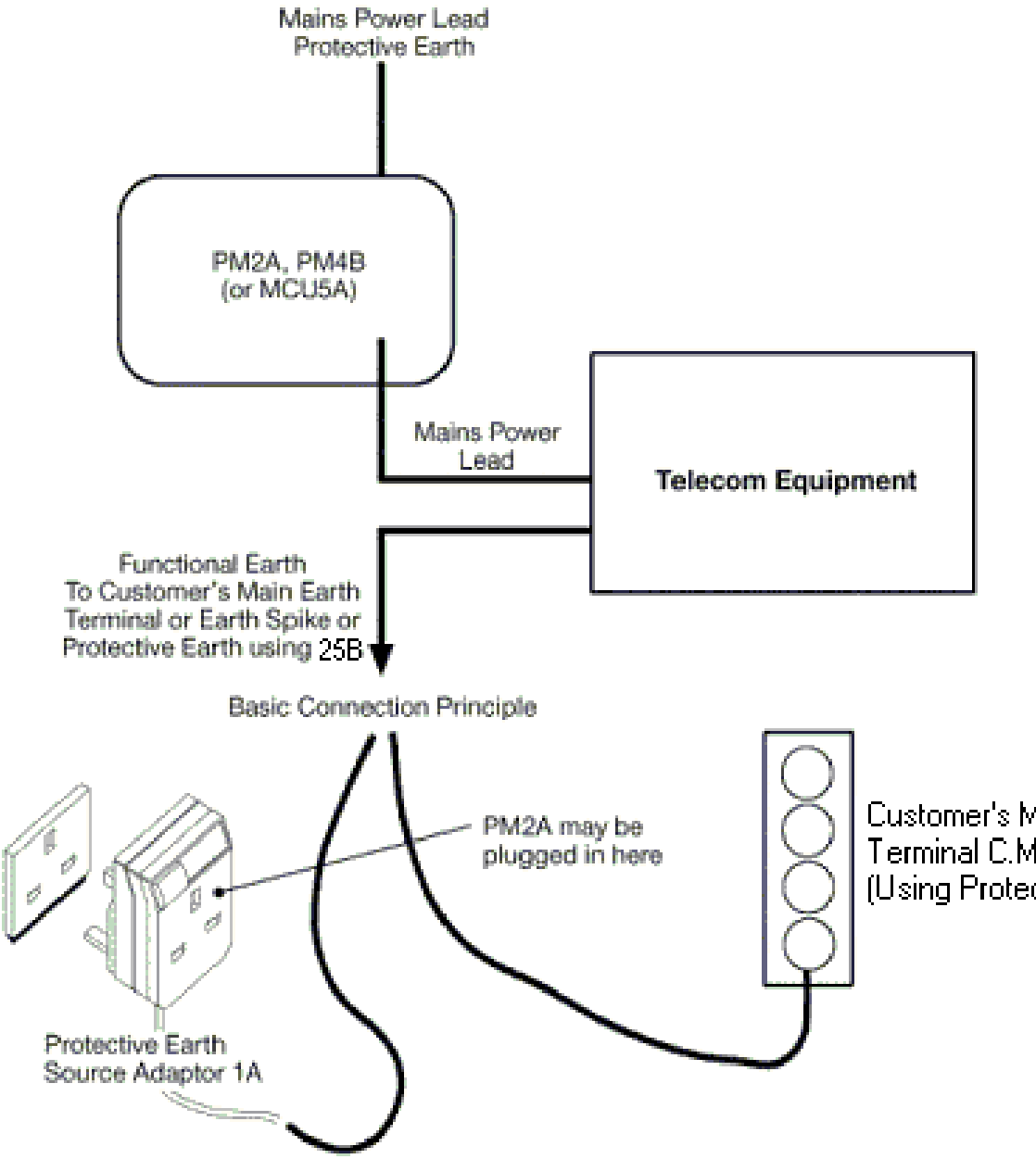


Figure 10.5 Protection on Customer's Premises from Mains-Borne Surges (using Protector 25B)



10.3 Earth Connection at Customer Premises

10.3.1 General

Lightning protection should only be provided in customer premises where the DP is also located within the premises or unless a short connection can be made to the customer earth terminal on the distribution box (<10m).

Section 10.3.2 gives a simplified procedure for providing a connection to earth at the consumer's main earthing terminal that should cover the majority of situations.

Section 10.3.3 describes how the protective earth may also be used for lightning protectors.

10.3.2 Providing a Connection to the Consumer's Main Earthing Terminal

The consumer's main earthing terminal (CMET) is the common point of connection for the earth of the incoming mains electricity supply, the protective conductors of the building's electrical installation and the main bonding conductors to metallic services, for example water, gas and heating pipes.

Note: Connection to the CMET may require the services of a Qualified Electrician.

The CMET may be a separate accessible threaded terminal or drilled bar, or it may be incorporated in a piece of electrical switchgear, for example a consumer unit.

The earth terminal of lightning protectors should be connected to the CMET with Wire Earthing 9141/A (1.5sq.mm cross sectional area) or Wire Earthing 9511/A (1.6sq.mm cross sectional area). The smaller wire will be adequate for lightning protection purposes. It is more important that the wire run is as straight as possible and avoids sharp bends.

Take care when connecting to the CMET not to loosen or disconnect any existing wiring.

The earth wire should only be connected to the CMET.. Keep connection as straight as possible without coils.

If the CMET is inside an electrical switchgear cabinet, then the final connection must be made by a Qualified person with the technical knowledge or sufficient experience to enable him to avoid the dangers which electricity may create, for example an electrician.

If a CMET is not available or does not have the capacity to take further connections, ask the customer to provide a new or extended CMET.

10.3.3 Use of the Protective Earth for Lightning Protectors

Where a small PABX, for example, is connected to the building protective earth, the earth terminal of the PABX can be used as a connection for lightning protectors. At some sites this may be a more convenient point to connect to than the CMET. Wiring Earth 9141/A should be used to make the connection.

Where the protective earth is used, protectors **which will not operate to mains voltage must be used**, for example Protector 25B.

The protective earth source adapter 1a (as shown in fig 10.5) may be used as an earth connection point for the connectors.

10.3.4 Testing the Earth Connection

Check the continuity of the earth connection using a suitable multi-meter. Take a measurement between the earth terminal of the lightning protector and an adjacent piece of earthed metalwork, for example a metal pipe or a radiator. This will prove the connection to the CMET.

If an existing earth connection is used, make a visual inspection of the earth wire and its connections in addition to carrying out a continuity check.

10.3.5 Using an External Earth Electrode System at Customer Premises

In situations where no CMET exists or is too far away (>10m) an external earth electrode system should be provided in accordance with Section 9.1.

The electrode should be connected to the lightning protector with 10sq.mm yellow/green sheathed cable.

The IEE regulations require that separate earth electrodes are bonded to the CMET. It is recommended therefore that a second 10sq.mm cable be connected to the earth electrode and left coiled in an accessible position. There should be sufficient length of cable to reach a future CMET which will normally be located adjacent to the consumer unit. The customer should be informed of the existence of the cable and its purpose and is to be advised to have it connected professionally.

A DWAL is a circuit which connects buildings designated to be on the same site, but does not utilise the BT network. However, a DWAL will use external category cable, U/G or O/H and consequently, commands the same rules for protection, as when terminating an equivalent network connection.

11 *Lightning Protection of Cables Serving Exposed Transmitter Sites*

11.1 Protection Policy

Radio and television broadcasting equipment is often installed on hilltops and because of this, the probability of a lightning strike to the mast is greatly increased.

Most radio and television masts are of considerable height, so masts of less than 25m in height (e.e. MOLO sites) would not normally be considered as extremely exposed and therefore not require secondary protection points.

(For Isolated Remote MOLO sites, or similar small transmitter sites, e.g. point-to-point radio links, see section 9.7).

Under certain weather conditions, not necessarily accompanied by visible lightning, discharge currents flow through the mast to earth raising the potential of the station earth. Unless adequate precautions are taken, which should include the bonding of all metalwork, the discharge current may seek an alternative path to earth by side flashing to other metalwork in the structure. To reduce the possibility of breakdown of BT cables, protection devices are fitted at the broadcasting station and at a point remote from the station called the Second Protection Point (SPP).

This Section details the precautions you should take and the protection recommended to minimise the risk of injury to personnel from, and damage to, cables within the BT network which can result from lightning strikes to metal self-supporting structures, stayed lattice masts or concrete towers at radio and television stations. Smaller aerials such as those used for mobile communications are not regarded as 'exposed transmitter sites' whether or not they are erected on rooftops. Such sites are not required to comply with the requirement of this section. Protection of amplifiers and regenerators between terminal ends of cables to radio stations is outside the scope of this section.

The following instructions apply to all new radio stations, existing stations where additional cables are being installed and stations where protection already exists but repeated damage is being experienced.

Locating the Second Protection Point (SPP)

The location of the SPP is determined from local soil resistivity readings and is situated where the local rise of earth potential resulting from a discharge to the mast is so small that the risk of damage to the local network is negligible.

From the Area Cable Plans determine the point at which the radio station cable would normally join the local cable network, and let this point be F1 (see *Figure 11.1*). Let the radial distance from the radio station to F1 be A1 metres. Determine the average soil resistivity at F1 and let this be P1 ohm metres.

If A1 is numerically greater than 2P1 then the radio station cable can acceptably join the local cable network at this point.

If A1 is less than 2P1 it is likely that the soil resistivity is high and you should find an alternative point for the radio station cable to join the local network. It may prove convenient for the radio station cable to run parallel with the local cable to an alternative jointing point.

Let this alternative jointing point be F2, the average soil resistivity at F2 be P2 ohm metres and the radial distance from the radio station to F2 be A2 metres.

Figure 11.1 Determining SPP Point for Transmitter Sites

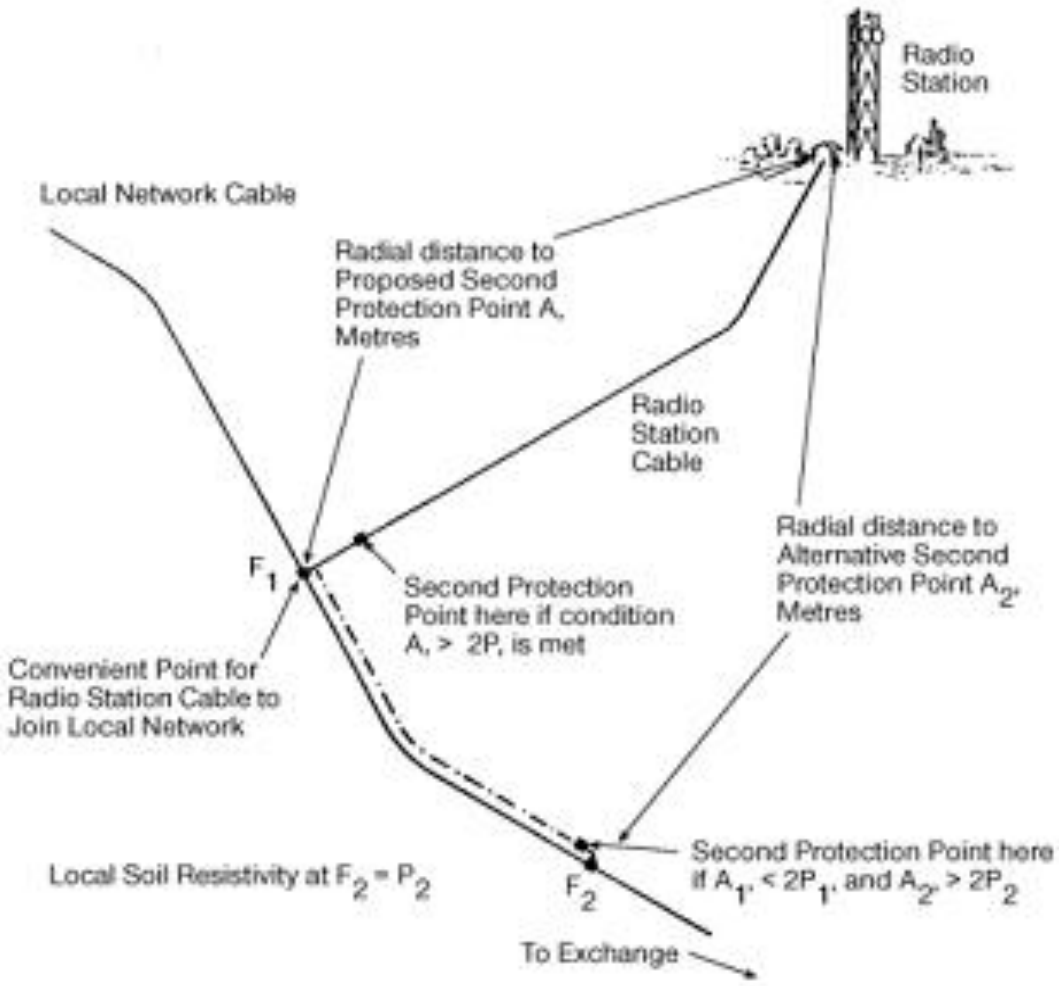


Figure 14.1 Determining Second Protection point for Transmitter Sites

If A2 is greater than 2P2, the radio station cable can join the local network cable at this alternative point.

In most cases A2 will be greater than A1.

In all cases you should provide protection at the SPP in a separate sheath closure, close to and on the radio station side of the joint which connects the station cable to the local network.

11.2 Methods of Protection

11.2.1 The Radio Station Cable

* The radio station may be served by either overhead or underground cables. The minimum size of conductor to be used should be 0.5mm. The cable between the radio station and the SPP should ideally be in one length (but see SPP - Pair Type Cable) and must serve only the radio station. There should be no inductive loading within this length. *

11.2.2 Protection at the Radio Station

The outlet cable must be terminated in one building only and as far from surrounding earthed metalwork as possible. Protection must be fitted on all pairs (including spare pairs) near to the point of entry of the cable to the building. Other buildings on the site must be served by tie cables with protectors fitted at both ends. Joints must not be made in the vicinity of the station to feed buildings independently.

Connect the earth for the protectors to the building earth electrode system, avoiding sharp bends. The minimum size of the earth lead should be 10sq.mm.

11.2.3 The Second Protection Point (SPP)

11.2.3.1 Coaxial Cables and 10 and 15khz Programme Circuits

These are usually point to point circuits which do not affect the other network cables. Lightning protection can conveniently be provided at intermediate amplifying points, and at the terminal station.

11.2.3.2 Pair-Type Cables

* Determining the location of the SPP is detailed above. Protectors must be fitted on all pairs, both working and spare, at a point on the station side of the joint which connects the outlet cable to the network. The SPP must not be used as a test access or flexibility point.

Any re-routing of pairs must take place in a normal joint on the exchange side of the second protection point (see *Figure 11.1*). *

A lightning protected joint incorporating encapsulated protectors should be used at the SPP (see Section 10).

* The earthing of protectors at the SPP is very important (see Providing an Effective Earth).

When joints are necessary between the radio station and the SPP, and are not of the in line twisted and tip-soldered type, protection must be fitted on all

pairs at every joint using the same techniques as described for the SPP. These intermediate protected joints must not be used as test access or flexibility points. *

11.2.3.3 Metallic Sheathed, Armoured and Moisture Barrier Cables

* If a cable includes any metallic sheath, armouring or moisture barrier in its makeup, it must be bonded to the station earth. The metallic element must be electrically continuous up to the SPP and should be bonded there to the same earth as the protectors. Where it is functionally necessary for screens to be isolated, connection to earth must be via a protector. *

11.2.3.4 Alternative Positioning of the Second Protection Point

In suburban areas of high soil resistivity, A may not be greater than 2P as described earlier. In these cases the SPP will be at the exchange MDF, that is the cable pairs serving the station are taken back to the exchange on a separate cable.

11.2.3.5 Optical Fibre Cables

* Where it is intended to provide an optical fibre cable to a broadcasting station then only Cable Optical Fibre 22 or COF 202 should be used. This cable contains no metallic elements and hence will not carry induced overvoltages. *

11.2.3.6 Providing an Effective Earth

It is important to provide an earth of 20 ohms or less at each point where protection is fitted. This earth can be provided using copper tape or rods. Conditions which will produce an earth of 20 ohms in soils of different soil resistivities are given in Earthing Manual ISIS EPT/PPS/B025.

11.3 Precautionary Measures

11.3.1 General

These measures are intended to safeguard installation and maintenance personnel while working on cables serving radio stations.

* Under no circumstances should any work be carried out while there is lightning activity in close proximity. *

You can obtain information on the seasonal trends of lightning activity from the Enquiry Point given at the start of this document.

While working in the radio station to connect or disconnect the main station earth to cable and protectors, stand on a ‘Mats IR’ and avoid simultaneously touching any cable conductors and any earthed metalwork within the station, such as trunking, racking etcetera.

11.3.2 Installing the Cable

Leave the cable disconnected at the radio station until the following work has been carried out in the order listed below:

1. Fit protectors on all pairs both working and spare, at the second protection point.
2. Fit protectors on all pairs both working and spare, at the intermediate protection points.
3. At the SPP bond the protectors to the earth provided.
4. At intermediate protection points, bond the protectors to the earth provided there.

The cable can then be terminated at the radio station, protectors being fitted on all pairs both working and spare. Finally, bond the lead from the station earth to the protectors' earth terminal.

11.3.3 Cable Maintenance

Restrict access to the cable between the station and the SPP to essential work only. Testing should be carried out from the station or from a point on the exchange side of the SPP.

* When testing or working on BT cables within the radio station, the main earth lead to the protectors must remain connected. When access to the cable between the station and SPP is essential, the earth lead to the protectors at the station cable termination must be removed and taped over. It is imperative that the earth for the protector is reconnected on completion of every period of work. *

11.4 Records

Once protection has been fitted at a radio station a record should be kept on:-

- CSS/LNR
- Line Plant Records
- Duct Records

Record the location of the SPP and of any intermediate protection points on the area cable plans using the symbol for a protected joint as shown in the 'external line plant symbols' (see EPT/OAM/B010).

12 *Lightning Protection to Aerial Cables*

As mentioned in Section 10, in cases where there is a history of lightning damage some on route protection may be justified. For example, it may be considered necessary to protect long sections of aerial cables where they pass through an exposed area.

Where lightning protection is provided to aerial cables be they copper or fibre it is recommended that all metal parts, for example suspension strands or moisture barriers, be bonded to the earth provided for the lightning protectors. Lightning protected joints may be provided at the base of the pole.

The following methods should be used if providing lightning protection to aerial optical fibre cables.

Protection is provided using protectors housed in a Cap-ended Closure accommodated in a jointing box.

Figure 12.1 Protection at O/H - U/G Junction of OF Aerial Cable

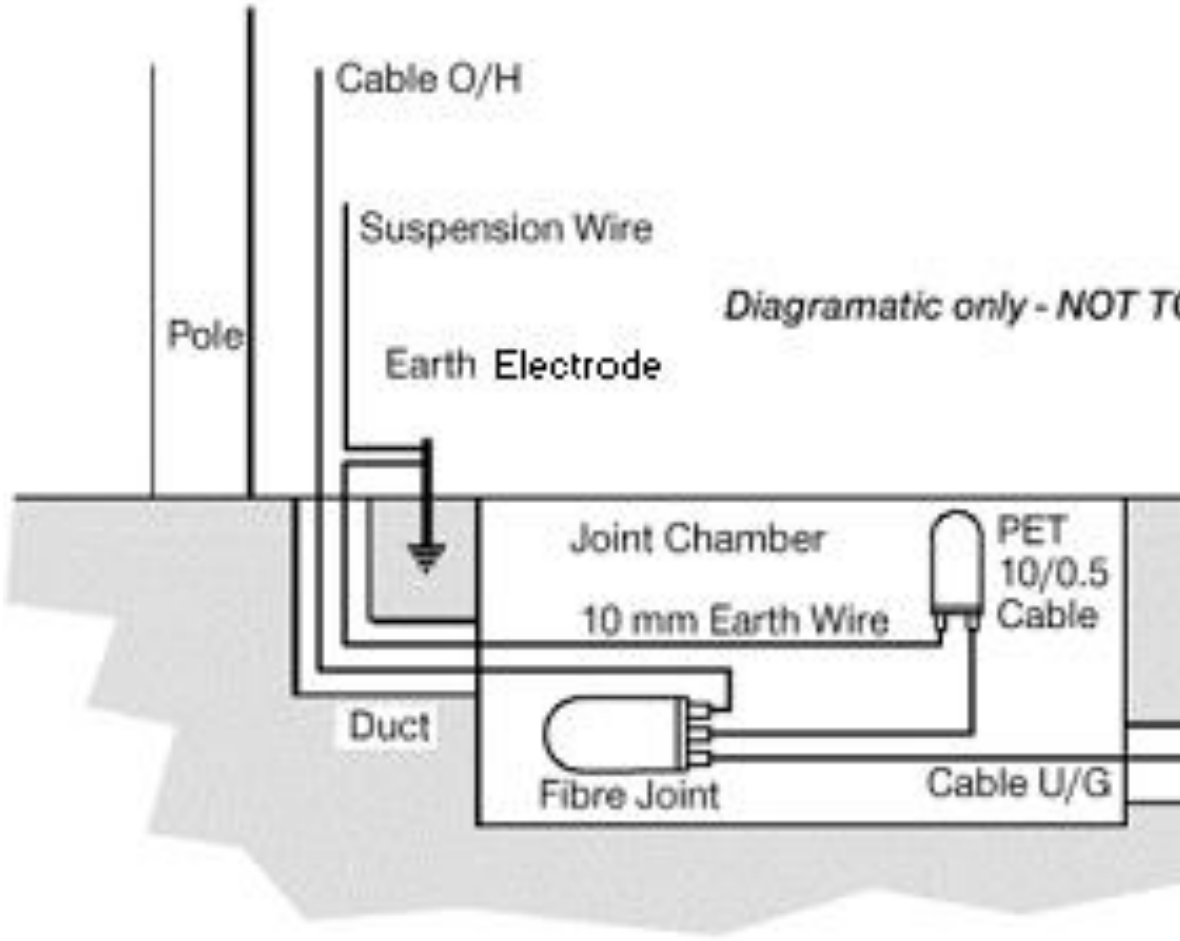
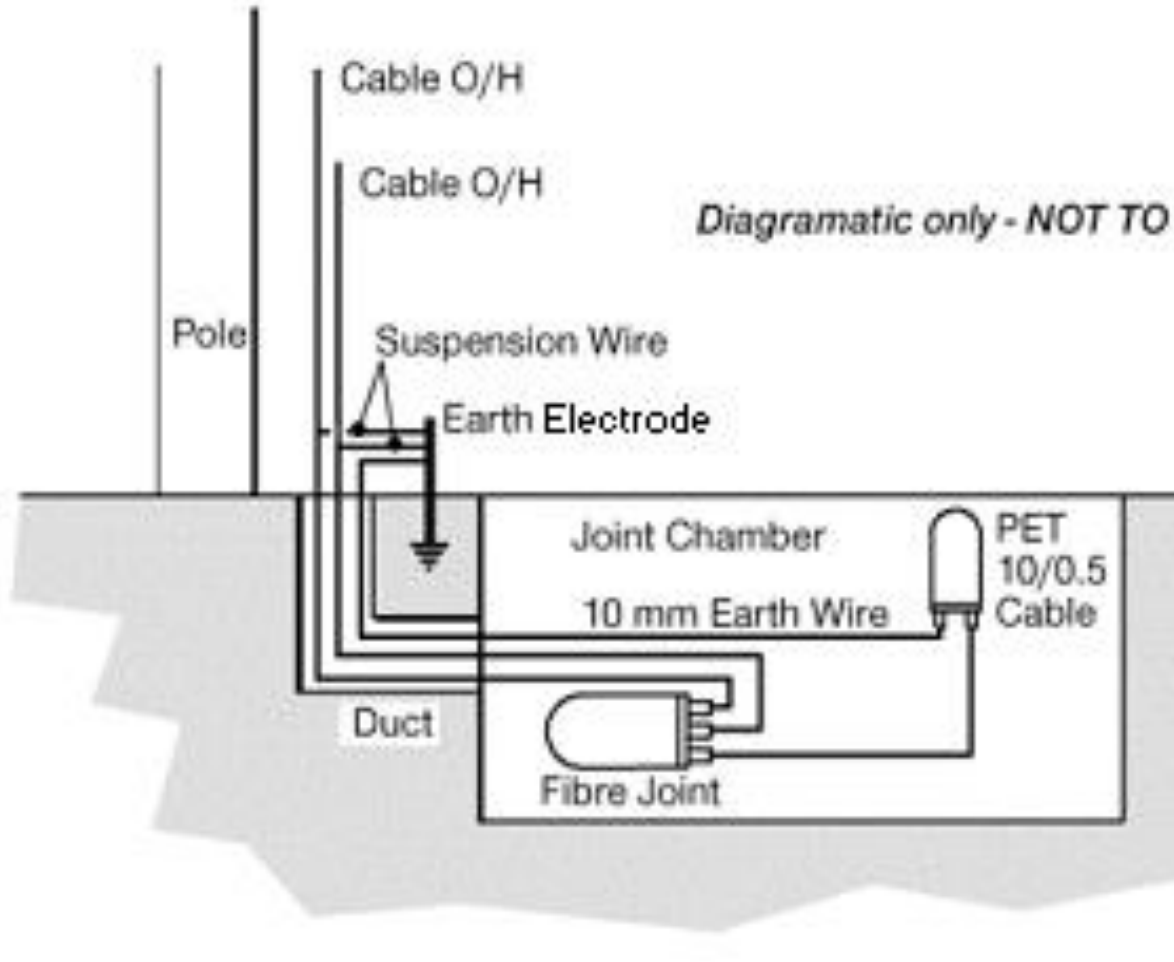


Figure 12.2 Protection at Intermediate Point of OF Aerial Cable



12.1 Protection at the Junction of Overhead and Underground Optical Cable

Prepare U/G cables in accordance with current practices.

Prepare O/H cables as follows:

1. Carefully cut the web between cable and suspension wire a sufficient length to allow for jointing of the fibre element of the cable within the joint box and the termination of the suspension wire to an external earth
2. Connect the shot gun protection barrier of the O/H cable to the moisture barrier of the U/G cable
3. Connect through the copper pairs from each cable
4. Terminate the strength member of the U/G cable onto the strength member pillar

5. The central cable former of the O/H cable is cut back and not terminated, the cable being supported by the cable clamps
6. Feed a length of cable PET 10/0.5 through a spare port in the joint base and prepare the cable
7. Tee pair 1 A and B wires into pair 1 A and B wires of the O/H and U/G cables
8. Tee pair 2 A and B wires into pair 2 A and B wires of the O/H and U/G cables
9. Bunch together pairs 3-6 and connect to the moisture barrier of the U/G cable and shotgun protection barrier of the O/H cable
10. Bunch together pairs 7-10 and connect to the unused strength member pillar
11. Store the Fibres, close and support the joint.

12.1.1 Jointing the Protectors

The other end of the PET 10/0.5 cable is terminated in a suitable cap ended Sleeve housing the protectors. Mount the Sleeve on a wall in the joint box.

Only 3 protectors are required. Connect as follows:

- Protector 1 - Pair 1 of the PET 10/0.5 cable
- Protector 2 - Pair 2 of the PET 10/0.5 cable
- Protector 3 - Pairs 3-6 bunched.

Connect bunched pairs 7-10 to the earth tag on the protector matrix.

12.1.2 Protection at Intermediate Points on Overhead Optical Cable

Proceed as for U/G cable - O/H cable protection except:

1. Leave pairs 7-10 unconnected in the joint closure.
2. Connect the suspension wires from both cables direct to earth.

Item	Item Code	Quantity
Protector 25B	314822	3
Cable PET 10/0.5	053001	As required
Cable ELP 6491 10mm GN/Y	791551	As required

Table 12.1 Stores List for Aerial OF Cable Lightning Protection

13 *Stores List of Protective Devices*

Protector	Item Code	Operates to Mains	Wired or Plug	Application	Notes
22C	Local Purchase	Yes	Plug	MDF Block type 39/40	Replaces type 14 series & 21A

					protectors
23C	033270	No	Plug	Krone, Strips Connection 237a	Replaces 23A/23B/22C (& magazine 5B) at cust premises
25B	315524	No	Wired	External Joint or Block Terminal	Replaces 18A/18B/18C/25A
EPM2B	076048	No	Plug	Box Conn 18 or 19	Replaces EPM2A
PM6D (Single Pin)	033147	Yes	Plug	Jacks Test 45 or 47	Replaces PM2A/6A/6B/6C
PM6D (5 Pin)	033273	Yes	Plug	Modular Frames	Replaces 6C
PM9C **UXD5 use only**	033774	Yes	Plug	Jacks Test 45 or 47	Replaces 4A/9A/9B
FTAM		Yes	Plug	Jacks test 45 or 47	Replaces all previous single pin protectors (inc PM 6C, 6D), except PM 4A/9A/9B
TCP Shoe		Yes	Plug	Jacks test 45 or 47	Replaces all previous single pin protectors (inc PM 6C, 6D), except PM 4A/9A/9B

14 *Stores List of Ancilliary LP Parts*

Item	Item Code	Remarks
Copper Strip 25mm x 3mm		Locally Purchased. Specification for tapes, with earth tails for use in trenchs or on the base of poles can be found in the

		attached document - Copper Earth Tape.doc
Copper Tube Termination }		Obtainable from
Crimping Tool }		Elpress-UK Ltd (0870 242 7048)
Wire Earthing 9141A/W	033589	1.5sqmm single copper conductor – cream sheath marked – Telecommunication Functional Earth (Copper soft single strand)
Wire Earthing 9511/A	033594	1.6sqmm single copper conductor – cream sheath marked – Telecommunication Functional Earth (Copper soft single strand)
Cable ELP 6491X 10sq.mm GN/Y	791551	10sqmm multi strand copper conductor with Green Yellow sheath (10mm Earthing Wire)
Rod Earth 3 Kit	016451	Contains Rod Earth 3, Tip, Driving Head, Nuts 3/8in.
Rod Earth 3	014450	Ungalvanised Mild steel rod 1.5m long by 16mm thick
Tip for Spike Earth 3	015951	
Heads Driving for Spike Earth 3	012201	
Nuts 3/8in BSF Hex Ord	013350	
Tape Sealing 3 (50mm)	071305	
Split Bolts	001815	
Earth & Bonding Clamp (EC13)	016979	(Telenco)
Protector Module 1B	314435	Circuit Link (Dummy) for use in Jacks Test 45,47 & 49 where LP not required
Protector Module 1B	033272	Replaces PM1A. Circuit Link (Dummy) for use in Jacks Test 45,47 & 49 where LP not required
External Connection Module 1B	075994	Fitted into Box Conn 18 / 19 – supplied fitted with EPM 1A – Circuit Link (Dummy)
Box Connection 18A	074855	Modular Box Conn for up to 20 prs
Box Connection 19A	075170	Modular Box Conn for up to 10 prs
Mounting BT 1A	073025	Used to mount Box Conn on Pole – allows dropwires to be dressed safely behind

		Box
Block Terminal 71A	072125	Terminates up to 20 prs in hollow pole
Block Terminal 66B	072256	Used to provide LP for up to 5 prs or on customer's dropwire in line of route
Sleeve 30P	075142	Pre assembled 20 pr LP Joint
Sleeve 31P	075143	Pre assembled 50 pr LP Joint
Sleeve 32P	075144	Pre assembled 100 pr LP Joint
In Line Mechanical Closure Large	021086	
Tubing Heat Shrinkable 28-6mm	073046	Allows provision of Water Block on 10sqmm Earthing wire
Box Connection 220A- Swivel 20 pair	015621	Allows provision of Krone 237a modules in "reduced headroom"
Strip Connection 237A	017401	Modular connection strip for 10 prs and allows use of Protector 23
Earthing Bar 23	003850	Required to connect earth across Strip Connection 237A prior to use of Protector 23
Protective Earth Source Adapter 1A	315553	Plug in to 13A socket to obtain Customer's earth

15 *Records & Reports*

15.1 Records

Once protection has been fitted a record should be kept on:-

- CSS/LNR
- Line Plant Records
- Duct Records

Record the location of the Plant on the area cable plans using the symbol for a protected joint as shown in the 'external line plant symbols' (see EPT/OAM/B010).

15.2 Reports

To enable the effectiveness of the protective measures to be analysed, any case of shock to personnel or damage to cables, protectors or equipment should be reported immediately to the Enquiry Point given at the beginning of this document.

16 *Enquiries*

- Technical Enquiries may be directed to :
  Neil Gilbert - 01473 646155
- See also Video – “Lightning – Protecting BT’s Network From It’s Power”, available, **free**, from the document author.

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