**These Electricity Safety Rules and associated National Safety Instructions are written to safeguard personnel working for or on behalf of National Grid, on or near to its electricity apparatus. National Grid can accept no responsibility or legal liability to any other party who suffers any loss, damage or injury in any way connected with the use of or reliance upon these documents.**

# NATIONAL SAFETY INSTRUCTION

**UK BP/SE/NSI 5**
**CABLE SYSTEMS**

## National Grid Transco Copyright



## DOCUMENT MANAGEMENT RECORD

| | |
|---|---|
| **Document Title** | CABLE SYSTEMS |
| **Document No:** | UK BP/SE/NSI 5 |
| **Previous Review Date:** | |
| **Next Review Date:** | |

| **Document Issue Status** | | | | |
|---|---|---|---|---|
| **Issue** | **Date** | **Notes** | **Originator** | **Authorised for Use** |
| 4 | December 04 | Re drafted for UK BP | S Atkin | J Fenn |
| 5 | August 2005 | Addition of Appendix A | S Atkin | SEPAG |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# CABLE SYSTEMS

## CONTENTS

# CABLE SYSTEMS

## 1 SCOPE

This National Safety Instruction sets down the principles and procedures to remove **Danger** when working on cables and their accessories.

## 2 DEFINITIONS

For the purposes of this document and Attachments, the following definitions apply. Terms printed in bold type are as defined in the NGC Safety Rules.

*Impressed Voltage Conditions* - Conditions which could cause dangerous induced voltages or currents, differences in earth potential or voltage differences across any break in the conductive path.

*Earthed Working* - The method of working where all **Equipment** and conductive materials which are exposed in the work area, are effectively bonded together and then connected to earth at the point of work.

*Insulated Working* - The method of working where the **Person** is insulated from contact with objects at different potentials.

*Bonding Connection* - An **Approved** form of connection applied at Link boxes, joint bays or other points of work to provide an efficient connection to eliminate differences in potential and to carry any current that may arise during fault conditions.

*Guidance Notes*- Illustrated examples of the application of the general principles laid out in this document.

## 3 DANGERS

The main **Dangers** when working on, or near to, cables and their accessories are electric shock, burns, or other injuries arising from

- the possibility of personnel mistaking cables on which it is unsafe to work for those on which it is safe to work
- voltage difference when the sheath or cores at the point of work are connected to a different earthing area from the one at the point of work, and an earth fault occurs in one of these earthing areas
- other cables or services within the work area which may be at a different potential
- induced voltages, or currents, arising from fault, or load currents in other **HV** circuits
- induced voltages, or induced currents which may arise when the cable being worked on is connected to an overhead line circuit
- proximity to exposed **Live Equipment**, other cables or services
- the sudden release of gas from pressurised cables.
- damaged or poor condition cables
- contact with live cables during excavations

## 4 APPLICATION OF INSTRUCTION

4.1 This Instruction must be applied to all NGT UK Electricity Transmission cable installations. However, the sections of this Instruction concerned with the precautions for working under *Impressed Voltage Conditions* need not be applied in the following circumstances

a where it has been established by calculation, test or existing knowledge that there is no possibility of dangerous *Impressed Voltage Conditions* arising

b when all adjacent circuits are limited to **Systems** having resistance earthing in which the fault current does not exceed 2.5kA

c when working on communication cables where other codes of practice apply.

d when using **Live** working techniques on **LV** cables.

4.2 When considering 4.1 'a' above, two conditions pertaining to electromagnetic induction and rise in earth potential can arise and the appropriate recommended voltage limits are

a 60 volts for steady state, i.e. continuous induced voltages

b 650 volts for fault conditions where the fault current can be cleared within 0.2s, or 430 volts where clearance times are more than 0.2s.

4.3 Following calculations and assessments of induction between cables in a number of installations, it is considered that precautions relating to working under *Impressed Voltage Conditions* are not required when working on cables which are wholly within one earthing system. Where adjacent earthing systems are bonded together by either cable sheaths or earthing conductor, it cannot be assumed that this necessarily constitutes a single earthing system. In these circumstances the precautions for working under *Impressed Voltage Conditions* must be applied, unless it has been established by calculation or test that the voltage limits will not be exceeded.

4.4 For optical fibre cable installations the precautions for working under *Impressed Voltage Conditions* need only be considered where the cable is armoured or screened with a metallic sheath or when a continuous tracer is incorporated into the construction of the cable.

## 5 GENERAL REQUIREMENTS FOR WORK ON HIGH VOLTAGE CABLES

5.1 Cable records must be used to identify a cable on which work or testing is to be carried out. If the cable records alone are insufficient to identify a cable, the cable must be positively identified by imposing a signal on it from an identified point. The signal must then be identified at the point of work using a detector. Care must be taken that the signal is genuine and not induced.

5.2 The identification tests must be carried out by the **Senior Authorised Person** issuing the **Permit for Work** or **Sanction for Work** in the presence of the **Competent Person** receiving the appropriate **Safety Document**, who must be satisfied that the correct cable has been identified.

5.3 The positively identified cable must be suitably marked at the point of work by the **Senior Authorised Person** issuing the **Permit for Work** or **Sanction for Work**

5.4 With the exception of the situations identified in paragraph 5.5, any **HV** cable must be spiked before work is carried out involving cutting the metallic cable sheath. The spiking must be carried out using an **Approved** earthed spiking gun, and under the **Personal Supervision** of the **Senior Authorised Person** issuing the **Safety Document**.

5.5 Cable spiking may be omitted in the following circumstances:

where the cable can be visually traced over its whole length from the point of work to a termination where either a **Primary Earth** is applied or the terminal **Equipment** has been proved not to be **Live** and is clearly identified, or

where the cable can be visually traced from the point of work to a point on the cable where it has previously been spiked, after which the cable has not been made **Live**, or

where the cable can be visually traced from the point of work to a point on the cable which has previously been identified and the cable sheath removed, after which the cable has not been made **Live**, or

for cables operating at 33kV and above, the cable has been positively identified using the method described in Appendix A.

5.6 When a cable is connected to an overhead line it is possible for high induced current to flow in the cable cores or sheath. Before any work is carried out in these circumstances advice must be sought from an **Authorised Person (Induced Currents)**.

5.7 On any cable circuit, carrying induced currents from an overhead line, the cable will be disconnected from the line before working on the cable cores.

5.8 On any cable circuit, carrying induced currents from an overhead line, the links at the cable ends will be removed before working on the cable sheath. To avoid **Danger** each link will be connected to earth before it is removed or replaced.

## 6 GENERAL REQUIREMENTS FOR WORK ON LOW VOLTAGE CABLES

6.1 All work must be carried out in accordance with UK BP/SE/NSI 12, "Low Voltage Equipment".

6.2 Cable records must be used to identify a cable on which work or testing is to be carried out. If the cable records alone are insufficient to identify a cable, the cable must be positively identified by imposing a signal on it from an identified point. The signal must then be identified at the point of work using a detector. Care must be taken that the signal is genuine and not induced.

6.3 The **Senior Authorised Person** issuing the **Safety Document** must suitably mark the positively identified cable at the point of work**.**

6.4 Until the cores of the cable have been checked, with an **Approved** voltage detector and confirmed **Dead**, the cable must be treated as **Live**. The cable sheath and insulation must be removed using **Live** working techniques, by a person who is competent to carry out this type of work. Once the cores have been proved **Dead**, there is no need to use **Live** working techniques.

6.5 Exceptions to the requirements of 6.2 are where the cable can be physically traced to the point of work from:

a The **Point(s) of Isolation** or

b A previous point of work where the cable has been proved, and remained, **Dead.**

## 7 GENERAL PRINCIPLES FOR WORKING ON CABLES SUBJECT TO IMPRESSED VOLTAGES

7.1 *Earthed Working* should generally be applied but where this is not reasonably practicable, or is undesirable, the **Senior Authorised Person** may instruct that *Insulated Working* may be adopted as an alternative. In order to achieve *Earthed Working* conditions, *Insulated Working* must be adopted initially .

7.2 The *Guidance Notes* illustrate methods of working which are combinations of *Earthed Working* and *Insulated Working*.

7.3 Where it is necessary to disconnect cable terminations, to establish **Points of Isolation** for work on **LV** cables, this must be done using *Insulated Working*.

7.4 If the work is to be carried out using *Insulated Working*, the precautions given below must be applied

a With the exception of the cores sheaths or armour to be worked on, all exposed metallic pipes, bracings, etc., within the work area and with which contact is possible, must be wrapped with insulating sheet. This is shown in Fig.1.

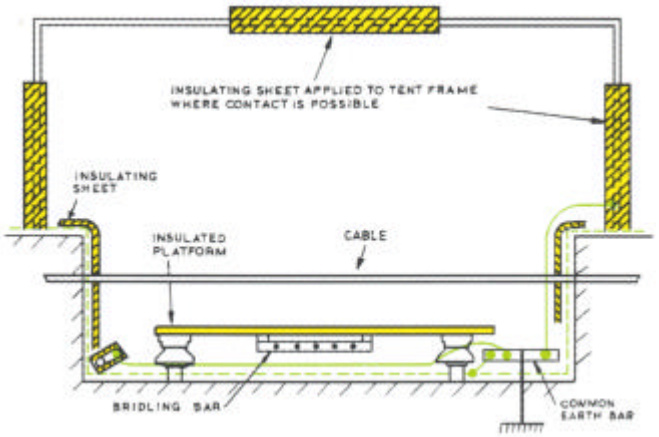



Fig 1.

b Consideration must be given to the environmental conditions under which insulated equipment is used. Excessive water or mud may compromise the insulating properties of the equipment.

c Under conditions of *Impressed Voltage*, the potential of the work area earth system may rise above that of the local mass of earth. If metallic connections such as cables or pipes extend from within the work area earth system to equipment outside that earth system, a hazard could exist to persons inside and outside the work area. All such metallic connections must have an insulating section so that a person cannot make simultaneous contact with two earth systems. A typical cable joint bay situation is shown in Fig.2.

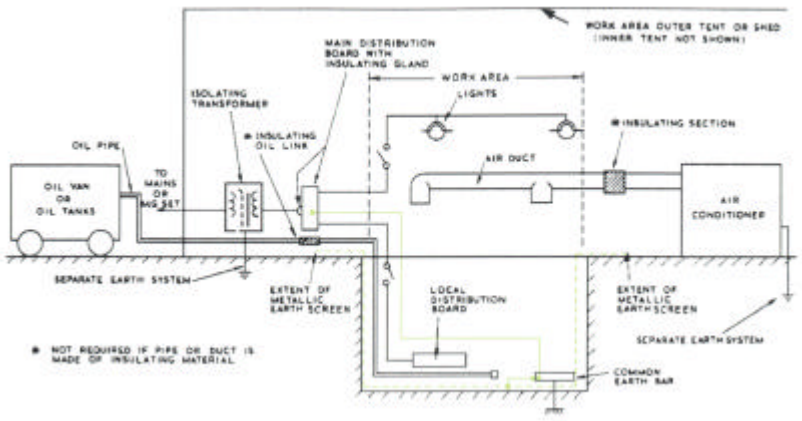



Fig 2.

d Metalwork on the work area side of the insulating section must be connected to the common earth bar. Earthed metalwork on the external side of the insulating section must be connected to a separate external earth system.

e External insulation must be applied to exposed metalwork and pipes near the boundary of the work earth screen so that persons in contact with the earth screen cannot make simultaneous contact with metalwork connected to the separate external earth system. Alternatively, the earth screen near the boundary can be covered with an insulating sheet or mat.

f Electrical supplies into the work area must be via an isolating transformer.

g *Insulated working* may be achieved by the use of an **Approved** Insulated Platform or alternatively by using a combination of at least two of any of the following **Approved** items

(i) Insulating mat

(ii) Insulating boots

(iii) Insulating gloves

(iv) Insulated tools

(v) Insulating sheet.

All equipment must be inspected for damage or defect immediately before use. Any equipment found faulty must be withdrawn from service.

h **Persons** carrying out *Insulated Working* must not accept materials from, or make physical contact with, anyone outside the insulated environment.

7.5 If any part of the work is to be carried out using *Earthed Working*, an earth screen, connected to the common earth bar, must be provided to extend outside the work area at the point of access for a distance of a least one metre. All exposed cable sheaths, metallic pipes, bracing's, etc., must be insulated using insulating sheet. (See Fig.3.) If the work area has no local earth, the common earth bar must be connected to an alternative earth. Any subsequent earthing to the cable at this point of work must be taken from this bar.

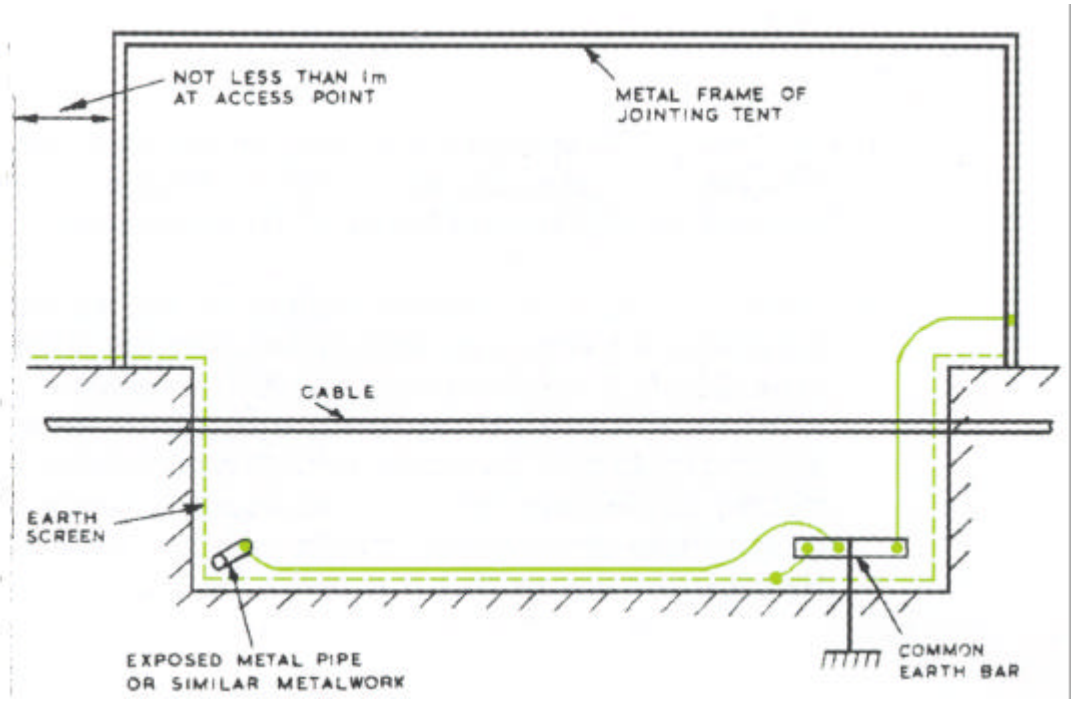



Fig 3.

## 8 WORK ON HV CABLE SHEATH DISCONNECTING LINK BOXES UNDER IMPRESSED VOLTAGE CONDITIONS

8.1 Until such time as *Earthed Working* conditions have been established, in accordance with section 7.1 and the appropriate *Guidance Note.* The fitting or removal of disconnecting links, SVL connections *or Bonding Connections* must be carried out using *Insulated Working* in accordance with the requirements laid out in section 7.4.

8.2 In some cases the carcass of a link box may be connected to a local earth and not connected to the earth associated with the cable sheaths. Before work is carried out on the cable sheath disconnecting links and SVL connections in these link boxes, the two earths must be connected together using *Insulated Working*.

8.3 In link boxes not fitted with special connecting points for the attachment of *Bonding Connections* it may be necessary to adjust or remove the links prior to the fitting of *Bonding Connections*. This must be done using *Insulated Working*.

8.4 Where the facility exists, link boxes should be **Locked** after each operation and an **Approved** notice attached. This notice must not be removed until work has been completed, the links returned to the normal operating position and the box finally **Locked**.

8.5 Where it is not possible to connect the earth end fitting of the *Bonding Connection* to the earth pillar or to the external earth connections of the link box, *Insulated Working* must be adopted.

## 9 PROCEDURE FOR CABLE SERVING TESTS UNDER A PERMIT FOR WORK

9.1 During testing other work may be undertaken on a cable, provided **Working Parties** are separated from testing teams by one major section, which will not be affected by the testing. The separation will be achieved in accordance with Appendix B.

9.2 Particular reference will be made to *Guidance Note* 1 "Over Sheath and Joint Barrier Tests on **HV** Cables".

9.3 Each testing team will have its own **Permit For Work** and clearly designated work locations.

9.4 Adjacent testing teams must be separated by one major section, which will not be affected by the testing. The separation will be achieved in accordance with Appendix B.

9.5 The **Competent Person** in charge of the testing will ensure that the testing team is at the correct location identified on the **Permit for Work**.

9.6 At the point of test adequate provision must be made to fence and barrier the location to prevent unauthorised access and contain the test equipment.

9.7 The **Competent Person** must ensure that the point of test is always attended during testing.

## 10 WORK ON METALLIC COOLING PIPES UNDER IMPRESSED VOLTAGE CONDITIONS

10.1 Work on metallic cooling pipes under *Impressed Voltage Conditions* will normally be carried out with the associated cable out of service.

10.2 Where it is necessary to work on metallic cooling pipes under *Impressed Voltage Conditions*, with the associated cabling in service, a **Senior Authorised Person** must specify the means to avoid **Danger**.

10.3 *Insulated Working,* in accordance with section 7.4, must be applied for all operations involving: disconnecting links, in link boxes, at turn round kiosks, bleed points and at terminations. (See Fig.4.)

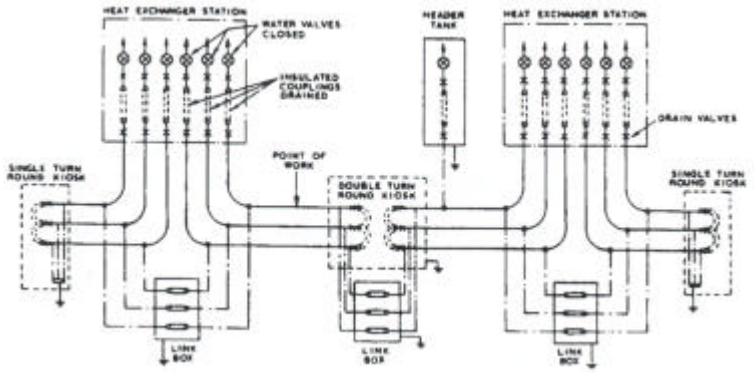



Fig 4.

## 11 WORK ON OR NEAR FAULTY, OR DAMAGED CABLES

11.1 Work should never take place on or near **Live HV** cables, where **Danger** may arise. The appearance of a cable is no guarantee of its conditions. No assumptions should be made that a cable with exposed conductors is **Dead**. This includes cables which have been badly damaged.

11.2 Before work starts on or near a faulty or damaged **HV** cable it must be positively identified and proved **Dead.** Identification must include reference to records and the use of a cable identifier. Proving **Dead** should be by spiking with an **Approved** earthed spiking gun.

11.3 Work on faulty or damaged **LV** cables should preferably be carried out with the cable **Dead**. **Live** work on faulty or damaged **LV** cables must never take place where **Danger** may arise.

11.4 It may be necessary to carry out tests on faulty or damaged **LV** cables while they are **Live** to locate the fault.

11.5 Once the location of a fault on a **LV** cable has been determined, work to repair it must be carried out in accordance with section 11.3.

## 12 AVOIDING DANGER FROM UNDERGROUND SERVICES

Damage to underground services during excavation work places site personnel at risk. It may also disrupt supplies fed from the service. It is important that all excavation work is carried out in a way that minimises damage to underground services. The Health and Safety Executive have issued advice in the Health and Safety series booklet HS(G)47 Avoiding danger from underground services. This booklet should be made available to anyone involved with excavation work. The following advice is based on HS(G)47.

### Obtaining information on services

Plans or other suitable information about all buried services in the area should be obtained before excavation work starts, when the work is being planned.

Where it is not possible to obtain information, as may be the case when emergency work has to be undertaken, the work should be carried out as though there are buried services in the area.

Account should be taken of any indication that buried services exist, such as the presence of lamp - posts, illuminated traffic signs, gas service pipes entering buildings, pit covers, pipeline marker posts, evidence of reinstated trenches. However if there are no such indications, this does not mean that there are no buried services.

**Use and limitation of plans**

Plans vary in scale, content and style. Adequate instruction and training in how to read and interpret plans should be given to anyone who needs to use them.

Plans can give an indication of the location, configuration and number of underground services at a particular site, and should help subsequent tracing by locating devices. However they may not be drawn accurately to scale and even if they claim to be should not be relied on solely to locate the services.

**Cable and pipe-locating devices**

The position of any services in or near the proposed work are should be pinpointed as accurately as possible by means of a locating device, using plans, and other information as a guide to the possible location of services

The degree of confidence with which buried services can be detected depend on a number of factors. It is important that anyone who uses a locator should have received thorough training in its uses and limitations. Locating devices should always be used in accordance with the manufacturer's instructions and should be regularly checked and maintained in good working order.

A locator may not be able to distinguish between cables or pipes running close together. Exposing one cable or pipe does not mean that there is not another close by. Frequent and repeated use should be made of locators during the course of the work.

**Safe digging practice**

Once a locating device has been used to determine position and route, excavation may proceed, with trial holes dug using suitable hand tools to confirm the position of any buried service.

Spades and shovels (preferably beaded) should be used rather than other tools. They should not be thrown or spiked into the ground, but eased in with gentle foot pressure.

Picks, pins or forks may be used with care to free lumps of stone and to break up hard layers of chalk or sandstone. Picks should not be used in soft clay or other soft soil near to buried services.

Propriety air digging tools, which remove soil with a high velocity jet of air will expose buried services without damaging them. The precautions needed to prevent injury from ejected soil and other material should be assessed.

Once exposed, services may need to be supported and should never be used as hand or footholds for climbing out of excavations.

If a buried service suffers damage during excavation during the excavation or subsequent work, the owner/operator should be informed.

**CABLE SYSTEMS**
**WORKING UNDER IMPRESSED VOLTAGE CONDITIONS**

## ATTACHMENT A

**CABLE SYSTEMS**
**WORKING UNDER IMPRESSED VOLTAGE CONDITIONS**

**CONTENTS**

**CABLE SYSTEMS**
**WORKING UNDER IMPRESSED VOLTAGE CONDITIONS**

## 1 SCOPE

The Guidance Notes in this Attachment supplement the requirements of NSI 5. They should be applied, for work on **HV** or **LV** cables where there is a possibility that such cables could be subject to dangerous induced voltages arising from impressed voltages.

## 2 GUIDANCE NOTES

| | |
|---|---|
| Guidance Note 1 | Oversheath and Joint Barrier Tests on **HV** cables. |
| Guidance Note 2 | Oversheath Repairs to Cables and Metallic Cooling Pipes. |
| Guidance Note 3 | Metallic Sheath Repairs to Cables and Repairs to Metallic Cooling Pipes. |
| Guidance Note 4 | Cutting and Capping **HV** Cables. |
| Guidance Note 5 | Making or Breaking-down Single-core Stop Joints or 3-core Stop Joints Incorporating Lead-through Bushings on **HV** Cables. |
| Guidance Note 6 | Repairing Cables using Extended Ferrule Repair Straight Joints. |
| Guidance Note 7 | Making or Breaking-down Single-core Stop Joints Incorporating two Plug-in Conductor Fittings. |
| Guidance Note 8 | Making or Breaking-down Single-core Stop Joints Incorporating a Locked and Plug-in Conductor Fitting. |
| Guidance Note 9 | Making or Breaking-down Single core Stop Joints Incorporating a Solidly Ferruled Conductor and a 'Slide-over' Centre Section. |
| Guidance Note 10 | Fitting Joint Outer Protective Boxes on Cables. |
| Guidance Note 11 | Making or Breaking-down Sealing Ends on Cables. |
| Guidance Note 12 | Repairing Oil and Gas Leaks. |
| Guidance Note 13 | Work in Cable Sheath Link Boxes not involving the Cutting or Disconnection of Bonding Leads. |
| Guidance Note 14 | Replacing Cable Sheath Link Boxes by Cutting and Jointing Existing Bonding Leads. |
| Guidance Note 15 | Replacing Cable Sheath Link Boxes by Breaking-down Existing Link Boxes. |
| Guidance Note 16 | Cutting and Capping LV Cables. |
| Guidance Note 17a | Jointing **LV** Cables (Insulated Working Method) |
| Guidance Note 17b | Jointing **LV** Cables (Earthing at the point of work) |
| Guidance Note 18 | Glanding-off **LV** Cables at Terminal Boxes. |
| Guidance Note 19 | Terminations in Fully Insulated Boxes. |
| Guidance Note 20 | Terminations in Non-insulated Metalclad Boxes. |
| Guidance Note 21 | General Commissioning Tests on **LV** Cables. |

| | |
|---|---|
| Guidance Note 22 | Oversheath Testing on **LV** Cables. |
| Guidance Note 23 | Dielectric Tests on **LV** Cables. |
| Guidance Note 24 | Work on 420 kV XLPE Cable System with Unearthed Cross Bonding Connections in Both Insulated and Earthed Working Conditions. |
| Guidance Note 24a | Making or Breaking down Straight Joints for Single Core XLPE Cable with Joint VMEVCB420. |
| Guidance Note 24b | Oversheath Repairs to XLPE Cable. |
| Guidance Note 24c | Replacement of SVL's, Connections, Cross Bonding Concentric Cable and Support Insulators. |
| Guidance Note 24d | Dismantling and Re-Assembly of Gas Insulated Horizontal and Vertical Sealing Ends. |
| Guidance Note 24e | Cutting of Cable for Removal of Damaged Section. |
| Guidance Note 25 | Use of Bridling Bar. |
| Guidance Note 26 | Use of Adaptor Plate. |
| Guidance Note 27 | Dielectric Tests on **HV** Cables. |

## GUIDANCE NOTE 1

## OVERSHEATH AND JOINT BARRIER TESTS ON HV CABLES

This Guidance Note supplements the relevant requirements of NSI 5 to enable testing of oversheaths and joint barriers on **HV** cables. (See Fig 1.1)

1. Utilising the appropriate procedures detailed in Section 7 of NSI 5 the following operations should be carried out:

   1.1 Cross-bonded or single point bonded systems are equipped with sheath voltage limiters (SVLs). The type and rating of the SVL fitted and the oversheath test voltage to be applied determines whether or not the SVL's should be disconnected before use. Reference should be made to the relevant work specification and/or technical information.

   1.2 The metallic sheaths of the section under test should then be disconnected from earth at the major section Link Box remote from the point of test by removing the links. The terminal pillars associated with the adjacent major section must be Earthed by means of *Bonding Connections* in this remote Link Box. Alternatively, it may be possible to earth these terminal pillars by replacing links in the appropriate position.

   1.3 In the Link Box at the point of test, the links should then be removed and connections applied between earth and all the terminals of the major section under test and earth *Bonding* C*onnections* must be applied to all terminals of the adjacent major section.

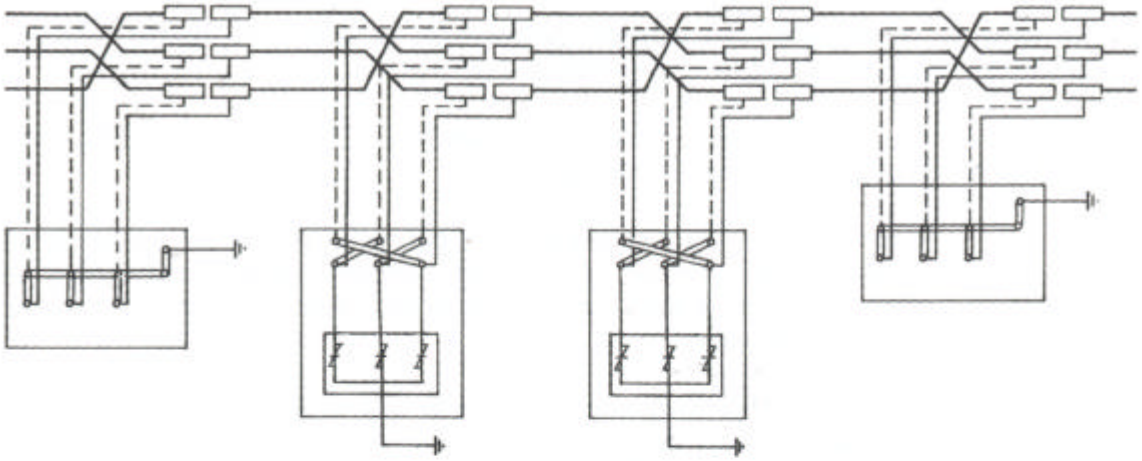
   1.4 Where so desired, the above connections may be made via an Adaptor Plate.

2. The metallic sheaths of the section to be tested are now earthed only at the point of test. The test connections may be removed, as necessary, only for the duration of the tests. Before connecting or disconnecting any test instrument the sheaths must be earthed or alternatively, the test instrument leads must be applied using *Insulated Working*.

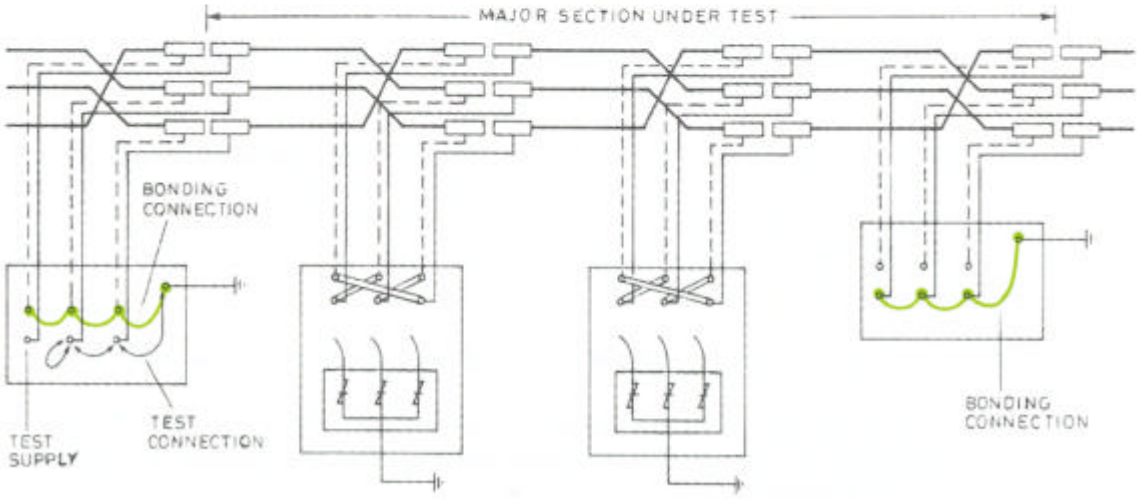
3. Similar procedures must be adopted if it is required to test individual minor sections.

   Note: If a voltage is applied to the oversheath of one section, the associated joint barriers will be subjected to the same test voltage provided that the sheaths of the adjacent sections(s) are earthed.

4. When it is required to identify sheaths, *Insulated Working* conditions must be adopted.



NORMAL OPERATING ARRANGEMENT




ARRANGEMENT FOR OVERSHEATH TESTING ON SINGLE SHEATH CIRCUITS OF MAJOR SECTIONS

Fig 1.1

## GUIDANCE NOTE 2

## OVERSHEATH REPAIRS TO CABLES AND METALLIC COOLING PIPES

This Guidance Note supplements the relevant requirements of NSI 5 to enable oversheath repairs to be carried out on cables and metallic cooling pipes.

1. Using *Insulated Working*, a section of the oversheath should be removed.

2. A *Bonding Connection* must then be applied to the exposed metallic sheath, armour or pipe and connected to the common earth bar via the Bridling Bar.

3. Repairs may then proceed under *Earthed Working* conditions.

4. When it is necessary to remove the *Bonding Connection* from the metallic surface *Insulated Working* must be resumed and the work completed under these conditions.

5. If it is impracticable or undesirable to apply the *Bonding Connection* to the metallic surface at, or close to, the point of work *Insulated Working* must be adopted throughout the work.

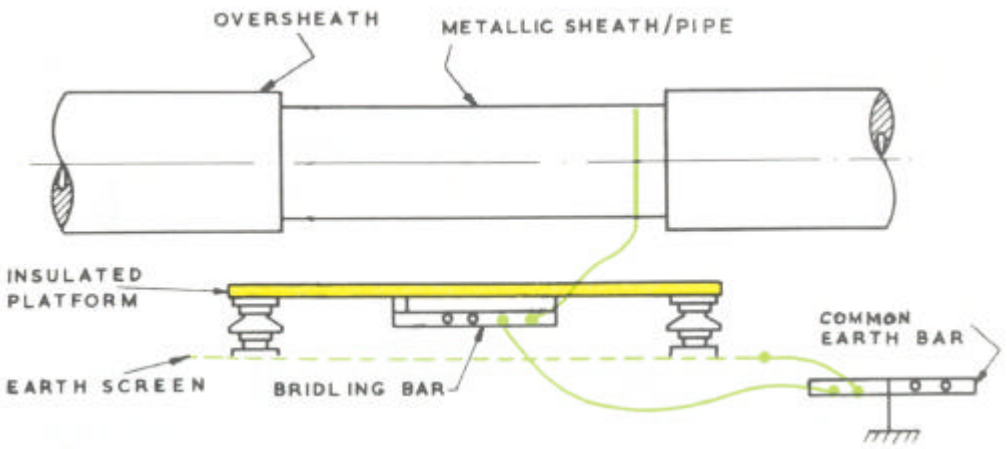



Fig 2.1

## GUIDANCE NOTE 3

## METALLIC SHEATH REPAIRS TO CABLES AND REPAIRS TO METALLIC COOLING PIPES

This Guidance Note supplements the relevant requirements of NSI 5 to enable metallic sheath repairs to be carried out on cables and repairs to metallic cooling pipes.

1 Using *Insulated Working*, a section of the oversheath should be removed to expose the metallic sheath.

2. A *Bonding Connection* must then be applied to the metallic sheath and connected to the common earth bar via the Bridling Bar.

3. If the continuity of the metallic sheath is to be broken, a second *Bonding Connection* must be applied to the metallic sheath such that an earth is positioned either side of the proposed break.

4. Repairs to the metallic sheath may then proceed under *Earthed Working* conditions, both *Bonding Connections* being maintained until the metallic sheath repair is completed.

5. Repairs to the oversheath must then be effected as follows:

   5.1 One *Bonding Connection* may be removed and the oversheath repaired at that point using E*arthed Working.*

   5.2 Using *Insulated Working*, the second *Bonding Connection* may then be removed and the repair completed.

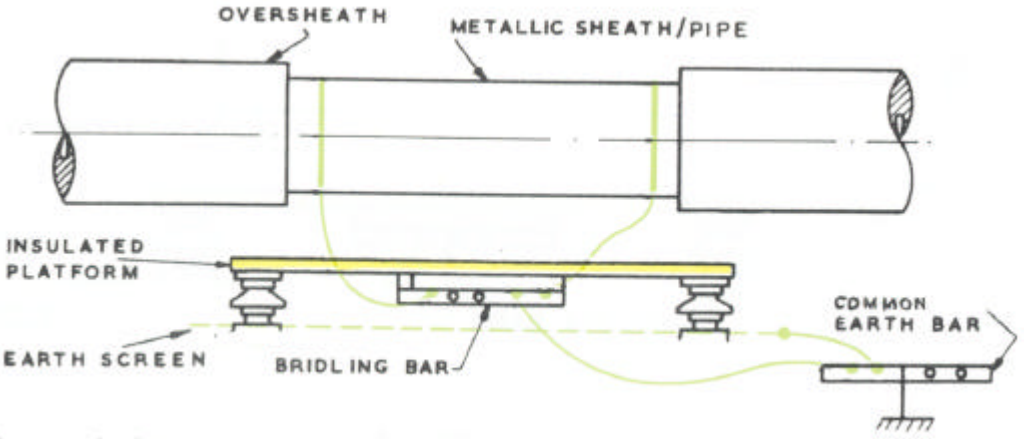



Fig 3.1

6. If it is impracticable or undesirable to earth the metallic sheath using *Bonding Connections* applied at or close to the point of work and the continuity of the sheath is not to be broken *Insulated Working* must be adopted throughout the work. If necessary, a *Bonding Connection* must be used to bond across any proposed break to maintain the continuity of the metallic sheath.

7. When carrying out repairs to LV cables or metallic cooling pipes, *Bonding Connections* must be applied to the LV cable sheath and/or armour or to the metallic cooling pipe, as appropriate.

## GUIDANCE NOTE 4

## CUTTING AND CAPPING HV CABLES

This Guidance Note supplements the relevant requirements of NSI 5 for cutting and capping of HV cables.

1. Using *Insulated Working*, a section of the oversheath should be removed to expose the metallic sheath.

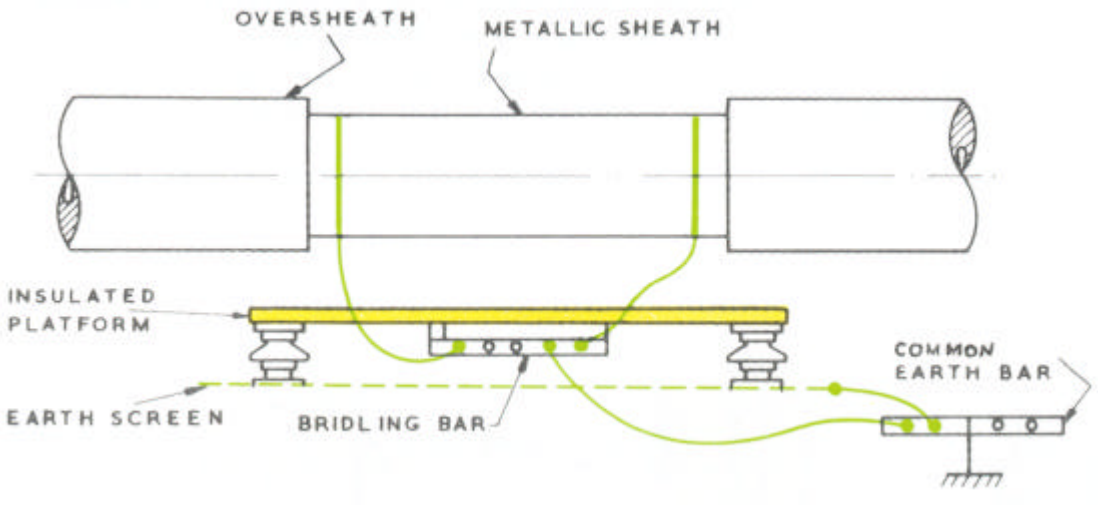



Fig 4.1

2. *Bonding Connections* must then be applied to the metallic sheath on both sides of the proposed cut and connected to the common earth bar via the Bridling Bar.

3. Unless it has been established that spiking is not necessary the cable must now be 'spiked' under *Earthed Working* conditions at the position of the proposed cut using a spiking gun earthed through a *Bonding Connection*.

4. The spiking gun should then be removed.

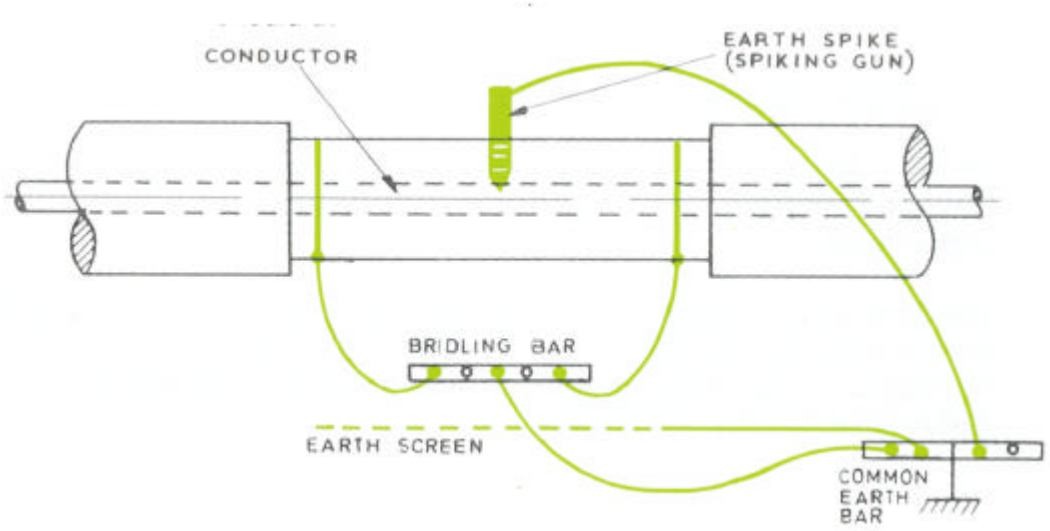



Fig 4.2

Note: Where spiking is carried out on cables with small diameter conductors, there is a possibility that a conductor may be completely severed by the spiking gun chisel. It will therefore be necessary to earth the cable conductor on each side of the spiking position in accordance with the following procedure:

5. A ring of metallic sheath should be removed in the vicinity of the proposed cut position, and temporary insulation applied over the *Bonding Connection* end fittings and remaining exposed portions of metallic sheath to which they are attached.

6. Using *Insulated Working*, the cable insulation may be removed to expose the conductor on one side of the spiked position only, and the conductor Earthed using a *Bonding Connection.* Temporary insulation must then be applied over the *Bonding Connection* end fittings and the exposed portion of conductor to which it is attached.

   The process should then be repeated at the position on the other side of the spiked position.

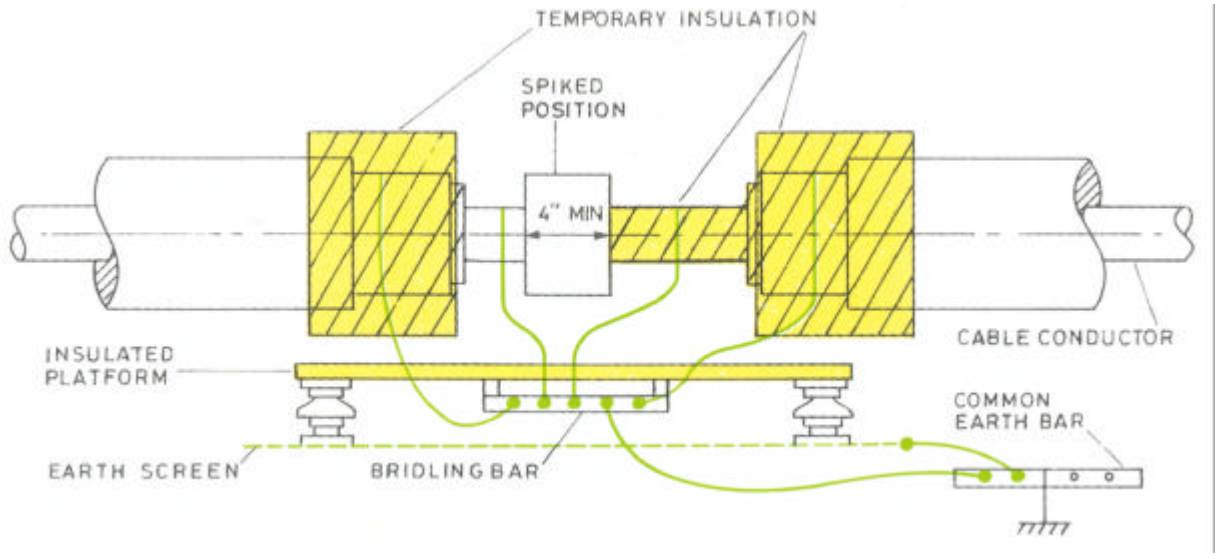



Fig 4.3

7. Using *Earthed Working*, the cable may now be cut at the prepared position.

8. On the above end to be capped, the conductor and metallic sheath should be connected together using a *Bonding Connection*, in the form of a flexible copper braid.

9. The *Bonding Connection(s)* applied between the conductor(s) and Bridling Bar should now be removed, and after removal of the temporary sheath insulation the cable may be capped. Care should be taken to ensure that this cap completely covers the flexible braid *Bonding Connection*.

10. If other work is carried out immediately, the *Bonding Connections* connected to the metallic sheath must remain in position.

11. If the cable is left 'pot ended', the *Bonding Connections* connected to the metallic sheath should be removed. The end caps should then be fully insulated using *Insulated Working*.

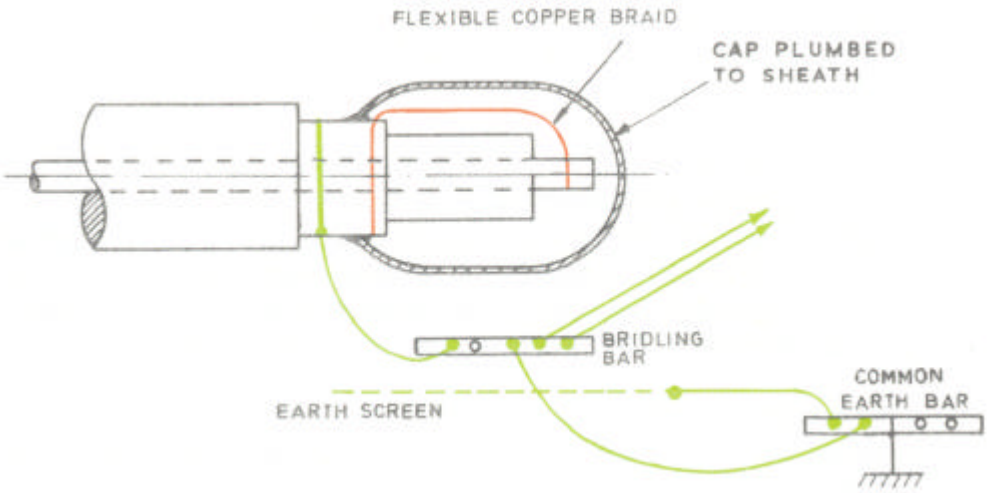

FLEXIBLE COPPER BRAID
CAP PLUMBED TO SHEATH
BRIDLING BAR
COMMON EARTH BAR
EARTH SCREEN

Fig 4.4

## GUIDANCE NOTE 5

## MAKING OR BREAKING-DOWN STRAIGHT OR TRIFURCATING JOINTS OR 3-CORE STOP JOINTS INCORPORATING LEAD-THROUGH BUSHINGS ON HV CABLES

This Guidance Note supplements the relevant requirements of NSI 5 for the making or breaking down of straight or trifurcating joints or 3-core stop joints incorporating lead through bushings on **HV** cables.

1. Prior to commencing jointing operations, it must be ensured that the conductors and metallic sheaths of the cables to be jointed are individually earthed to the common earth bar via the Bridling Bar using the procedures detailed below. The *Bonding Connections* used for this purpose should be threaded through the joint sleeve and end bells as necessary to allow these items to be located over the cable at the appropriate time.

   1.1 Where the metallic sheath of the cable is electrically continuous within the work area, the cable must be prepared and cut in accordance with Guidance Note 4, Clauses 1-7.

   1.2 Where the metallic sheath of the cable is not electrically continuous within the work area, *Insulated Working* must be used to expose a section of metallic sheath on one side of the discontinuity which must then be earthed by a *Bonding Connection* applied to the common earth bar via the Bridling Bar. This operation must then be repeated on the metallic sheath on the other side of the discontinuity.

   1.3 If, on a capped cable, the conductors and metallic sheath are not connected together, the cable must be prepared in accordance with the principles of Guidance Note 4, Clauses 1-7 omitting the spiking.

   1.4 If, on a capped cable, the conductor and metallic sheath are connected together, the cap should be removed provided the metallic sheath is earthed. (If the metallic sheath is not earthed, *Insulated Working* must be used to expose a section of the sheath and a *Bonding Connection* applied. A *Bonding Connection* must then be applied between the conductor and the Bridling Bar so that the *Bonding Connection* (flexible copper braid) between the conductor and the metallic sheath can be removed.

2. Provided that the conductors are kept earthed at all times, the *Earthed Working* can now be used up to the application of the insulation.

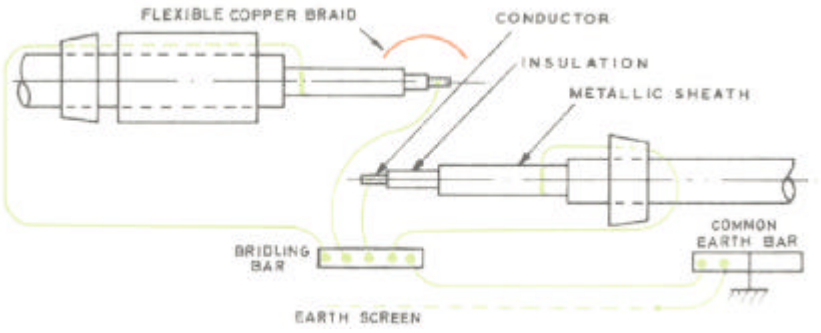



Fig 5.1

3. The cable insulation may now be removed as required to enable the ferruling operation to be carried out. Earthed *Bonding Connections* should then be applied to the conductors as close as possible to the insulation, using a caliper clamp type *Bonding Connection*. Other conductor *Bonding Connections* may now be removed and the operation can proceed as follows:

3.1 For Milliken type conductors a *Bonding Connection*, connected to earth, should be applied to the ferrule via the compression equipment and the conductors placed as far as possible into the ferrule. The caliper clamp type *Bonding Connection* may then be removed and the conductor pushed fully home. The ferrule should then be jointed on to both conductors. If space permits a *Bonding Connection*, connected to earth, should be applied to the ferrule and the compression equipment removed. Alternatively, if it is not possible to apply a *Bonding Connection* to the ferrule with the compression equipment still attached, *Insulated Working* must be used to remove the compression equipment and to earth the ferrule with a *Bonding Connection*.

3.2 For other types of conductor the ferrule should be jointed on to both conductors with the caliper clamp type *Bonding Connection* in position. A *Bonding Connection* should then be applied to the ferrule and the caliper clamp type *Bonding Connection* removed.

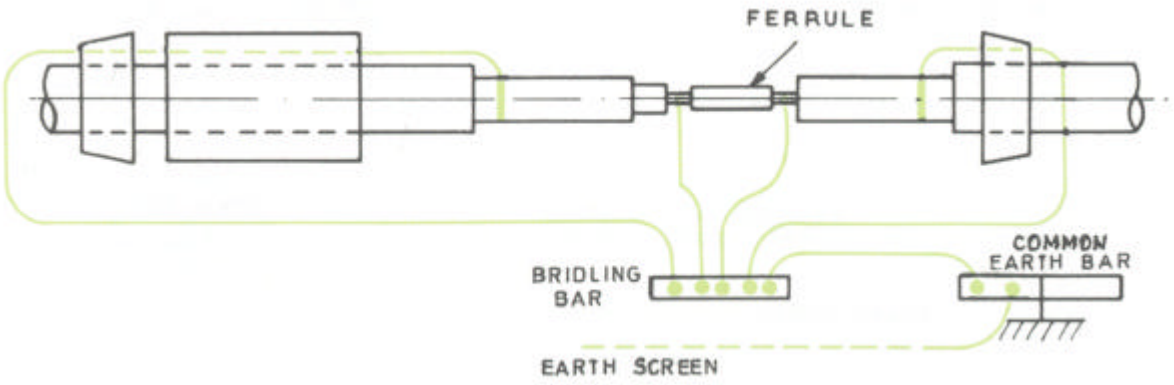



Fig 5.2

4. The insulation and metallic sheaths should be finally prepared up to the re-insulation process.

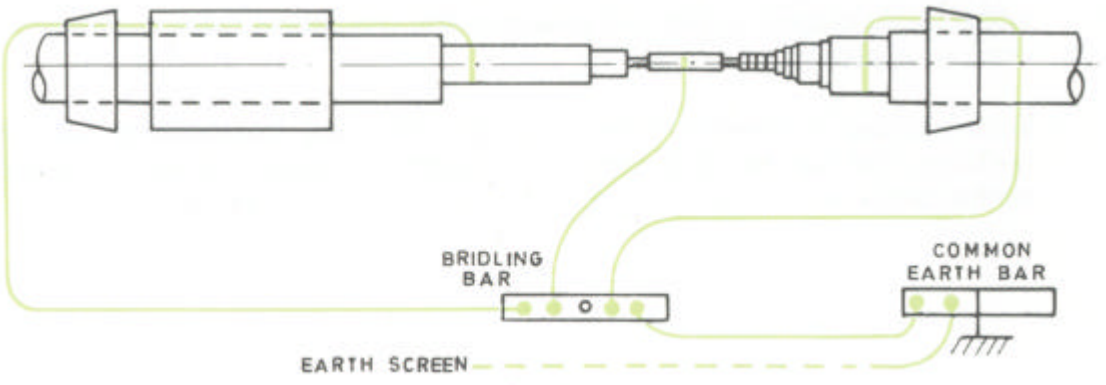



Fig 5.3

5. Temporary insulation must then be applied over the exposed metallic sheaths and clamps. Using *Insulated Working* the *Bonding Connections* on the ferrule must be removed. Insulation should then be applied to the conductor up to 3mm radial thickness.

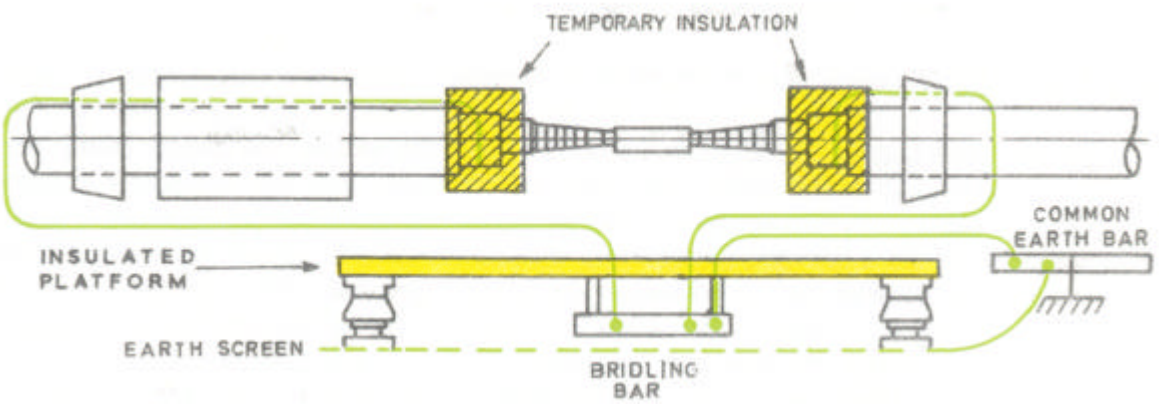



Fig 5.4

6. Using *Earthed Working*, the temporary insulation may be removed and the joint completed up to, and including, plumbing and impregnation.

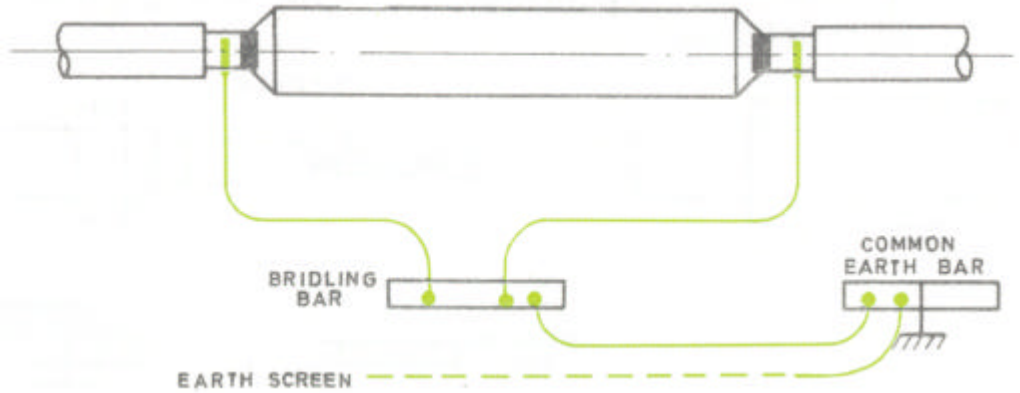



Fig 5.5

7. The joint outer protective box, permanent oil feed lines and bonding leads should then be fitted in accordance with Guidance Note 10.

8. When breaking-down a joint, the reverse of the procedures detailed above must be used, as applicable.

9. When making or breaking-down a 3-core stop joint incorporating lead-through bushings, this can be done using the procedures detailed above by treating the central barrier and the lead-through bushings as part of the ferrules.

## GUIDANCE NOTE 6

## REPAIRING HV CABLES USING EXTENDED FERRULE REPAIR STRAIGHT JOINTS

This Guidance Note supplements the relevant requirements of NSI 5 for the repair of **HV** cables using extended ferrule repair straight joints.

1. Where it has been established that spiking is not necessary the following procedures should be adopted.

   1.1 Using *Insulated Working*, a section of oversheath should be removed to expose the metallic sheath.

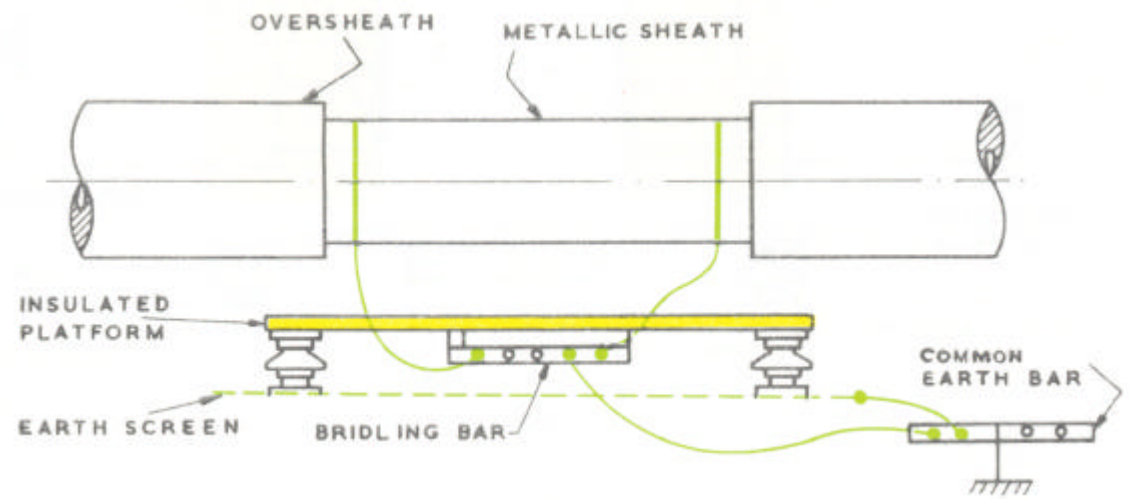



Fig 6.1

   1.2 *Bonding Connections* must then be applied to the metallic sheath on both sides of the proposed cut and connected to the common earth bar via the Bridling Bar.

   1.3 A ring of metallic sheath should be carefully removed in the vicinity of the proposed cut position, and temporary insulation applied over the *Bonding Connection* end fittings and remaining exposed portions of metallic sheath to which they are attached.

   1.4 Using *Insulated Working*, the cable insulation may be removed to expose the conductor, which must be earthed each side of the proposed cut using *Bonding Connections*.

   1.5 Using *Earthed Working*, the cable may now be cut at the prepared position.

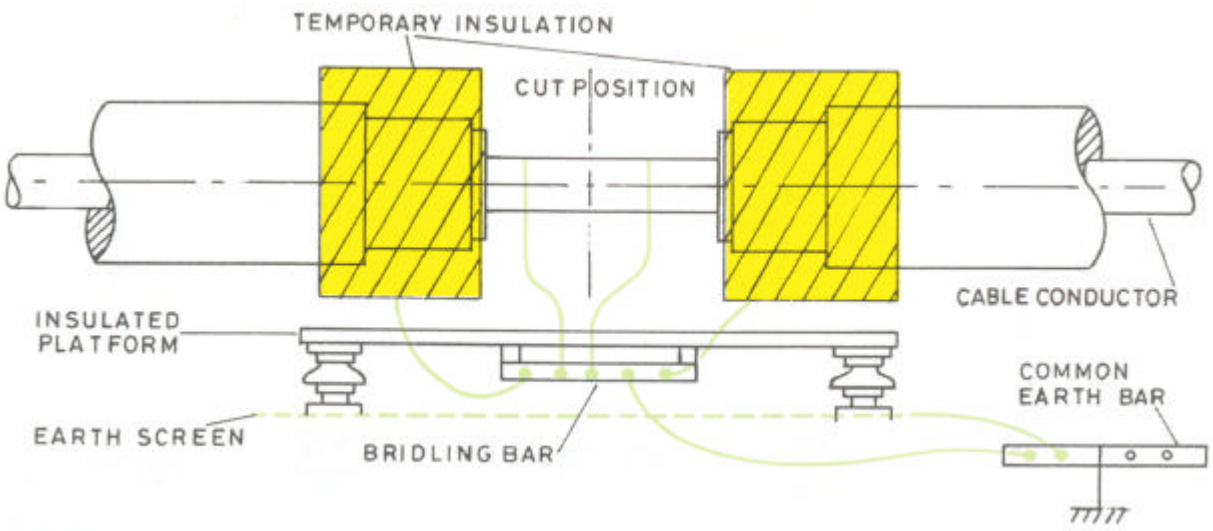



Fig 6.2

1.6 Jointing may now continue in accordance with the relevant Clauses of Guidance Note 5.

2. Where positive identification cannot be established the cable must be spiked and cut in accordance with Guidance Note 4.

## GUIDANCE NOTE 7

## MAKING OR BREAKING-DOWN, SINGLE-CORE STOP JOINTS INCORPORATING TWO PLUG-IN CONDUCTOR FITTINGS

This Guidance Note supplements the relevant requirements of NSI 5 for the making or breaking-down of single-core stop joints incorporating two plug-in Conductor fittings.

1. Prior to commencing jointing operations on the first cable to be worked on, it must be ensured that the conductor and metallic sheath of the cable are individually earthed to the common earth bar via the Bridling Bar using the procedures detailed below. The *Bonding Connections* for this purpose should be threaded through the end bell as necessary to allow this item to be located over the cable at the appropriate time.

    1.1 Where the metallic sheath of the cable is electrically continuous within the work area, the cable must be prepared and cut in accordance with Guidance Note 4, Clause 1-7.

    1.2 Where the metallic sheath of the cable is not electrically continuous within the work area, *Insulated Working* must be used to expose a section of metallic sheath on one side of the discontinuity which must then be earthed by a *Bonding Connection* applied to the common earth bar via the Bridling Bar. This operation must then be repeated on the metallic sheath on the other side of the discontinuity.

    1.3 If, on a capped cable, the conductors and metallic sheath are not shorted together, the cable must be prepared in accordance with the principles of Guidance Note 4, Clauses 1-7 omitting the spiking.

    1.4 If, on a capped cable, the conductor and metallic sheath are connected together, the cap should be removed provided the metallic sheath is earthed. (If the metallic sheath is not earthed, *Insulated Working* must be used to expose a section of the sheath and a *Bonding Connection* applied. A *Bonding Connection* must then be applied between the conductor and the Bridling Bar so that the *Bonding Connection* (flexible copper braid) between the conductor and metallic sheath can be removed.

2. Provided the conductor is kept earthed at all times, *Earthed Working* can now be used up to and including the application of the insulation and the screen over the profile of the stress cone.

3. The cable insulation may now be removed as required to enable the ferruling operation to be carried out. Earthed *Bonding Connections* should then be applied to the conductors as close as possible to the insulation, using a caliper clamp type *Bonding Connection*. Other conductor *Bonding Connections* may now be removed and the operation can proceed as follows:

    3.1 For Milliken type conductors a *Bonding Connection*, connected to earth, should be applied to the ferrule and the conductors placed as far as possible into the ferrule. The caliper clamp type *Bonding Connection* should then be removed and the conductor pushed fully home.

    3.2 For other types of conductor, the ferrule should be jointed on to the conductor with the caliper clamp type *Bonding Connection* in position. A *Bonding Connection*, connected to earth, should then be applied to the ferrule and the caliper type *Bonding Connection* removed.

4. Work should now proceed with the application of the insulation and stress cone. During the fitting of the stress cone, either *Insulated Working* or *Earthed Working* can be adopted to suit the jointing operations.

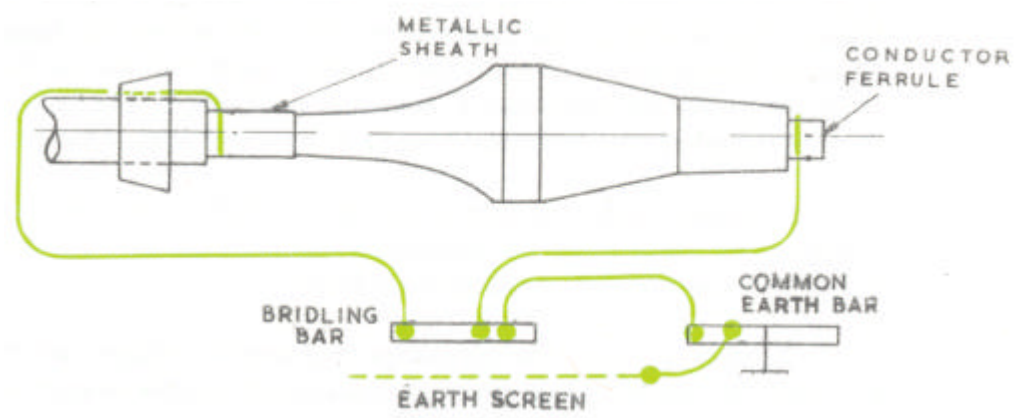



Fig 7.1

5. The centre section of the joint, the casing of which must be earthed via a *Bonding Connection* to the Bridling Bar, should be brought up to the end of the cable until the ferrule is on the point of entering the centre section. Using *Insulated Working*, the *Bonding Connection* on the ferrule should be removed. The centre section should immediately be passed over the cable end until the ferrule plugs into the central conductor fitting.

6. The side of the joint being worked on can then be completed, up to and including plumbing and impregnation, using *Earthed Working*.

7. The other side of the joint should be completed using similar procedures to those detailed above.

8. The joint outer protective box, permanent oil feed lines and bonding leads should then be fitted in accordance with Guidance Note 10.

9. When breaking-down a stop joint of this type, the reverse of the procedures detailed above must be used, as applicable.

## GUIDANCE NOTE 8

## MAKING OR BREAKING-DOWN, SINGLE-CORE STOP JOINTS INCORPORATING A LOCKED AND A PLUG-IN CONDUCTOR FITTING

This Guidance Note supplements the relevant requirements of NSI 5 for the making or breaking-down of single-core stop joints incorporating a locked and plug-in Conductor fitting.

1. Prior to commencing jointing operations on the first cable to be worked on which is on the locking side of the joint, it must be ensured that the conductor and metallic sheath of the cable are individually earthed to the common earth bar via the Bridling Bar using the procedures detailed below. The *Bonding Connections* for this purpose should be threaded through the end bell as necessary to allow this item to be located over the cable at the appropriate time.

    1.1 Where the metallic sheath of the cable is electrically continuous within the work area, the cable must be prepared and cut in accordance with Guidance Note 4, Clause 1-7.

    1.2 Where the metallic sheath of the cable is not electrically continuous within the work area, *Insulated Working* must be used to expose a section of metallic sheath on one side of the discontinuity which must then be earthed by a *Bonding Connection* applied to the common earth bar via the Bridling Bar. This operation must then be repeated on the metallic sheath on the other side of the discontinuity.

    1.3 If, on a capped cable, the conductors and metallic sheath are not shorted together, the cable must be prepared in accordance with the principles of Guidance Note 4, Clauses 1-7, omitting the spiking.

    1.4 If, on a capped cable, the conductor and metallic sheath are connected together, the cap should be removed provided the metallic sheath is earthed. (If the metallic sheath is not earthed, *Insulated Working* must be used to expose a section of the sheath and a *Bonding Connection* applied. A *Bonding Connection* must be applied between the conductor and the Bridling Bar so that the *Bonding Connection* (flexible copper braid) between the conductor and metallic sheath can be removed.

2. Provided the conductor is kept earthed at all times, *Earthed Working* can now be used up to and including the application of the insulation and the screen over the profile of the stress cone.

3. The cable insulation may now be removed as required to enable the ferruling operation to be carried out. Earthed *Bonding Connections* should then be applied to the conductors as close as possible to the insulation, using a caliper clamp type *Bonding Connection*.

    Other conductor *Bonding Connections* may now be removed and the operation can proceed as follows:

    3.1 For Milliken type conductors a *Bonding Connection*, connected to earth, should be applied to the ferrule and the conductors placed as far as possible into the ferrule. The caliper clamp type *Bonding Connection* should then be removed and the conductor pushed fully home.

    3.2 For other types of conductor, the ferrule should be jointed on to the conductor with the caliper clamp type *Bonding Connection* in position. A *Bonding Connection*, connected to earth, should then be applied to the ferrule and the caliper type *Bonding Connection* removed.

4. Work should now proceed with the application of the insulation and stress cone. During the fitting of the stress cone, either *Insulated Working* or *Earthed Working* can be adopted to suit the jointing operations.

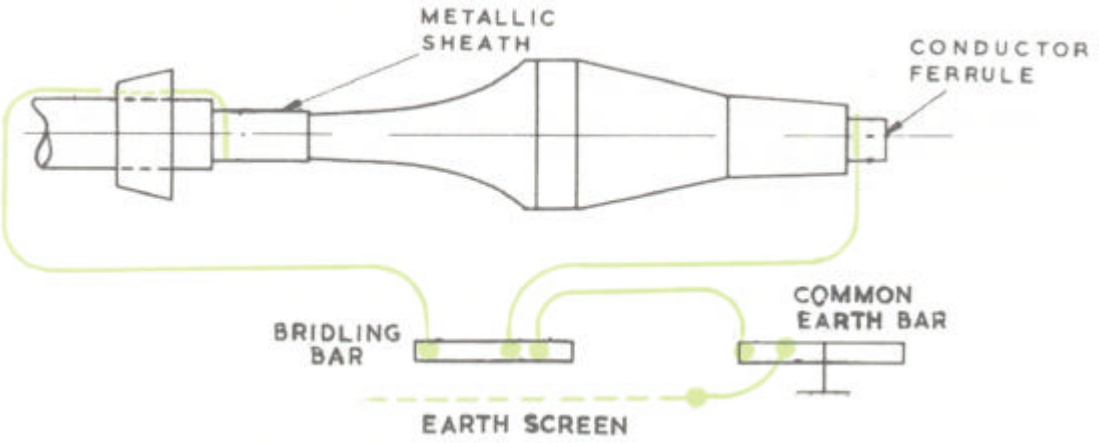



Fig 8.1

5. The centre section of the joint, the casing of which must be earthed via a *Bonding Connection* to the Bridling Bar, should be brought up to the end of the cable until the ferrule is on the point of entering the centre section. Using *Insulated Working*, the *Bonding Connection* on the ferrule should be removed. The centre section should immediately be passed over the cable end until the ferrule plugs into the central conductor fitting.

6. The locking ring or nut must be screwed on to the ferrule using the insulated spanner.

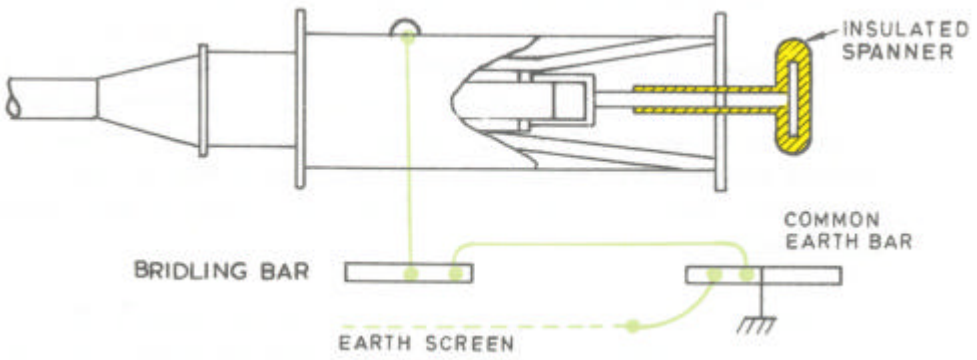



Fig 8.2

7. The side of the joint being worked on can then be completed, up to and including plumbing and impregnation, using *Earthed Working*.

8. The other side of the joint should be completed using similar procedures to those detailed above.

9. The joint outer protective box, permanent oil feed lines and bonding leads should then be fitted in accordance with Guidance Note 10.

10. When breaking-down a stop joint of this type, the reverse of the procedures detailed above must be used, as applicable.

## GUIDANCE NOTE 9

## MAKING OR BREAKING-DOWN, SINGLE-CORE STOP JOINTS INCORPORATING A SOLIDLY-FERRULED CONDUCTOR AND A 'SLIDE-OVER' CENTRE SECTION

This Guidance Note supplements the relevant requirements of NSI 5 for the making or breaking-down of single-core stop joints incorporating a Solidly-ferruled Conductor and a 'slide-over' centre section.

1. Prior to commencing jointing operations on the first cable to be worked on, it must be ensured that the conductor and metallic sheath of the cable are individually earthed to the common earth bar via the Bridling Bar using the procedures detailed below. The *Bonding Connections* for this purpose should be threaded through the joint sleeve and end bells as necessary to allow these items to be located over the cable at the appropriate time.

    1.1 Where the metallic sheath of the cable is electrically continuous within the work area, the cable must be prepared and cut in accordance with Guidance Note 4, Clauses 1-7.

    1.2 Where the metallic sheath of the cable is not electrically continuous within the work area, *Insulated Working* must be used to expose a section of metallic sheath on one side of the discontinuity which must then be earthed by a *Bonding Connection* applied to the common earth bar via the Bridling Bar. This operation must then be repeated on the metallic sheath on the other side of the discontinuity.

    1.3 If, on a capped cable, the conductors and metallic sheath are not shorted together, the cable must be prepared in accordance with the principles of Guidance Note 4, Clauses 1-7, omitting the spiking.

    1.4 If, on a capped cable, the conductor and metallic sheath are connected together, the cap should be removed provided the metallic sheath is earthed. (If the metallic sheath is not earthed, *Insulated Working* must be used to expose a section of the sheath and a *Bonding Connection* applied. A *Bonding Connection* must be applied between the conductor and the Bridling Bar so that the *Bonding Connection* (flexible copper braid) between the conductor and metallic sheath can be removed.

2. Provided the conductor is kept earthed at all times, *Earthed Working* can now be used up to the application of the insulation.

3. The cable insulation may now be removed as required to enable the ferruling operation to be carried out. Earthed *Bonding Connections* should then be applied to the conductors as close as possible to the insulation, using a caliper clamp type *Bonding Connection*. Other conductor *Bonding Connections* may now be removed and the operation can proceed as follows:

    3.1 For Milliken type conductors a *Bonding Connection*, connected to earth, should be applied to the ferrule via the compression equipment and the conductors placed as far as possible into the ferrule. The caliper clamp type *Bonding Connection* should then be removed and the conductor pushed fully home. The ferrule should then be jointed on to both conductors. If space permits, a *Bonding Connection* connected to earth should then be applied to the ferrule and the compression equipment removed. Alternatively, if it is not possible to apply a *Bonding Connection* to the ferrule with the compression equipment still attached, *Insulated Working* must be used to remove the compression equipment and to earth the ferrule with a *Bonding Connection*.

    3.2 For other types of conductor, the ferrule should be jointed on to the conductor with the caliper clamp type *Bonding Connection* in position. A *Bonding Connection*, connected to earth, should then be applied to the ferrule and the caliper type *Bonding Connection* removed.

4. The metallic sheaths should then be finally prepared and the complete built-up cable insulation applied on both sides of the joint.

5. The centre section of the joint, the casing of which must be earthed via a *Bonding Connection* to the Bridling Bar, should be brought up to the end of the cable until the ferrule is on the point of entering the centre section. Using *Insulated Working*, the *Bonding Connection* on the ferrule should be removed. The centre section should immediately be moved further along the cable until the ferrule registers correctly to the central conductor fitting.

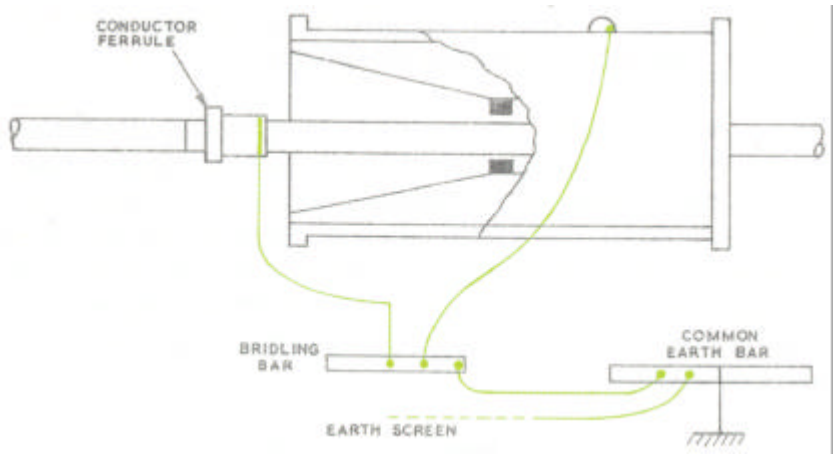



Fig 9.1

6. The locking ring(s) or nut(s) should be screwed on to the ferrule using the insulated spanner.

7. The joint may be completed up to and including plumbing and impregnation using *Earthed Working*.

8. The joint outer protective box, permanent oil feed lines and bonding leads should then be fitted in accordance with Guidance Note 10.

9. When breaking-down a stop joint of this type, the reverse of the procedures detailed above must be used, as applicable.

## GUIDANCE NOTE 10

## FITTING JOINT OUTER PROTECTIVE BOXES ON HV CABLES

This Guidance Note supplements the relevant requirements of NSI 5 for the fitting of joint outer protective boxes on **HV** cables.

1. Generally, for joints without bonding leads, *Insulated Working* should be adopted for the removal of any *Bonding Connections* connected to the metallic sheath, and the fitting of the outer protective box. With some joints however it is possible to pass an earthed *Bonding Connection* to the joint sleeve through the filling turret whilst the box is being fitted and then remove the *Bonding Connection* connected to the metallic sheath. In such cases the outer protective box can be fitted using *Earthed Working*, but *Insulated Working* must be used to remove the *Bonding Connection* connected to the joint sleeve.

2. For joints with bonding leads, *Earthed Working* may be used to fit the outer protective box provided the sequence of operations given below is adopted and the metallic sheaths are first earthed by *Bonding Connections* connected to the joint bay common earth bar via the Bridling Bar.

   2.1 Where the *Link Box* is installed and the bonding leads are continuous between the *Link Box* and the joint sleeve:

   a *Insulated Working* must be adopted to connect a *Bonding Connection* between the *Link Box* permanent earth and the joint bay common earth bar, unless a permanent connection is already installed.

   b The bonding leads should be passed through the spout provided in the outer protective box and together with any permanent earth connections, should then be permanently installed and connected at both ends to the joint sleeve, *Link Box* or local earth as appropriate, using *Earthed Working*.

   c *Bonding Connections*, connected to earth, should be applied to all terminal pillars in the *Link Box* and the earths connected to the metallic

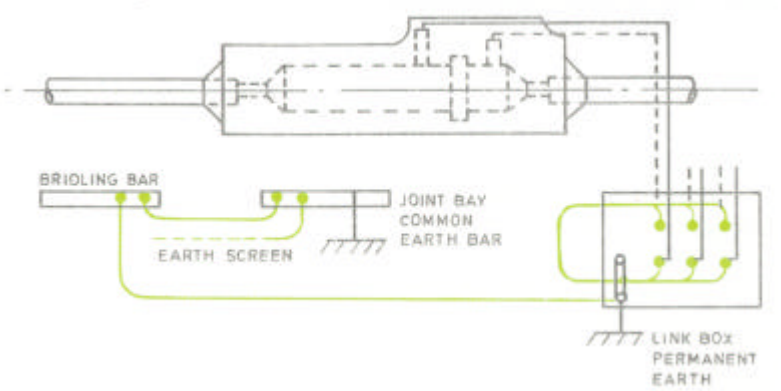



Fig 10.1

   d The installation of the outer protective box may now be completed including permanent oil feed lines, provided an insulated link has first been fitted in these lines.

   e *Insulated Working* must then be used to remove any *Bonding Connections* applied between the joint bay and *Link Box* permanent earths, unless a permanent connection has since been installed in which case *Earthed Working* may be used.

   2.2 Where the *Link Box* is installed after the joint, or the bonding leads from the joint have not yet been jointed on to existing leads from the *Link Box*:

   a A temporary local earth point must be established at the free end of the bonding leads, remote from the joint sleeve.

b *Insulated Working* must be adopted to connect a *Bonding Connection* between the local earth at the free end of the bonding leads and the joint bay common earth bar.

c Using *Earthed Working*, all conductors at the free end of the bonding leads must be earthed via *Bonding Connections* and the conductors at the other end bolted to the connecting lugs of the joint sleeve, after the bonding lead has been passed through the spout provided in the outer protective box. The *Bonding Connections* connected to the metallic sheath may then be removed and the installation of the outer protective box completed including permanent oil feed lines, provided an insulated link has first been fitted in these lines.

d *Insulated Working* must then be used to remove the *Bonding Connection* between the local earth at the free end of the bonding leads and the joint bay common earth bar.

e Reference should be made to Guidance Notes 14 and 15 for the procedure when the *Link Box* is to be installed or the bonding leads jointed.

3. When removing Joint Outer Protective Boxes, the reverse of the procedures detailed above must be used, as applicable.

## GUIDANCE NOTE 11

## MAKING OR BREAKING-DOWN SEALING ENDS ON H.V. CABLES

This Guidance Note supplements the relevant requirements of NSI 5 for the making and breaking-down of sealing ends on **HV** cables.

1. Prior to commencing jointing operations it must be ensured that the metallic sheath of the cable and the conductor are earthed.

   1.1 *Insulated working* must be used to expose a section of the metallic sheath and then to earth this by a *Bonding Connection* applied to the common earth bar.

   1.2 If, on a capped cable, the conductor and metallic sheath are not shorted together the cable should be prepared in accordance with the principles of Guidance Note 4, Clauses 1-7, omitting the spiking.

2. Providing the conductor is kept earthed at the point of work at all times, *Earthed Working* can be used in accordance with the appropriate jointing instructions.

3. Remove the cable insulation as required in preparation for attaching the conductor fitting. Apply a calliper clamp type *Bonding Connection* to the conductor as close as possible to the insulation. Other conductor earths may now be removed and the conductor cut at the appropriate position. The operation may now proceed as follows:

   3.1 For Milliken type conductors a *Bonding Connection,* connected to earth, should be applied to the conductor fitting and the conductors placed as far as possible into the conductor fitting. The calliper clamp type *Bonding Connection* should then be removed and the conductor pushed fully home.

   3.2 For other types of conductor, the conductor fitting should be jointed on to the conductor, with the calliper clamp type *Bonding Connection* in position. A *Bonding Connection* connected to earth, should then be applied to the conductor fitting and the calliper clamp type *Bonding Connection* removed.

4. Work should now proceed in accordance with the appropriate jointing instructions. (See Fig. 11.1).

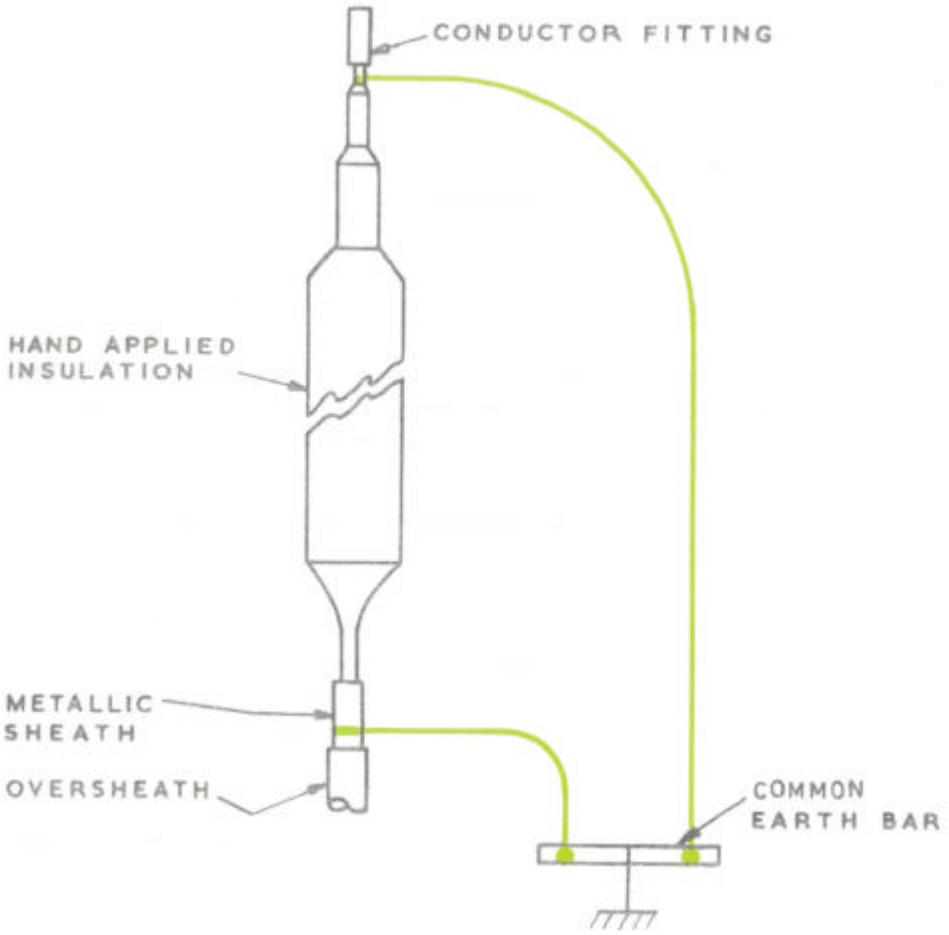



Fig 11.1

5. Where possible, during the lowering of the porcelain, a *Bonding Connection* connected to earth, should be passed through it and attached to the conductor.
(See Fig. 11.2).

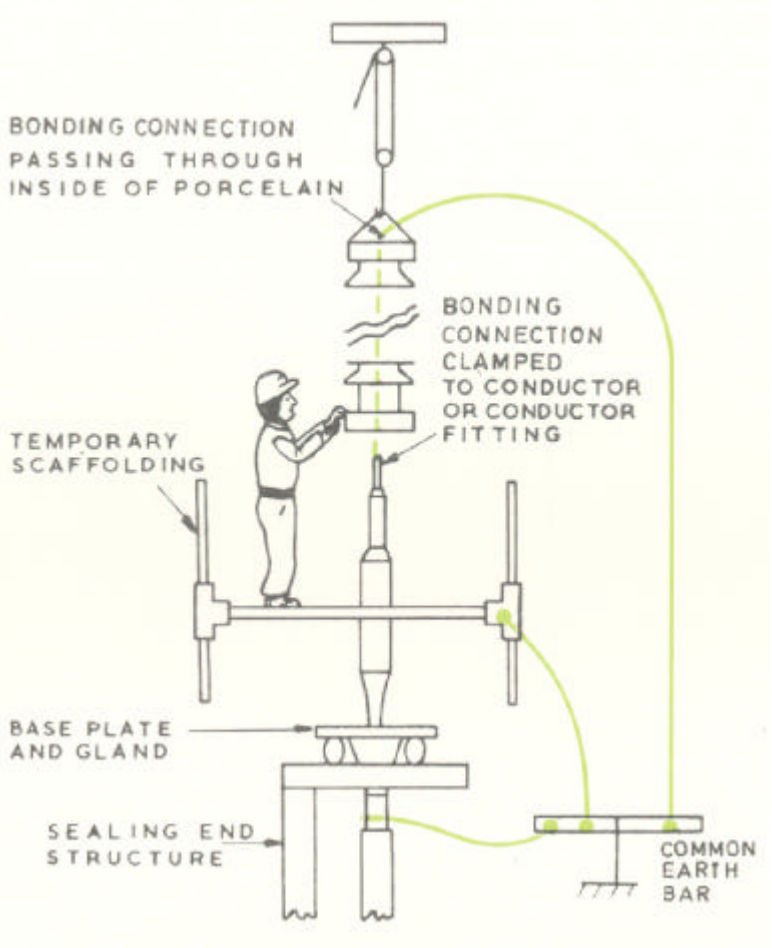



Fig 11.2

6. When the design of sealing end is such that the clearance between the conductor stalk and the top cap does not permit the passage of a *Bonding Connection,* then using *Insulated Working* the *Bonding Connection* can be temporarily removed during the operation of lowering the porcelain into position. The *Bonding Connection* must be replaced as soon as possible but until this is done the Person doing the work must comply with *Insulated Working* standards. (See Fig. 11.3).

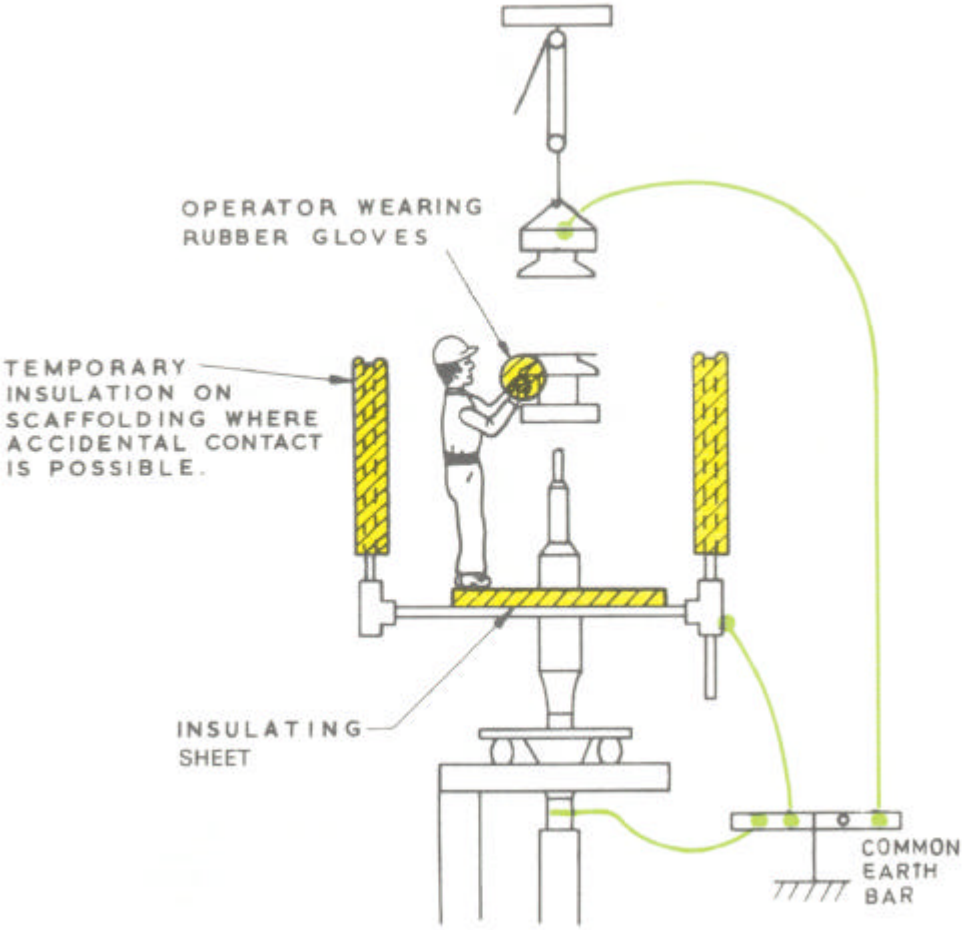



Fig 11.3

6. When breaking-down a sealing end, the reverse of the procedures detailed above should be used, as applicable.

## GUIDANCE NOTE 12

## REPAIRING OIL AND GAS LEAKS

This Guidance Note supplements the relevant requirements of NSI 5 for the repairing of oil and gas leaks.

1. Where leaks develop in metallic sheaths, cable accessories or metallic feed lines between the insulated oil or gas links and the associated joint or sealing end, the work should be treated as a metallic sheath repair. (see Guidance Note 3).

2. Where leaks occur in metallic feed lines between the insulated oil or gas links and the oil or gas reservoir, this Guidance Note with the precautions for *Impressed Voltage Conditions* need not be applied.

## GUIDANCE NOTE 13

## WORK IN CABLE SHEATH LINK BOXES NOT INVOLVING THE CUTTING OR DISCONNECTION OF BONDING LEADS

1. The work may be undertaken using one of the methods given below:

1.1 If it is practicable to maintain an earth connection via *Bonding Connections* or links to all terminals in the *Link Box* being worked on, then *Earthed Working* may be used.

1.2 If it is necessary to remove the earth connection from terminal pillars within the *Link Box* being worked on then *Insulated Working* may be used.

1.3 If it is not practicable to use either *Earthed Working* or *Insulated Working* techniques throughout, then the method of working detailed below, which embodies the principle of ensuring that at all times there is a connection between earth and the metallic sheath of at least one cable on either side of the point of work, may be used providing the following requirements are first complied with. (See Fig. 13.1).

Using the procedures detailed in Section 7 of NSI 5

a At the adjacent *Link Boxes* on each side of the point of work:

- Remove the links and disconnect the SVL if fitted.
- Using *Bonding Connections* bond together the metallic cable sheaths of the section adjacent to the point of work. These bonds must be clear of earth.
- **Approved** Notices must be displayed at these **Locations**.

Note: The bonding arrangements described in ‘a’ above, can, in some cases, be achieved by suitable repositioning of links.

b At the point of work:

- *Bonding Connections,* connected to earth, must be applied to the terminal pillars of at least one bonding lead core from either side of the point of work.

1.4 *Insulated Working* may now be dispensed with and work can proceed on the terminal pillars other than those earthed as in 1.3b above.

1.5 During the course of the work the *Bonding Connections* applied in 1.3b may be removed to allow work on those pillars providing *Bonding Connections*, connected to earth, are first applied to the terminal pillars of at least one other bonding lead from either side of the point of work.

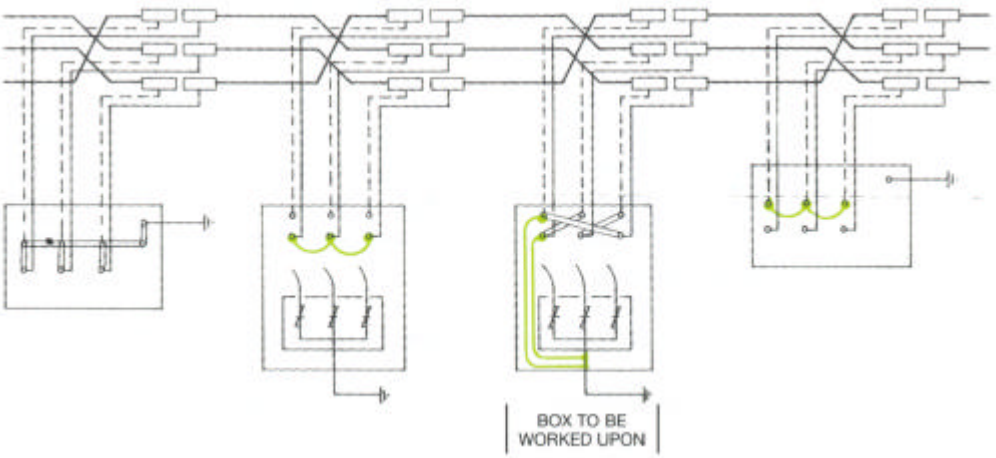



Fig 13.1

## GUIDANCE NOTE 14

## REPLACING CABLE SHEATH LINK BOXES BY CUTTING AND JOINTING EXISTING BONDING LEADS

This Guidance Note supplements the relevant requirements of NSI 5 for replacing cable sheath *Link Boxes* by cutting and jointing existing bonding leads.

1. The work may be undertaken using one of the methods given below:

1.1 If it is practicable to maintain an earth connection via *Bonding Connections* or links to all terminals in the *Link Box* being worked on, then *Earthed Working* may be used.

1.2 If it is necessary to remove the earth connection from terminal pillars within the *Link Box* being worked on then *Insulated Working* may be used.

1.3 If it is not practicable to use either *Earthed Working* or *Insulated Working* techniques throughout, then the method of working detailed below, which embodies the principle of ensuring that at all times there is a connection between earth and the metallic sheath of at least one cable on either side of the point of work, may be used providing the following requirements are first complied with.

Using the procedures detailed in Section 7 of NSI 5

a At the adjacent *Link Boxes* on each side of the point of work:

- Remove the links and disconnect the SVL if fitted.
- Using *Bonding Connections* bond together the metallic cable sheaths of the section adjacent to the point of work. These bonds must be clear of earth.
- **Approved** Notices must be displayed at these **Locations**.

Note: The bonding arrangements described in ‘a’ above, can, in some cases, be achieved by suitable repositioning of links.

b At the point of work:

If *Bonding Connections* are not already applied between earth and all the terminal pillars or links of the *Link Box* to be replaced, then these must be applied.

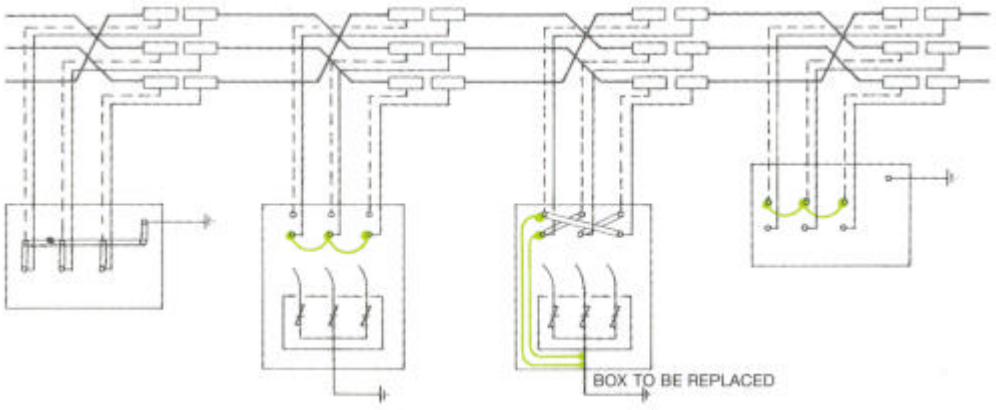



Fig 14.1

1.4 *Insulated Working* may now be dispensed with. One of the existing bonding leads between the cable joint and the *Link Box* should be cut at the appropriate place for jointing, and both the inner and outer conductors (on the cable joint side of the cut) must be connected to the local earth by suitable *Bonding Connections*. (Fig 14.2)

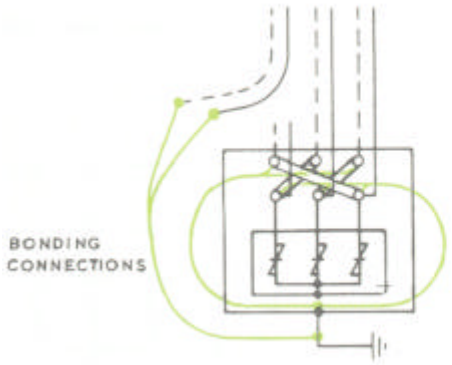



Fig 14.2

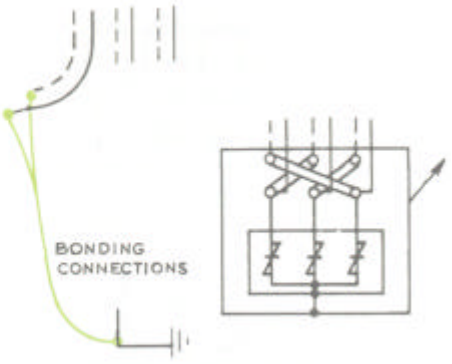



Fig 14.3

1.5 The other two existing bonding leads should be cut and the *Link Box* removed (Fig 14.3)

1.6 The new *Link Box* complete with appropriate lengths of bonding leads, should be placed in situ. Where the terminal pillars of the *Link Box* are not provided with special connecting points for *Bonding Connections*, the links must be bolted into their normal operating positions.

1.7 Straight joints should be made between the two bonding leads referred to in 1.5 and the corresponding leads of the new *Link Box*. (See Fig 14.4)

1.8 Where practicable, earthed *Bonding Connections* should be applied to the terminal pillars corresponding to the bonding leads just jointed. (Fig 14.5). Where the terminal pillars are not provided with suitable connecting points, earthed *Bonding Connections* must be connected to all three links.

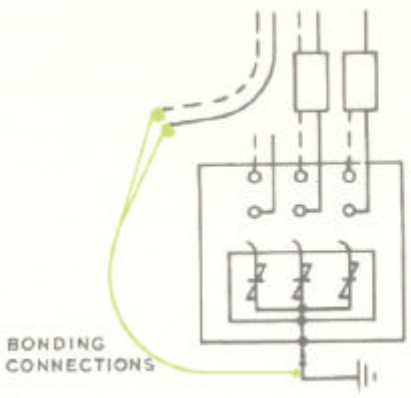



Fig 14.4

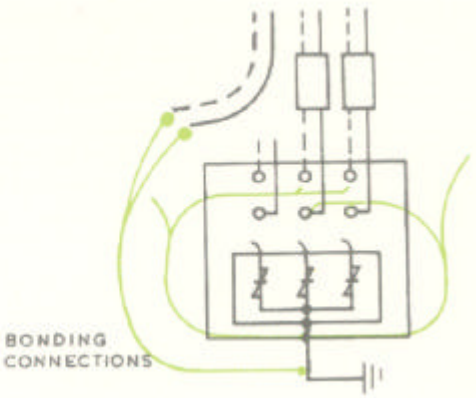



Fig 14.5

1.9 The remaining bonding lead should be jointed. (See Fig 14.6). Where appropriate earthed *Bonding Connections* should be applied to its terminals. (See Fig 14.7)

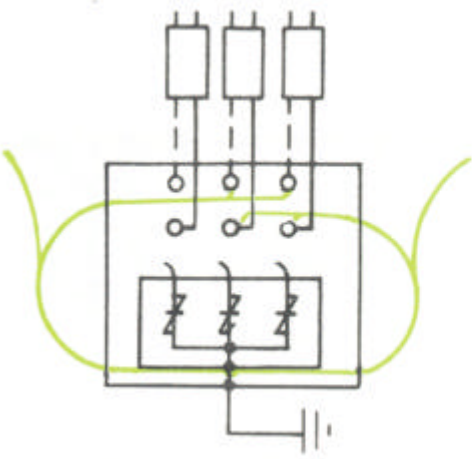


Fig 14.6

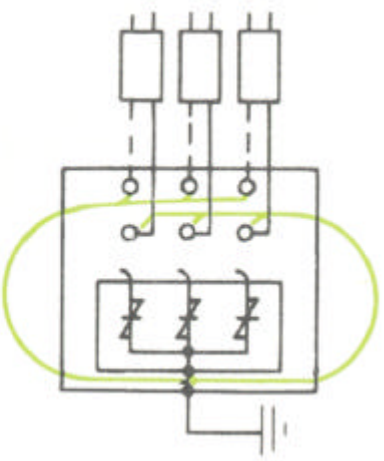


Fig 14.7

1.10 Using the procedure detailed in Section 9 of NSI 5.

- The *Bonding Connections* at the point of work should be removed and the *Link Box* returned to service.
- Any connections applied under 1.3a should be removed and the bonding arrangement at the bonding position on each side of the point of work returned to the correct operational mode.

1.11 All the *Link Boxes* should be **Locked** and any **Approved** Notices removed.

1.12 In the case of single-phase *Link Boxes* or single core bonding leads, similar procedures to those given above must be adopted, care being taken to ensure that at all times there is a connection between earth and the metallic sheaths of at least one cable on each side of the point of work.

## GUIDANCE NOTE 15

## REPLACING CABLE SHEATH LINK BOXES BY BREAKING-DOWN EXISTING LINK BOXES

This Guidance Note supplements the relevant requirements of NSI 5 for the replacing of cable sheath *Link Boxes* by breaking-down existing *Link Boxes*.

1. The work may be undertaken using one of the methods given below:

1.1 If it is practicable to maintain an earth connection via *Bonding Connections* or links to all terminals and bonding leads at the point of work at all times, then *Earthed Working* may be used.

1.2 If it is necessary to remove the *Bonding Connections* from the terminal pillars or bonding leads at the point of work, then *Insulated Working* may be used.

1.3 If it is not practicable to use either *Earthed Working* or *Insulated Working* techniques throughout, then the method of working detailed below, which embodies the principle of ensuring that at all times there is a connection between earth and the metallic sheath of at least one cable on either side of the point of work, may be used provided the following requirements are first complied with:

Using the procedure detailed in Section 7 of NSI 5.

a At the adjacent *Link Boxes* on each side of the point of work:

- Remove the links and disconnect the SVL if fitted.
- Using *Bonding Connections* bond together the metallic cable sheaths of the section adjacent to the point of work. These bonds must be clear of earth.
- **Approved** Notices must be displayed at these **Locations**.

Note: The bonding arrangements described in ‘a’ above, can, in some cases, be achieved by suitable repositioning of links.

b At the point of work:

- One link must be connected to earth using a *Bonding Connection*. (See Fig 15.1). *Insulated Working* may now be dispensed with, and the remaining two links and SVL connections (where fitted) removed. A pair of terminal pillars connected to cables from each side of the point of work shall now be connected to earth using *Bonding Connections*.
- The remaining link together with its Earthed *Bonding Connection* may now be removed. (See Fig 15.2).

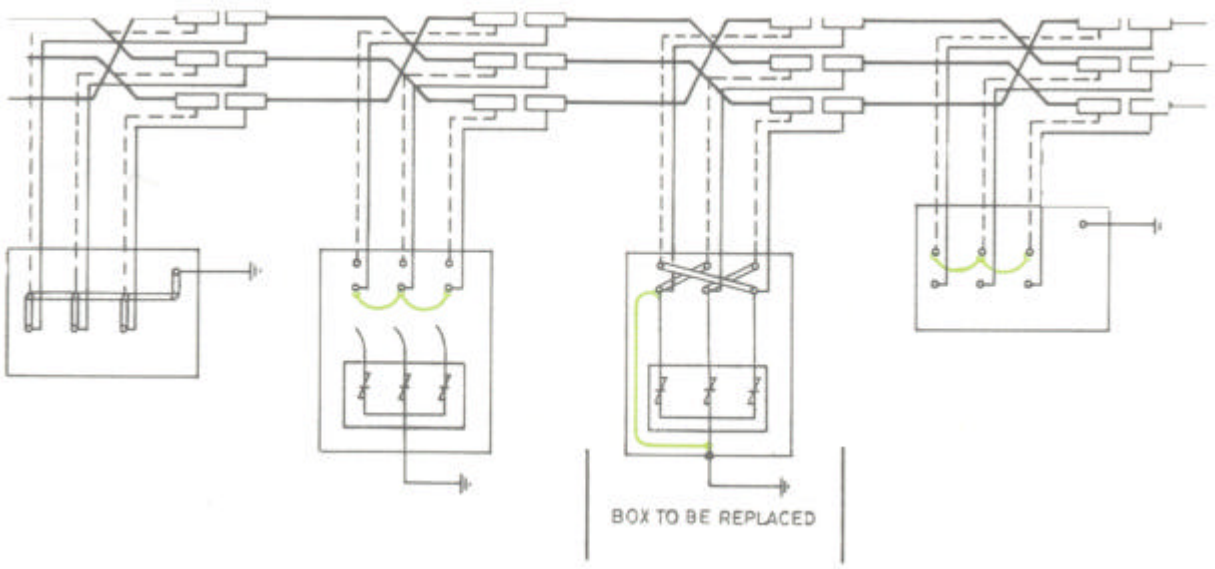



Fig 15.1

1.4 In the case of underground Link Boxes, the compound may now be removed by suitable means.

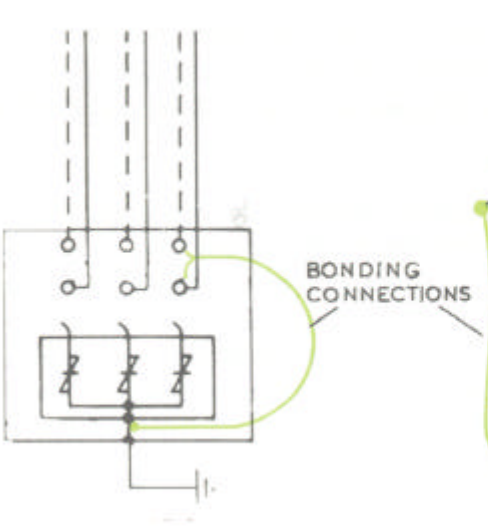



Fig 15.2

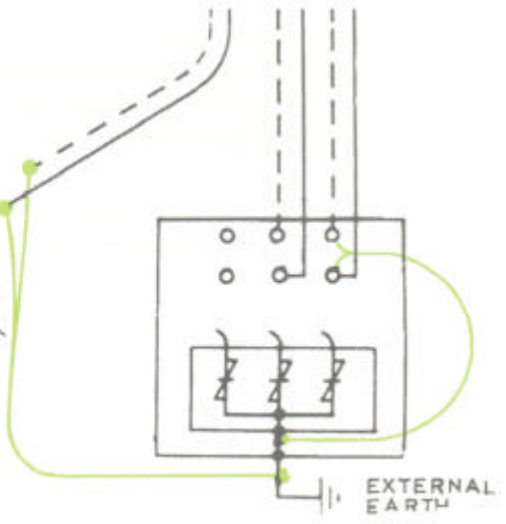



Fig 15.3

1.5 One of the existing unearthed bonding leads between the joint and the Link Box should be detached from the pillars and removed from the *Link Box*.

1.6 A *Bonding Connection* must be connected to the inner and outer conductors of this bonding lead, the earth end fitting having first been connected to a local earth bar or rod external to the *Link Box*. (See Fig 15.3)

1.7 The other two existing bonding leads between the joints and the *Link Box* should be dealt with as in 1.5 (See Fig 15.4).

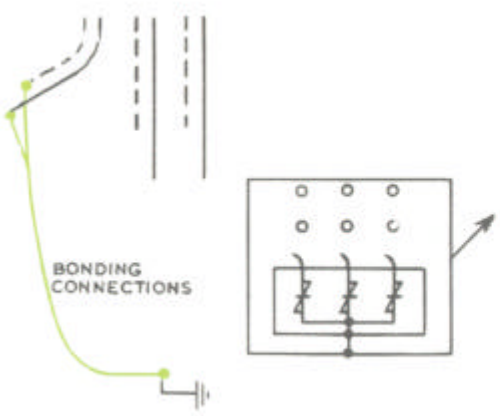



Fig 15.4

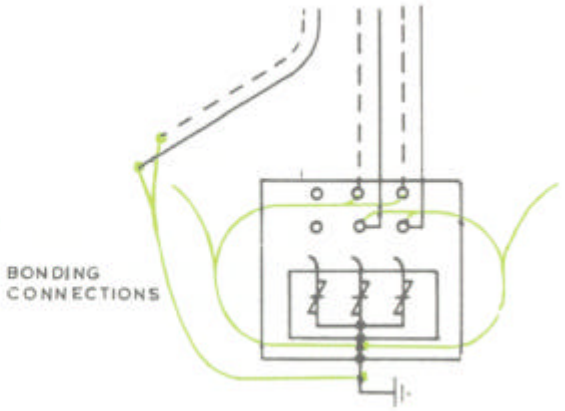



Fig 15.5

1.8 The Link Box should be removed and the new Link Box installed.

1.9 The two bonding leads referred to in 1.7 should be connected into the new Link Box ad *Bonding Connections* attached between earth and their terminal pillars (See Fig 15.5). Where the terminal pillars of the Link Box are NOT provided with special attachment points for *Bonding Connections*, the link that is common to these two bonding leads must be fitted and earthed by means of a *Bonding Connection*.

1.10 The *Bonding Connection* earths should be removed from the bonding lead referred to in 1.6 and then connected into the new *Link Box*. (See Fig 15.6) *Bonding Connections* must be attached between earth and the corresponding terminal pillars. (See Fig 15.7). Where the terminal pillars of the *Link Box* are NOT provided with special attachment points for *Bonding Connections*, then the remaining two links must be fitted and earthed by means of *Bonding Connections*.

1.11 The Link Box should then be completed as required.

1.12 Using the procedure detailed in Section 7 of NSI 5:

a The *Bonding Connections* at the point of work should be removed and the Link Box returned to service.

b Any connections applied under 1.3a should be removed and the bonding arrangement at the bonding position on each side of the point of work returned to the correct operational mode.

1.13 All the Link Boxes should be Locked and any **Approved** Notices removed.

1.14 In the case of single-phase Link Boxes or single core bonding leads, similar procedures to those given above must be adopted, care being taken to ensure that at all times there is a connection between earth and the metallic sheaths of at least one cable on each side of the point of work.

## GUIDANCE NOTE 16

## CUTTING AND CAPPING LV CABLES

This Guidance Note supplements the relevant requirements of NSI 5 for the cutting and capping of **LV** cables.

1. *Insulated Working* must be used throughout this Guidance Note.

2. At terminations at each end of the section to be worked on, all conductors must be Isolated from their terminal equipment.

3. A section of oversheath should be removed to expose the metallic sheath and/or armour.

4. *Bonding Connections* must then be applied to the metallic sheath and/or armour on both sides of the proposed cut and connected to the common earth bar via the Bridling Bar.

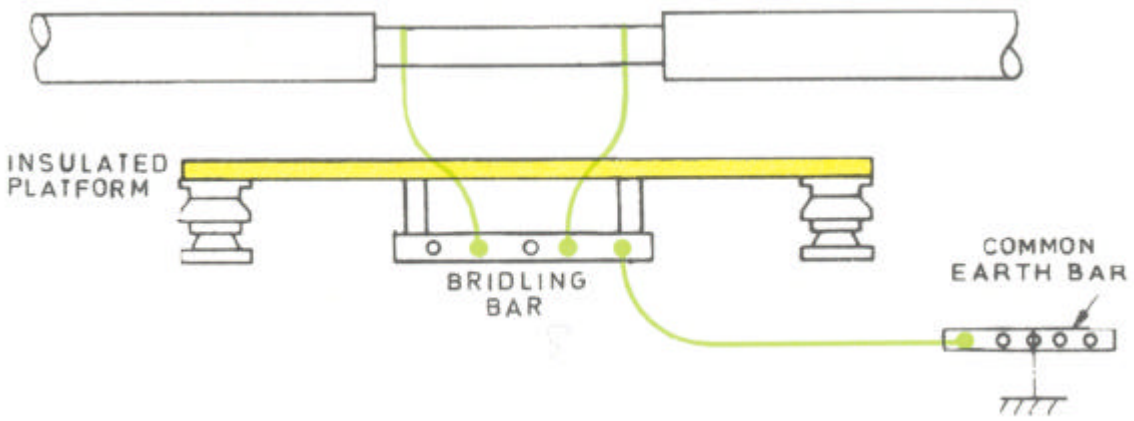



Fig 16.1

5. A section of metallic sheath and/or armour together with any inner sheath or insulation surrounding the cores must be removed without disturbing the conductor insulation. The exposed ends of the metallic sheath and/or armour together with the bonding clamps, must be temporarily insulated.

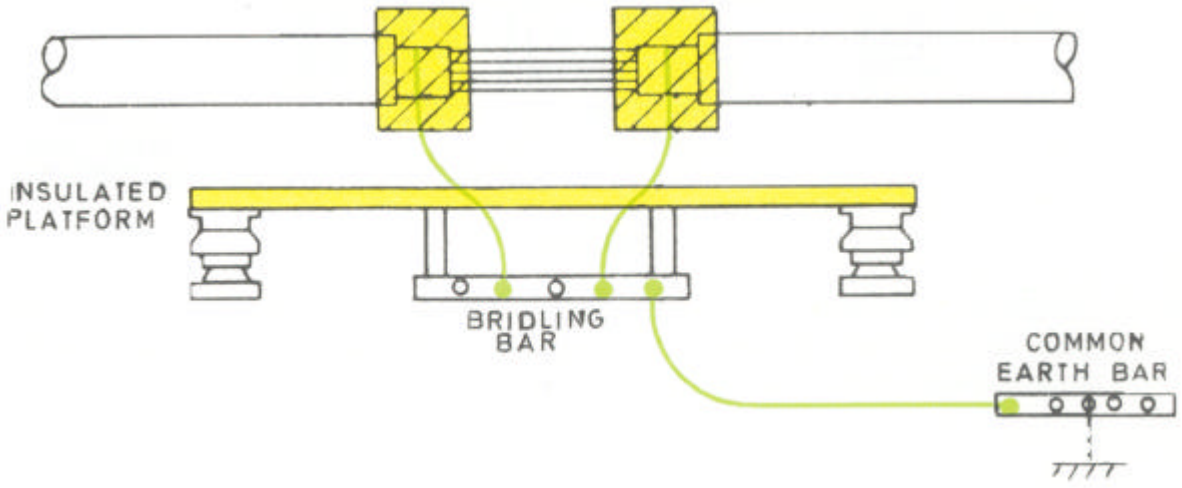



Fig 16.2

6. The cores must be cut one at a time. After each cut the core ends must be moved well apart to avoid accidental contact and then insulated by a cap or other suitable means. This procedure should be followed until all the cores have been cut.

During this process personal contact must not be made with more than one conductor at any one time; this includes avoiding the simultaneous touching of the two ends of a conductor after it has been cut. (See Fig 16.3).

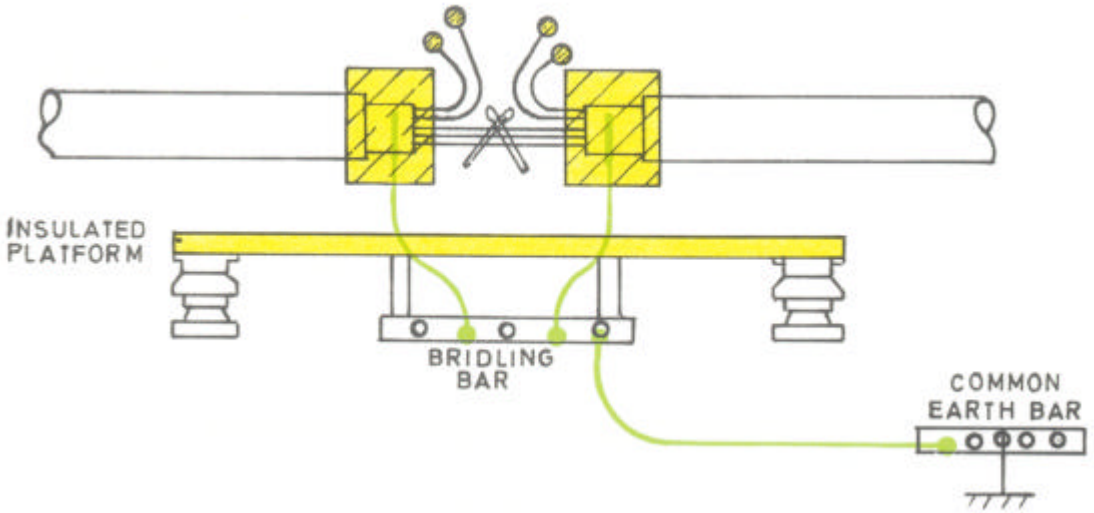



Fig 16.3

7. The temporary insulation must be removed from the metallic sheath and/or armour and associated clamp(s) on one of the cable ends only. (See Fig 16.4).

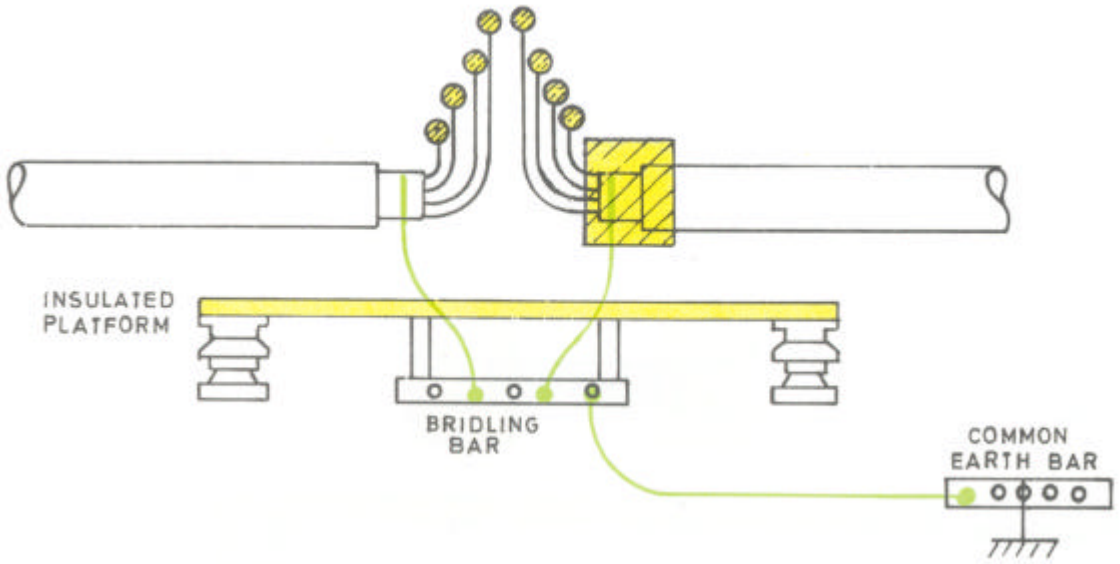



Fig 16.4

8. The *Bonding Connection* on the cable end must be disconnected from the Bridling Bar and then removed from the metallic sheath and/or armour. (See Fig 16.5).

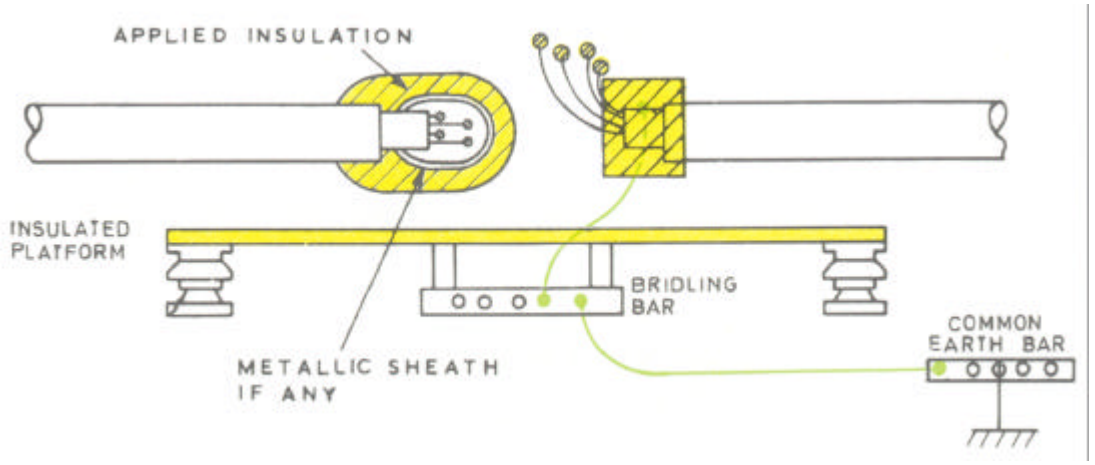



Fig 16.5

9. The sheath should be capped and all the exposed metallic sheath an/or armouring, including any metal cap, must be fully insulated.

10. The procedures detailed in Clauses 7-9 should be repeated for the other cable end, if applicable.

## GUIDANCE NOTE 17a

## JOINTING LV CABLES (INSULATED WORKING METHOD)

This Guidance Note supplements the relevant requirements of NSI 5 for jointing of **LV** cables.

1. At terminations at each end of the section to be worked on, all conductors must be Isolated from their terminal equipment.

2. Where the metallic sheath and/or armour is electrically continuous within the work area, the cable must be cut and prepared in accordance with Guidance Note 16.

3. Where the metallic sheath and/or armour is electrically continuous within the work area, each side of the discontinuity in turn should be prepared as follows:

   Using *Insulated Working*

   3.1 A section of oversheath should be removed to expose the metallic sheath and/or armour.

   3.2 Two *Bonding Connections* must then be applied to the metallic sheath and/or armour and connected to the common earth bar via the Bridling Bar, using the procedures set down in Guidance Note 25. (See Fig 17.1a)

   3.3 A section of metallic sheath and/or armour between the *Bonding Connections* must be removed from the cable without disturbing the conductor insulation.

   Temporary insulation must be applied over the exposed metallic sheath and clamp (A) Fig 17.1(a)

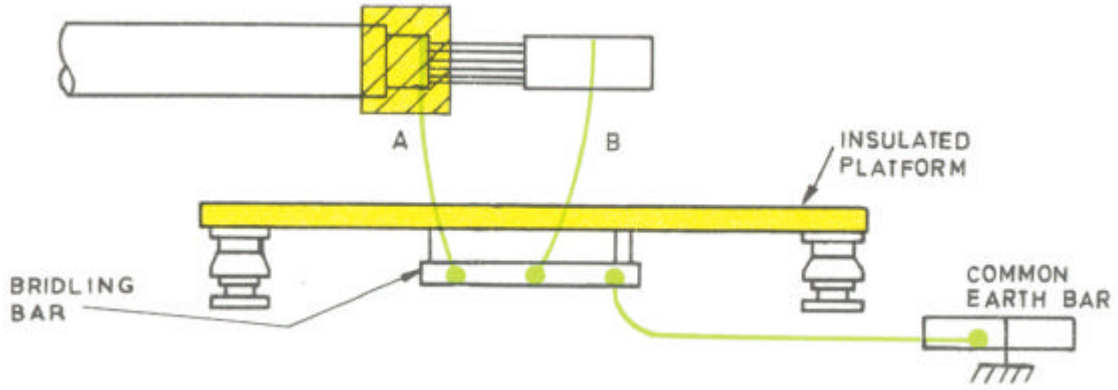



Fig 17.1a

   3.4 Remove *Bonding Connection* (B) and using *Insulated Working* remove remainder of metallic sheath and/or armour.

3.5 The individual conductor ends must be insulated to prevent accidental contact. (See Fig 17.2(a)).

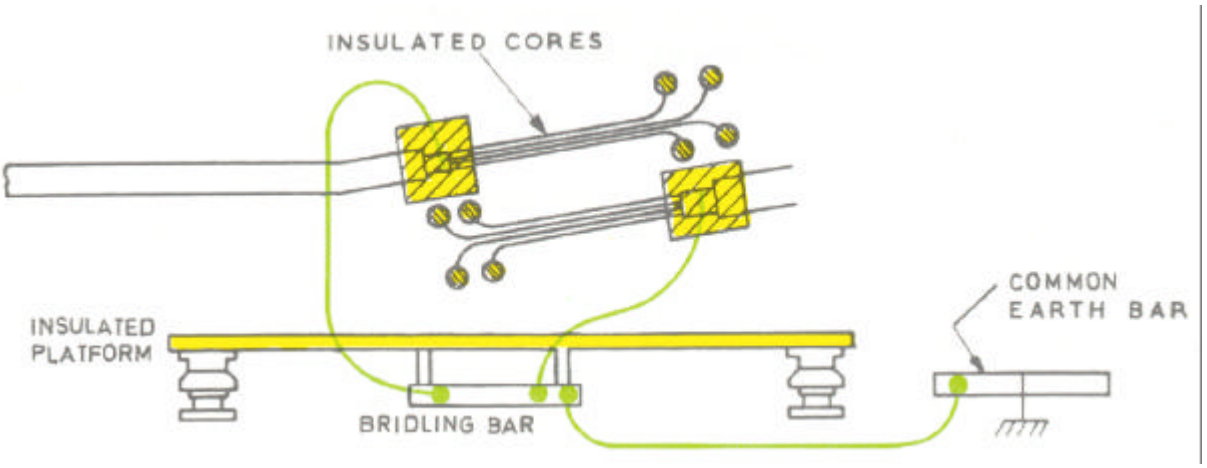



Fig 17.2a

4. Jointing can now proceed using *Insulated Working* ensuring that only one core from one cable is handled at any one time. During each ferruling operation one of the two cores being jointed must beheld with **Approved** insulated pliers. Each completed ferrule must be insulated before proceeding with the next ferruling operation. (See Fig 17.3a)

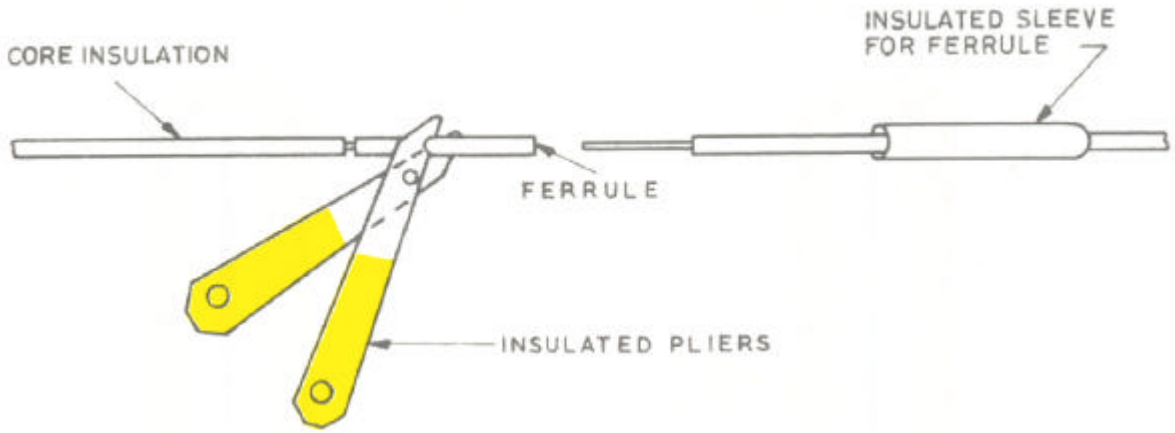



Fig 17.3a

5. After connecting all the cores, the joint should be completed by connecting through the metallic sheath(s) and/or armour(s), after which the *Bonding Connections* should be removed and the outer protective box applied or oversheath repair made as necessary. (See Fig 17.4a).

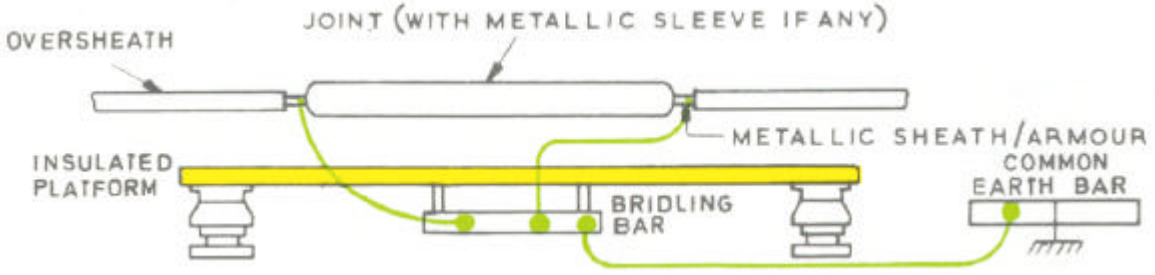



Fig17.4a

## GUIDANCE NOTE 17b

## JOINTING LV CABLES (EARTHING AT THE POINT OF WORK)

This Guidance Note supplements the relevant requirements of NSI 5 for jointing of **LV** cables.

1. Prior to commencement of work on the conductors, the core to earth insulation resistance of all cores must be checked on both cables to be jointed together. (See Guidance Note 23).

   The insulation resistance per core should be not less than the equivalent of 1 megohm for each 1000 metres. If the insulation resistance per core is less than this value then:

   1.1 The operation can proceed providing all work is carried out using *Insulated Working* unless otherwise specified.

   1.2 Alternatively the fault must be located and repaired prior to continuing the operation.

2. At each end of the cables remote from the point of work, all conductors must be bonded together and insulated from the metallic sheath and from earth using *Insulated Working* and an **Approved** Notice displayed. (See Fig 17.1b)

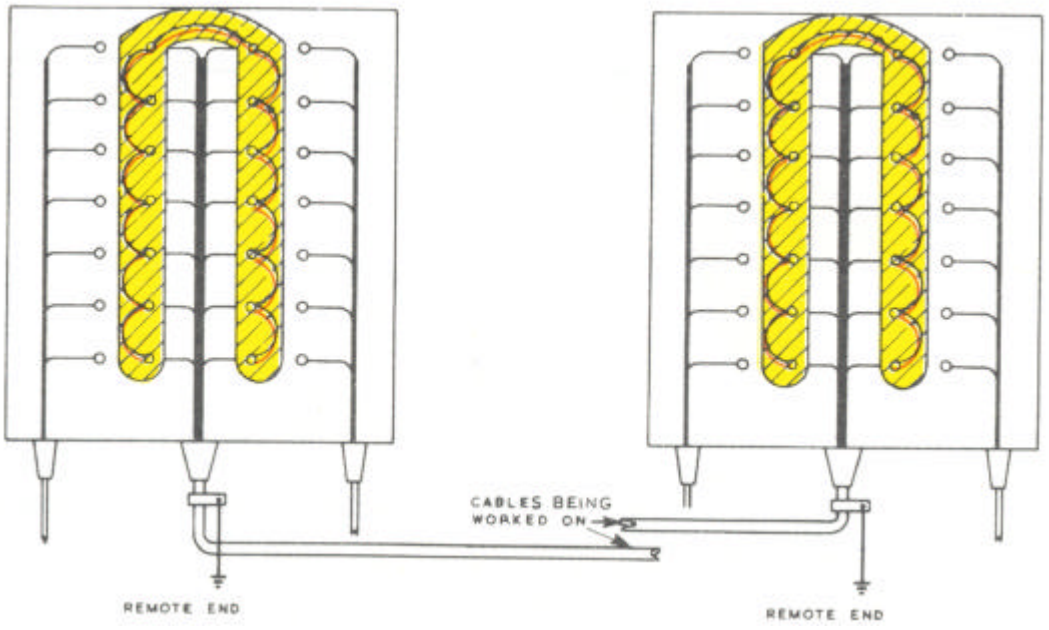



Fig 17.1b

3. Where a metallic sheath and/or armour is electrically continuous within the work area, the cable must be cut and prepared in accordance with Guidance Note 16, Clauses 4-6.

4. Where the metallic sheath and/or armour is not electrically continuous within the work area, each side of the discontinuity in turn should be prepared as follows:

   4.1 Using *Insulated Working* a section of oversheath should be removed to expose the metallic sheath and/or armour.

   4.2 Two *Bonding Connections* must then be applied to the metallic sheath and/or armour and connected to the common earth bar via the Bridling Bar, using the procedures set down in Guidance Note 25. (See Fig 17.2b)

   4.3 A section of metallic sheath and/or armour between the *Bonding Connections* must be removed from the cable without disturbing the conductor insulation.

Temporary insulation must be applied over the exposed metallic sheath and clamps (A) as Fig 17.2b.

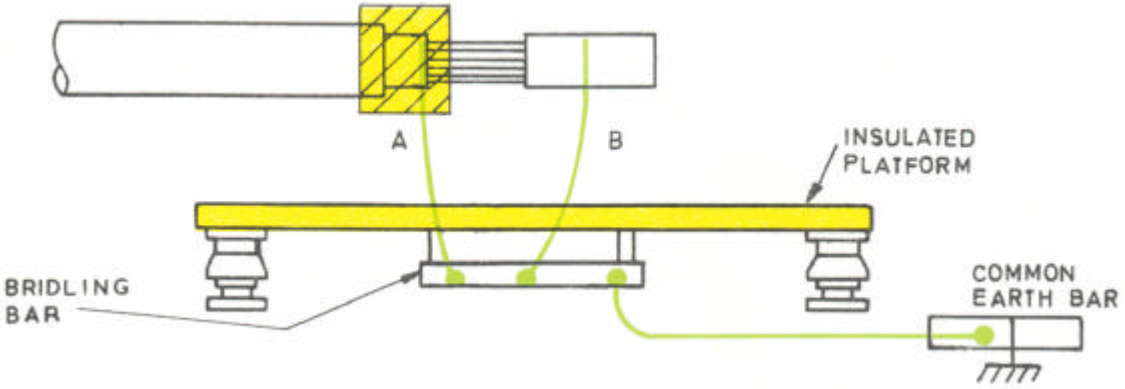



Fig 17.2b

4.4 Remove *Bonding Connection* (B) and using *Insulated Working* remove remainder of metallic sheath and/or armour.

The individual conductor ends must be insulated to prevent accidental contact. (See Fig 17.3b)

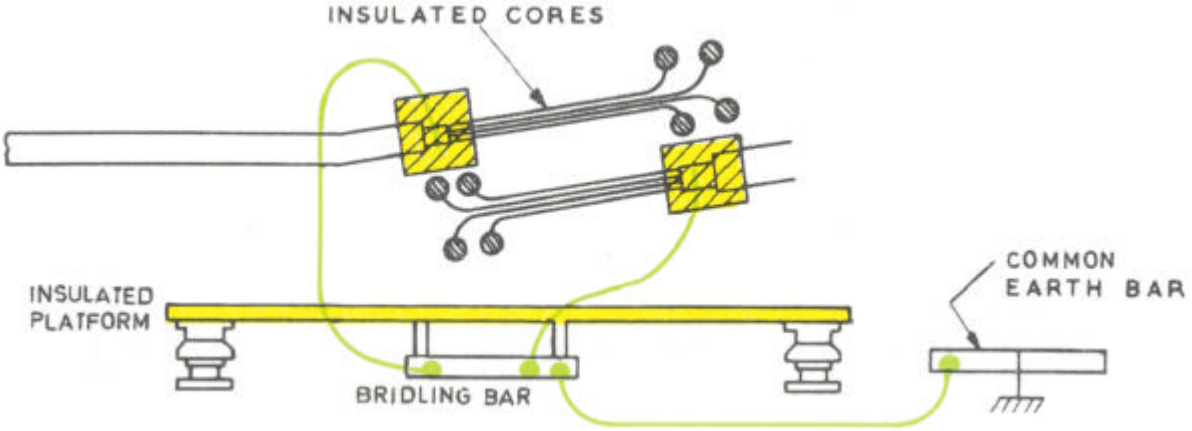



Fig 17.3b

5. Using *Insulated Working*, one core from each cable on either side of the discontinuity must be earthed by a B*onding Connection* applied to the common earth bar via the Bridling Bar. Care must be taken to ensure that only the core from one cable is handled at any one time.

6. *Insulated Working* may now be dispensed with, and all cores may be jointed other than those earthed as in 5, above. Each completed ferrule must be fully insulated before proceeding with the operation detailed in 7, below.

7. Using *Insulated Working,* remove the *Bonding Connections* applied in 5 above, ensuring that only the core from one cable is handled at any one time.

The two cores may now be jointed, one of the cores being held with **Approved** insulated pliers during the ferruling operation. (See Fig. 17.4b)

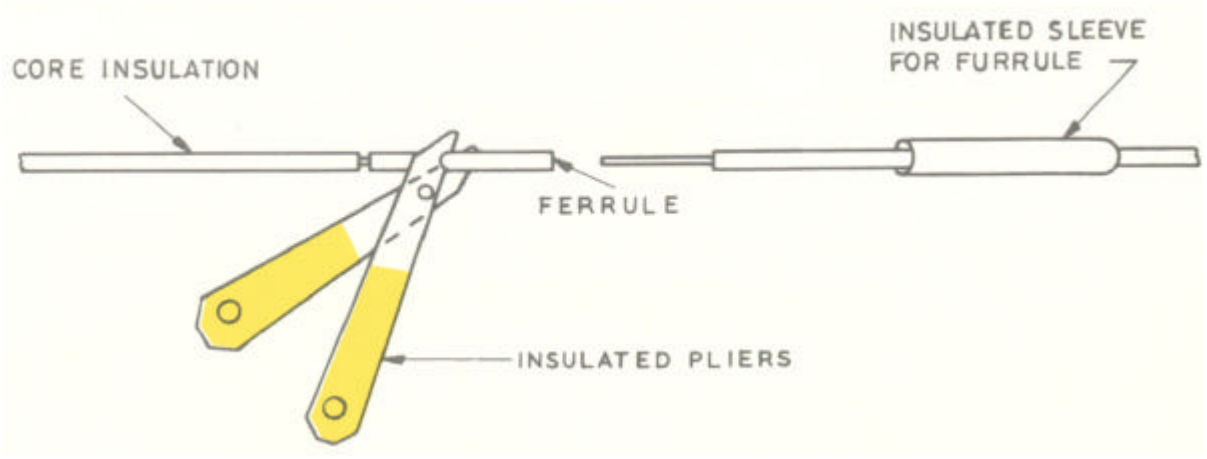



Fig 17.4b

8. After connecting all the cores, the joints should be completed by connecting through the metallic sheath(s) and/or armour(s), after which the *Bonding Connections* should be removed and the outer protective box applied or oversheath repair made as necessary. (See Fig. 17.5b)

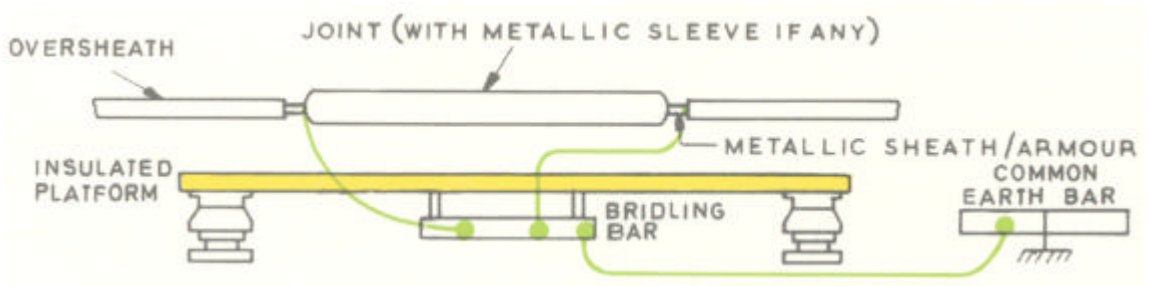



Fig 17.5b

## GUIDANCE NOTE 18

## GLANDING-OFF L.V. CABLES AT TERMINAL BOXES

This Guidance Note supplements the relevant requirements of NSI 5 for the glanding-off of **LV** cables at terminal boxes.

1. Using *Insulated Working* a section of oversheath should be removed to expose the metallic sheath and/or armour.

2. Two *Bonding Connections* must then be applied to the metallic sheath and/or armour and connected to the common earth bar via the Bridling Bar. (See Fig. 18.1)

3. A section of metallic sheath and/or armour between the *Bonding Connections* must be removed from the cable without disturbing the conductor insulation.

   Temporary insulation must be applied over the exposed metallic sheath and clamp (A) as Fig. 18.1.

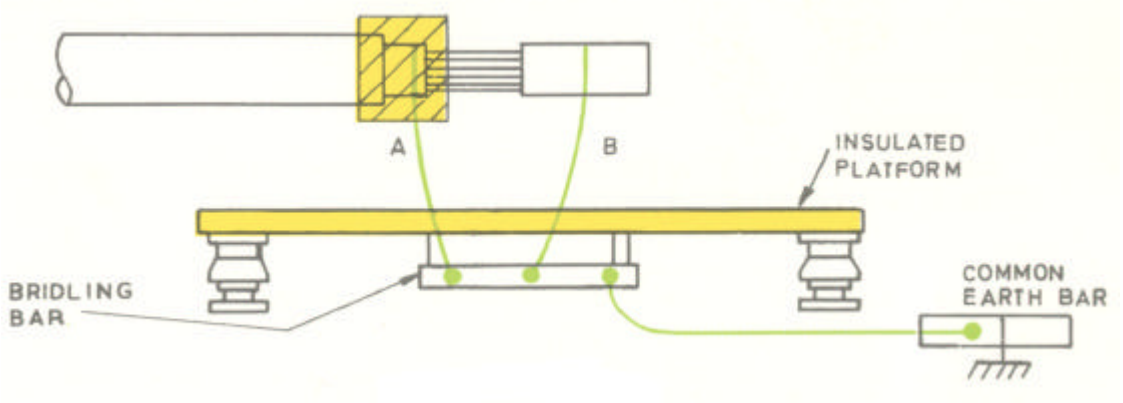



Fig 18.1

4. Remove *Bonding Connection* (B) and using *Insulated Working* remove remainder of metallic sheath and/or armour.

   The individual conductor ends must be insulated to prevent accidental contact. (See Fig. 18.2)

   Remove temporary insulation.

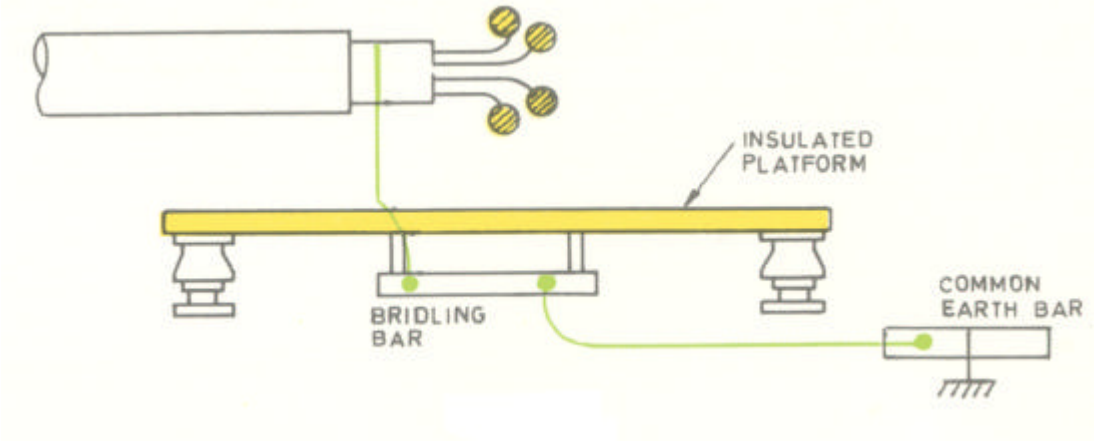



Fig 18.2

5. The cable should be glanded-off and the permanent sheath and/or armour earth connection made. (See Fig. 18.3)

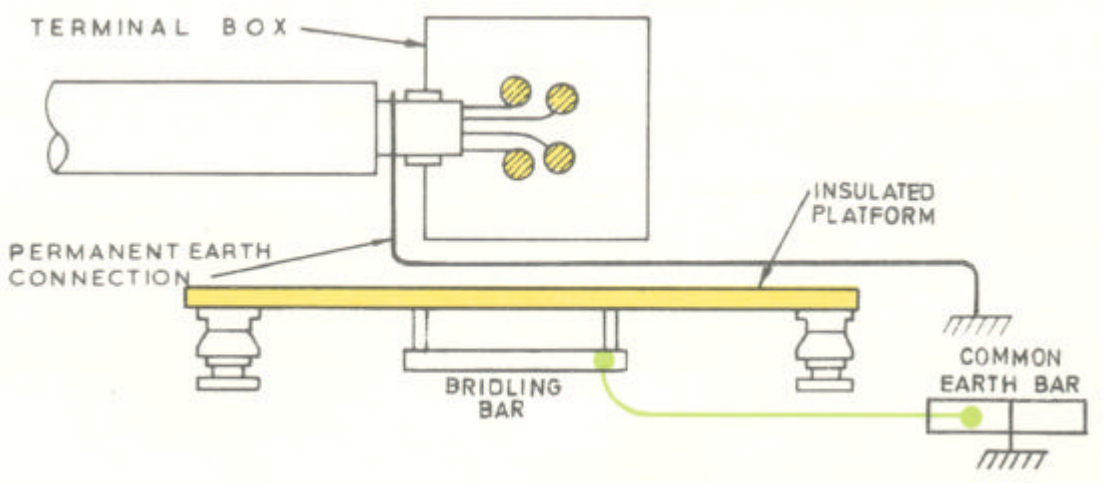



Fig 18.3

6. The *Bonding Connection* connected to the metallic sheath and/or armour can now be removed and the oversheath repaired.

## GUIDANCE NOTE 19

## TERMINATIONS IN FULLY INSULATED BOXES

This Guidance Note supplements the relevant requirements of NSI 5 for terminating of **LV** cables in fully insulated boxes.

1. *Insulated Working* must be used throughout the Guidance Note.

2. Prior to terminating any core it must be ensured that any existing connections to off going **Equipment** are **Isolated** on their terminals.

3. Each core can now be terminated individually on its own terminal. Care must be taken to ensure that no contact is made between any two cores and/or terminals; and in fully insulated metalclad boxes, special care must be taken to prevent the conductor touching the metal case.

## GUIDANCE NOTE 20

## TERMINATING IN NON-INSULATED METALCLAD BOXES

This Guidance Note supplements the relevant requirements of NSI 5 for the terminating of **LV** cables in non-insulated, metalclad boxes.

1. Prior to commencement of work on the conductors, the core to earth insulation resistance of all cores must be checked (see Guidance Note 23). The insulation resistance per core should be not less than the equivalent of 1 megohm for each 1000 metres. If the insulation resistance per core is less than this value, then;

   1.1 The operation can proceed providing all work is carried out using *Insulated Working.*

   1.2 Alternatively, the fault must be located and repaired prior to continuing the operation.

2. At the remote end of the cable from the point of work, all conductors must be bonded together and insulated from the metallic sheath and from earth using *Insulated Working* and an **Approved** Notice displayed.

3. Using *Insulated Working,* one core must be connected to earth at the point of work.

4. *Insulated Working* may now be dispensed with, providing at all times while work is being carried out at least one core is connected to earth at the point of work.

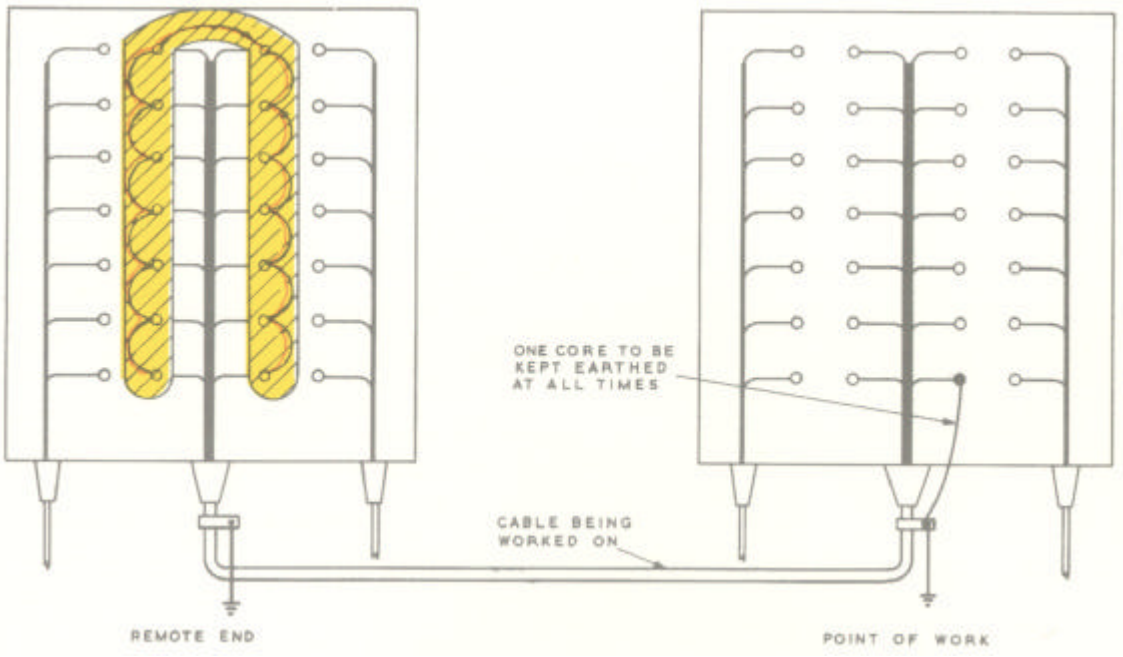



Fig 20.1

5. Using *Insulated Working* the final earth should be removed from the point of work and the connections restored to normal at the remote end.

## GUIDANCE NOTE 21

## GENERAL COMMISSIONING TESTS ON LV CABLES

This Guidance Note supplements the relevant requirements of NSI 5 for general commissioning tests on **LV** cables.

1. *Insulated Working* must be adopted for all general commissioning tests on **LV** cables.

2. Test equipment and instruments, which are to be connected to **LV** cable cores, must be insulated from earth by placing them on an Insulating Platform or Insulating Mat. An isolating transformer must be interposed between the test equipment and any mains or other power supply.

3. **LV** cable cores should not be used for temporary telephones unless special arrangements have been made to provide the necessary insulation level by using isolating transformers.

## GUIDANCE NOTE 22

## OVERSHEATH TESTING ON LV CABLES

This Guidance Note supplements the relevant requirements of NSI 5 for oversheath testing on insulated sheaths of **LV** cables.

1. *Insulated Working* must be used throughout this Guidance Note, except when applying or removing test leads from earthed sheaths.

2. The metallic sheath is to be made discontinuous at each end of the section to be tested and earthed only at the point of test. Adjacent sections must be earthed at the end adjacent to the section under test.

3. The earth at the point of test may be removed for the duration of the test but the sheath must be earthed before applying or removing test leads.

   Note: When testing to identify **LV** cables or to locate faults, *Insulated Working* must be adopted.

## GUIDANCE NOTE 23

## DIELECTRIC TESTS ON LV CABLES

This Guidance Note supplements the relevant requirements of NSI 5 for dielectric tests on **LV** cables.

1. *Insulated Working* must be used throughout this scheme, except when applying or removing test leads from earthed conductors.

2. The metallic sheath of the section under test must be earthed at the terminations at each end of the section under test.

3. The conductors must be isolated from terminal equipment and Earthed at the point of test only. These earth(s) maybe removed for the duration of the test but the conductors must be earthed before applying or removing test leads.

   Note: When testing to identify cores or locate faults *Insulated Working* must be used.

**GUIDANCE NOTE 24**

**WORK ON 420 kV XLPE CABLE SYSTEM WITH UNEARTHED CROSS BONDING CONNECTIONS IN BOTH INSULATED AND EARTHED WORKING CONDITIONS**

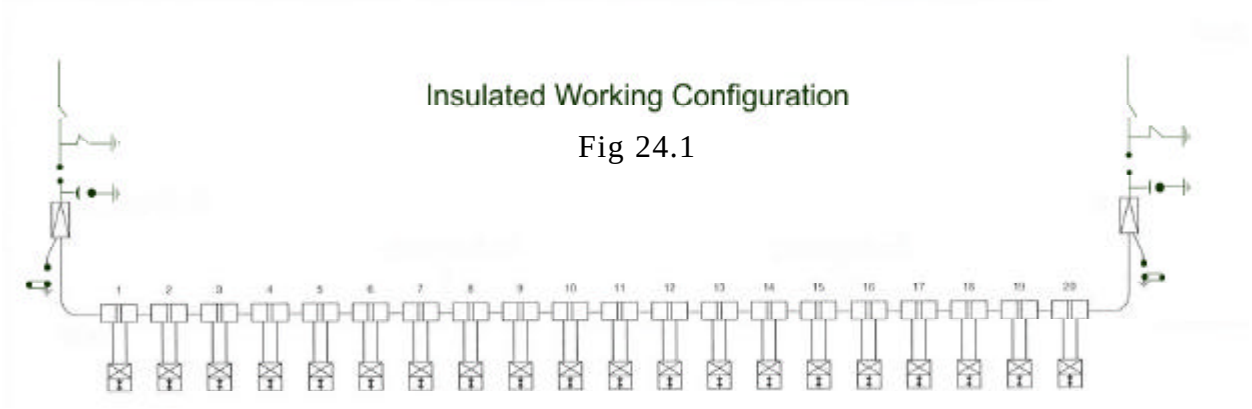



Fig 24.1

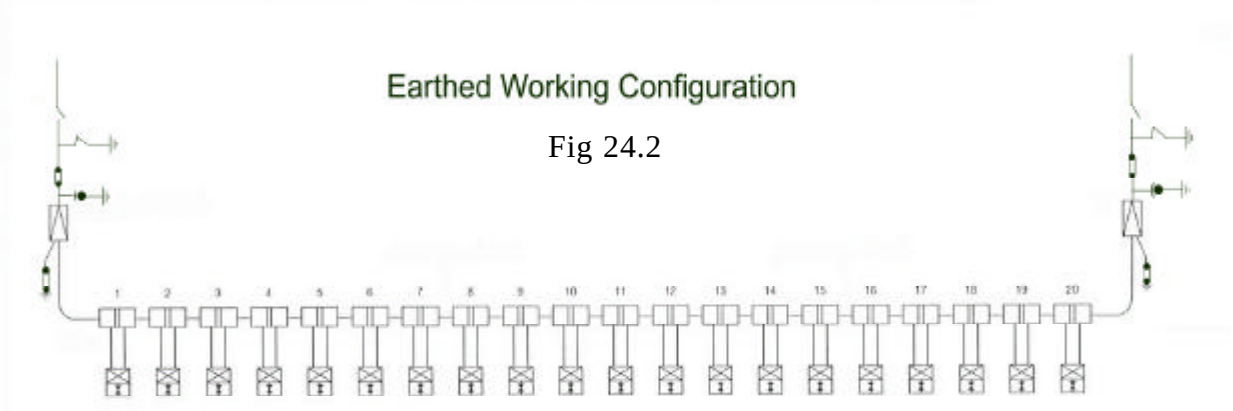
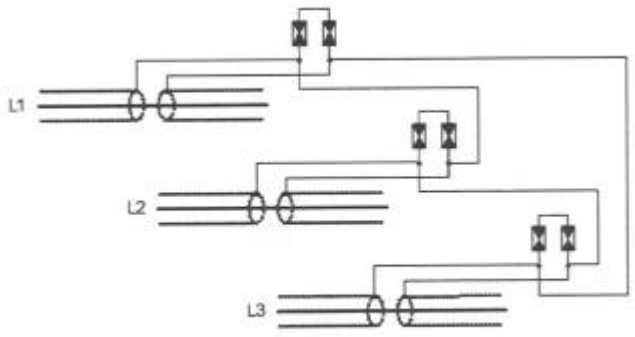



Fig 24.2




Cross Bonding Arrangement Fig 24. 3

**GUIDANCE NOTE 24a**

**MAKING OR BREAKING DOWN STRAIGHT JOINT FOR SINGLE CORE XLPE CABLE WITH JOINT VMEVCB420**

These scheme supplements the relevant requirements of NSI5 for making or breaking down XLPE straight joints type VMEVCB420 utilising *Insulated Working* (see Fig 24.1 above).

1. Prior to commencing jointing operations, it must be ensured that conductor and metallic sheaths are isolated from earth at both circuit ends as shown in fig 24.1. It must be established that the cable is undamaged throughout the route length and no conducting loops have been established in either the conducting sheath or conductor.

2. The immediate area around the joint to be worked on will be screened with **APPROVED** insulating material from other joints and conducting parts.

3. The concentric bonding cable must be disconnected from the SVL's for the joint to be worked on using *Insulated Working* and the inner and outer cores insulated from earth and each other.

4. The joint will be dismantled/re-assembled using *Insulated Working* with temporary insulation fitted to the exposed conducting sheath whilst working on the cable core (see fig 24.4).

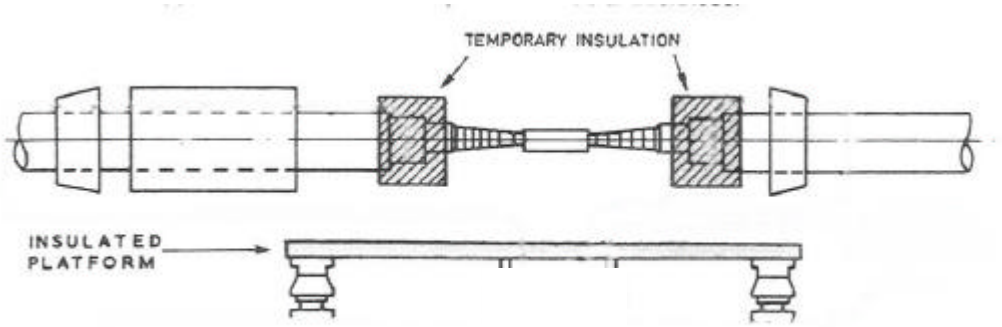



Fig 24.4

5. The joint barrier insulation will be tested prior to attaching the concentric cross bonding cable using *Insulated Working* in the reverse order to 3. above connecting to the SVL's last.

6. Any electrical supplies brought into the work area must comply with 7.4 f.

## GUIDANCE NOTE 24b

## OVERSHEATH REPAIRS TO XLPE CABLE

This scheme supplements the relevant requirements of NSI5 for making repairs to XLPE over-sheath utilising *Earthed Working* (see Fig 24.2 above).

1. Work on the cable over-sheath can be carried out using the earthed working configuration shown in fig 24.2 but if the conducting metallic sheath is to be exposed/touched, this must be done using *Insulated Working* (see fig 24.5). This avoids differences with local earth potentials and that of the remotely earthed sheath under system fault conditions.

2. The immediate area around the cable to be worked on will be screened with **APPROVED** insulating material from other joints and conducting parts.

3. Any electrical supplies brought into the work area must comply with 7.4 f.

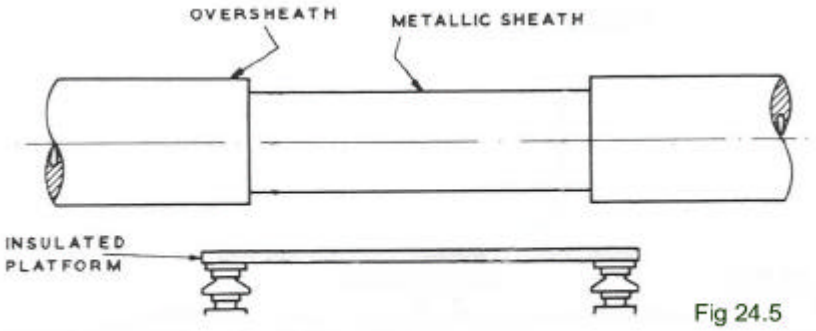



Fig 24.5

## GUIDANCE NOTE 24c

## REPLACEMENT OF SVL's, CONNECTIONS, CROSS BONDING CONCENTRIC CABLE AND SUPPORT INSULATORS

This scheme supplements the relevant requirements of NSI5 for making or breaking down XLPE 420 kV unearthed cross bonding connections and SVL's utilising *Insulated Working* (see Fig 24.1 above).

1. Work on the cable SVL's, support insulators, concentric, single core and bus bar connections must be carried out using *Insulated Working* (see fig 24.6). Any disconnected connection must be fitted with temporary insulation to prevent contact with other conducting metalwork and local earth. This avoids differences with local earth potentials and that of the remotely earthed sheath under system fault conditions.

2. Work is only permitted on one phase SVL assembly at a time with adjacent metallic parts being screened with **APPROVED** insulating material.

3. Testing of SVL's can be carried out using this scheme by disconnecting the single and concentric cables as described in 1 & 2 above. Testing should be carried out on one pair of SVL's at a time with all connections being replaced before others are tested.

4. Any electrical supplies brought into the work area must comply with 7.4 f.

5. The correct position of all connections must be checked before the cable is returned to service.

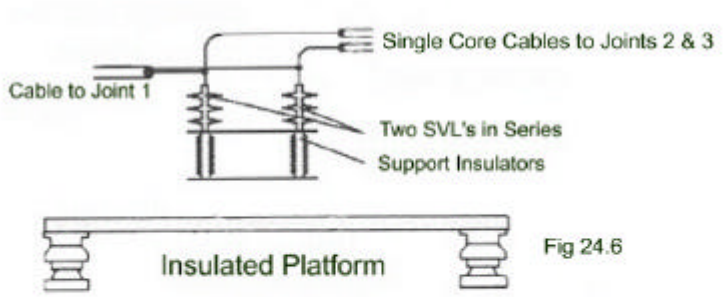



Fig 24.6

**GUIDANCE NOTE 24d**

**DISMANTLING AND RE-ASSEMBLY OF GAS INSULATED HORIZONTAL AND VERTICAL SEALING ENDS**

This scheme supplements the relevant requirements of NSI5 for making or breaking down XLPE Gas Insulated sealing ends type EHSV420 utilising *Earthed Working* (see Fig 24.2 above).

1. Work on both horizontal and vertical cable sealing ends is carried out using earthed working as shown in Earthed Working Configuration Fig 24.2.

2. The processes described in Guidance Note 11 should be followed for all major reworking of a sealing end and conductor.

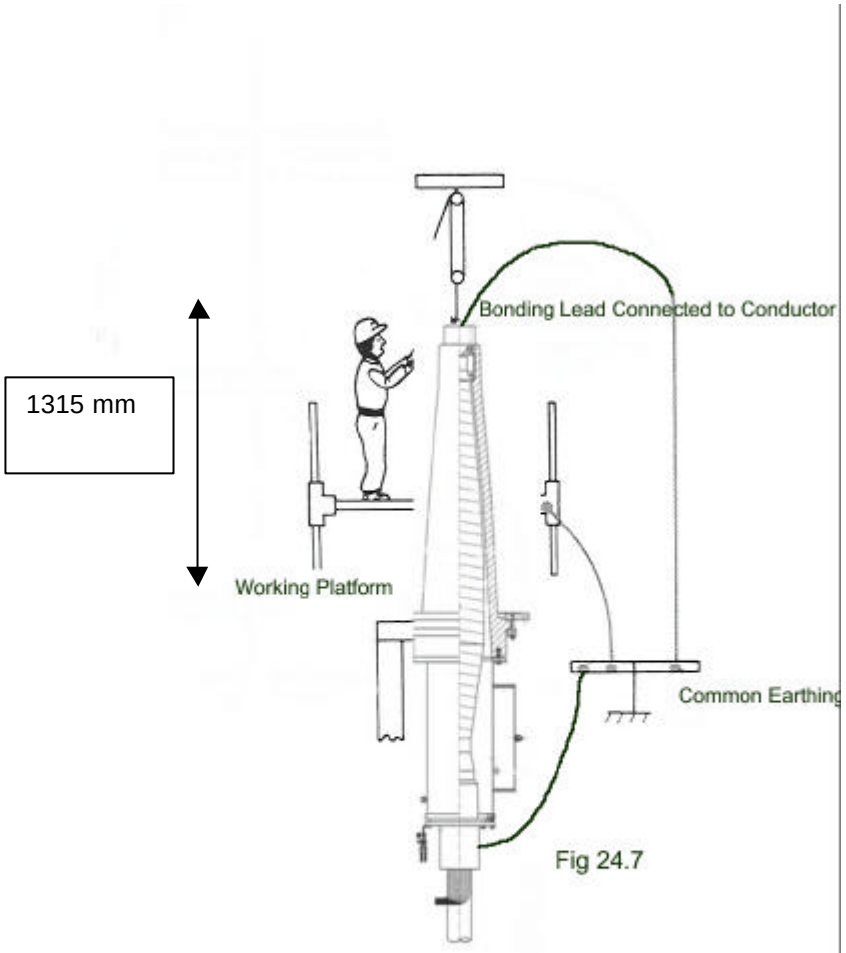



Fig 24.7

## GUIDANCE NOTE 24e

## CUTTING OF CABLE FOR REMOVAL OF DAMAGED SECTION

This scheme supplements the relevant requirements of NSI5 for cutting and removal of XLPE cable from the vicinity of other HV cables in service utilising *Insulated Working* (see Fig 24.1 above).

1. Prior to commencing cutting operations, it must be ensured that conductor and metallic sheaths are isolated from earth at both circuit ends as shown in fig 24.1. It must be established that the cable is undamaged throughout the route length and no conducting loops have been established in either the conducting sheath or conductor. Only one cut can be performed at a time in order to avoid the establishment of conducting loops.

2. The immediate area around the joint to be worked on will be screened with **APPROVED** insulating material from other joints and conducting parts.

3. Work on the cable over-sheath can be carried out using the insulated working configuration shown in fig 24.1 but when the conducting metallic sheath is to be exposed/touched, this must be done using *Insulated Working* (see fig 24.8). This avoids differences with local earth potentials and that of the sheath/conductor.

4. Any electrical supplies brought into the work area must comply with 7.4 f.

5. After the conducting sheath has been removed as shown in fig 24.8 the sheath exposed to touch should be screened with temporary insulation whist the XLPE insulation is removed to expose the conductor. The conductor can then be cut.

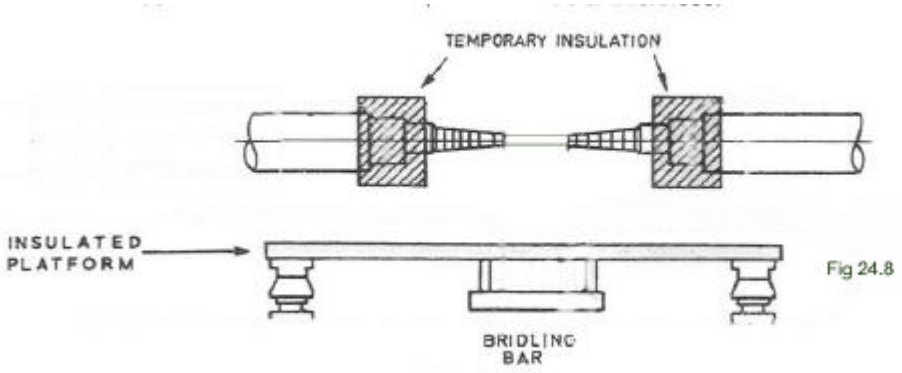



Fig 24.8

6. On the section of cable to be removed an insulated cap must be fitted to the cable end as shown in fig 24.9. This cap must be either of **APPROVED** insulated design of covered with temporary insulation, which remains in situ until the cable to be removed, is clear of other cables connected to the system. This must be in place before a second cut is made in the cable length to be removed; this cap must be repeated at the second cut before the cable is removed. This is to avoid high circulating currents should the cable to be removed have a current loop established, also to avoid contact with induced voltages established in significant lengths of cable being removed.

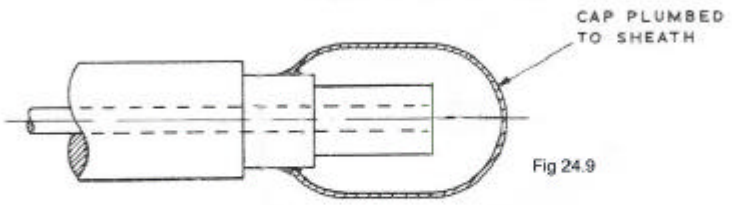



Fig 24.9

## GUIDANCE NOTE 25

## USE OF BRIDLING BAR

This Guidance Note sets down the procedures for using the Bridling Bar for earthing and through-bonding of conductors or cable sheaths. The Bar can be used attached to, or detached from, the Insulated Platform, as required.

### 1. USE OF BRIDLING BAR FOR EARTHING

1.1 When using *Insulated Working,* immediately prior to the application of an earthed *Bonding Connection* there could be Danger from anyone holding the connection in one hand and touching, with another part of the body, a conductor or sheath subject to induction. To avoid this, the Bridling Bar, attached to, but insulated from, the Insulated Platform provides an intermediate bonding point with the local earth system.

1.2 The *Bonding Connection* must be first attached to the conductor or sheath to be earthed. Care must be taken to ensure that no part of the *Bonding Connection* is allowed to come into contact with earth or any other conducting material. The free end of the *Bonding Connection* is then attached to the Bridling Bar using an Operating Pole.

1.3 If at this stage the Bridling Bar is not connected to a common earth bar a connection must be made, the connection first being applied to the common earth bar and then to the Bridling Bar using an Operating Pole.

This operation must NOT be carried out by anyone on the Insulated Platform.

### 2. USE OF BRIDLING BAR FOR 'THROUGH BONDING'

2.1 Using *Insulated Working, Bonding Connections* must first be attached to the conductors or sheaths to be bonded. Care must be taken to ensure that no parts of the *Bonding Connections* are allowed to come into contact with earth or any other conducting material. The free ends of the *Bonding Connections* are then attached to the Bridling Bar using an Operating Pole.

Note: The removal of connections from the Bridling Bar must be barred out in the reverse order to that in which they were applied.

## GUIDANCE NOTE 26

## USE OF ADAPTOR PLATE

The Adaptor Plate is designed to facilitate the earthing of cable sheaths and the testing of cable sheaths and barrier joints at Link Boxes.

All operations involved in the fitting, use and removal of the Adaptor Plate must be carried out under *Insulated Working* conditions using Insulated Tools and Operating Poles, as appropriate.

### 1. USE OF ADAPTOR PLATE FOR EARTHING CABLE SHEATHS

1.1 Before application the Adaptor Plate must be carefully examined to ensure that it is clean and free of moisture, that all slide bars are secured in the 'Sheath to Earth' position and the lifting attachment is securely fitted.

1.2 After attaching one end of a *Bonding Connection* to the Adaptor Plate earthing bar, the free end must be connected to the Link Box earthing system.

1.3 Disconnect the SVLs from the Link Box Pillars.

1.4 Remove all links from the Link Box, place the Adaptor Plate over the Link Box pillars and secure the Plate to the pillar studs.

All cable sheaths connected to the Link Box are now earthed.

### 2. USE OF ADAPTOR PLATE FOR TESTING CABLE SHEATHS AND BARRIER JOINTS

2.1 After completing the above procedure, the slide bar connections on the Adaptor Plate may be adjusted as necessary and test voltages applied to the cable sheaths through the Adaptor Plate test bar.

## GUIDANCE NOTE 27

## DIELECTRIC TESTS ON HV CABLES

This Guidance Note supplement the relevant requirement of UK BP/SE/NSI 5 and all work shall be carried out in accordance with UK BP/SE/NSI 5 Section 7 General Principles for Working on Cables Subject to Impressed Voltages

### High Voltage Pressure Tests

Where conductor dielectric testing is necessary, the joint barriers and any Sheath Voltage Limiters (SVL's) fitted in Link Boxes along the route must be short circuited and connected to earth with Test Connections for the period of the test.

The test voltage connections require to be connected to each phase conductor in turn, the connection and disconnection of these shall be carried out in accordance with UK BP/SE/NSI 5 Section 7.

## APPENDIX A

## IDENTIFYING HV CABLES, OPERATING AT OR ABOVE 33KV, WITHOUT SPIKING

General Requirements

This appendix supplements the requirements of UK BP/SE/NSI 5 Section 5 General Requirements for Work on **High Voltage** Cables. This Appendix outlines the general principles to be adopted to positively identify an **HV** cable where spiking could cause damage and necessitate the installation of cable and repair joints. This technique shall be applied where the work to be carried out requires the metallic sheath to be cut but it is not intended to cut the conductor. If the work to be carried out on the cable require the conductor to be cut the cable shall be spiked.

The identification tests must be carried out by the **Senior Authorised Person** issuing the **Permit for Work** or **Sanction for Work**.

The cable must be positively identified by either:

a Imposing a signal on it from an identified point and verifying positively the presence of the signal at the position where it is proposed to cut the metallic sheath. Care must be taken to ensure that the signal is genuine and not induced.

or

b Utilise the procedures detailed in UK BP/SE/NSI 5 Guidance Note 1 Oversheath and Joint Barrier Tests on **HV** Cables and Guidance Note 2 Oversheath Repairs to Cables And Metallic Cooling Pipes in the following manner.

(i) The integrity of the sheath must be verified by oversheath testing in accordance with UK BP/SE/NSI 5 Guidance Note 1.

(ii) Using *insulated working* a section of the oversheath should be removed at the position where the work requiring the cutting of the metallic sheath is to be carried out.

(iii) A *Bonding Connection* must then be applied to the exposed metallic sheath and connected to the common earth bar via the Bridling Bar.

(iv) Using the procedures detailed in UK BP/SE/NSI 5 Guidance Note 1 carry out an oversheath test on the cable to be worked upon. The objective of the test is to confirm the presence of the *Bonding Connection* at the position where the cutting of the metallic sheath is to be carried out. This will be indicated by the operator of the test set being unable to raise the test voltage and at the same time the milliameter of the set indicating the passage of high current.

(v) Again using the procedures detailed in UK/BP/SE/NSI 5 Guidance Note 1 disconnect the oversheath test equipment.

(vi) At the position where the metallic sheath is to be cut and removed use *Insulated Working* to remove the *Bonding Connection* previously applied as detailed in (iii) above.

(vii) Using the procedures detailed in UK BP/SE/NSI 5 Guidance Note 1 carry out an oversheath test on the cable to be worked upon. The objective of the test is to confirm that the removal of the *Bonding Connection* where the cutting of the metallic sheath is to be carried out enables the operator of the test set to raise the test voltage to the value required by the work specification. The milliameter on the test set should only indicate the passage of a low value of current consistent with the normal oversheath test value. If the operator is not able to raise the voltage and high current still flows through the milliameter then this indicated the presence of an earth path additional to that provided by the previously applied *Bonding Connection*. This may be a genuine oversheath fault or an inadvertent earth elsewhere on the metallic sheath or bonding system on the section under test. In such circumstances the **Senior Authorised Person** shall consider the test results and decide whether the results have unambiguously identified the metallic sheath to be worked on as the correct cable.

## APPENDIX B

## PROCEDURE FOR MAINTAINING ONE MAJOR SECTION ISOLATION BETWEEN WORKING PARTIES DURING CABLE SHEATH TESTING

1. To prevent overlap and maintain continuity of work one **Senior Authorised Person** will be designated the Co-ordinating **Senior Authorised Person** for each cable circuit outage. All **Safety Documents** will be issued with his knowledge and agreement.

2. One isolated Major Section must be maintained between each testing team and any other **Working Party**.

3. Before agreeing to the issue of any **Safety Documents** the co-ordinating **Senior Authorised Person** will remove links and disconnect SVLs from the cross bonding link boxes/pillars within this Major Section. The link boxes/pillars shall be secured with unique locks, the keys being held in the Safe Custody of the Co-ordinating **Senior Authorised Person**.

4. The link boxes/pillars will remain **Locked** until **Safety Documents** on the adjacent sections have been cancelled.