

Company Directive

STANDARD TECHNIQUE: CA2C/9

Relating to General Requirements for 11kV Cable Jointing

Policy Summary

This ST document contains all the General Requirements for 11kV cable jointing. These General Requirements detail the separate techniques, which collectively form a Jointing Procedure.

This ST has not been written as a training document. It is not intended to be exhaustive in content and you must refer to your supervisor if you require training or instruction.

You shall work safely and skilfully, utilising the training/instruction you have already received, relating to the contents of this document and its cross-references.

You must make sure that you understand your job instructions and that you have the necessary tools and equipment for the job.

Author: Richard Summers

Implementation Date: December 2017

Approved by



Policy Manager

Date:

12 December 2017

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IMPLEMENTATION PLAN

Introduction

This ST document contains all the General Requirements for 11kV cable jointing. These General Requirements detail the separate techniques, which collectively form a Jointing Procedure.

Main Changes

Document updated to reflect the implementation of the Lovink M series straight joints during Q2 2018.

Impact of Changes

None at this time – Document issued ahead of change-over to M Series Lovink Joints.

Implementation Actions

These changes will be briefed by our training team who will be visiting all locations Q1 2018

Team Managers to ensure all of their 11kV Jointers attend these sessions

Implementation Timetable

This Standard Technique can be implemented with immediate effect.

Document Revision & Review Table		
Date	Comments	Author
December 2017	GR 3 removal of contradiction with Safety Rules GR 17 Clarifications for abrading sheaths GR 34 Updated to include M series foam rings GR 37 Updated to include M series insulation shrouds GR 39 Updated to include M series inner shells GR 41 Updated to include M series filling instructions GR 44 Updated to include M series copper stocking GR 75 Removed – no longer required	Richard Summers
May 2016	Document has been modified to take into account the WPD losses strategy and the harmonization of the 11kV cables within the company. General requirement 44 modified additional copper stocking added to take into account the extended outer shells. General requirement 45 modified addition of water blocking tape to the end of the MDPE to take into account sheath testing. Minor changes to remove SHOPS and replace with E5.	Peter White
October 2015	General requirement 3 matrix amended to specify the use of additional equipment of dielectric wellington boots when applying equipotential bonds. General Requirement 10 modified to add clarity on the application of equipotential bonds. Removal of typographical errors in General Requirement 8.	Peter White
July 2015	General Requirement 3 amended to specify that Electrical Gloves shall be Class 1 rated.	Peter White
May 2014	Pages 175, 177, 178 and 179 have been modified to reflect the changes that have occurred in ST: OH4H/5 namely the inclusion of the Surge Arrester Adaptor Plate on the outdoor termination.	Peter White
April 2013	The changes that have been made to this document are the inclusion of all the 11kV cables and the associated general requirements which have over the years been used in the Midlands Areas and not used in the South Wales and South Western areas, thus providing a unified common document applicable to the whole company. Only one clearly defined method of removing the easi-strip semi-conducting insulation screens of EPR and XLPE polymeric cables, by using the abra file. Use of aluminium oxide tape to polish the XLPE insulation after using the fully bonded screen removal tool. Inclusion of flame abrading of MDPE Oversheaths. Stress control of screened 3 core paper cables. Inclusion of the Rothenberger Nr.I tool for removing PICAS metallic sheath ONLY. Mechanical connectors butting up to the phase insulation. Earth tails removed from all 11kV joints. Inclusion of outer cone separable connectors and separable connector surge diverters. Inclusion of generic torque settings of various nuts and bolts. Izumi shearbolt tool only approved tool to be used for all shearbolts. Rectification of known typographic errors.	Peter White

ST: CA2C/9 GENERAL REQUIREMENTS FOR 11kV CABLE JOINTING.

INTRODUCTION

This ST document contains all the General Requirements for 11kV jointing. These General Requirements detail the separate techniques, which collectively form a Jointing Procedure.

The PPE matrix in GR3 has been updated to specify that the electrical gloves used shall be Class 1 gloves.

As from 1st March 2015 WPD have changed the specification of Approved cable sizes. These changes will affect all new installations and are aimed at reducing cable losses in accordance with the WPD Losses Strategy. This means that the 95mm² triplex and single core cables are now removed from general use, they can only be used for padmounts and the repair of faults in existing 95mm² circuits.

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GENERAL REQUIREMENT 1

GENERAL CLEANLINESS AND ACCIDENT PREVENTION

1.1 SITE SAFETY

The majority of accidents can be avoided by taking reasonable care and precautions when performing normal duties associated with any work. Fortunately most of these accidents which do occur are of a minor nature, but there is always the risk of them developing into something more serious, with a consequent increase in the pain and suffering of the victim. Any accidents that do occur must be reported as soon as possible after the event.

Western Power Distribution spends many thousands of pounds each year to create the safest possible working conditions for its employees and take particular care in the selection and provision of tools and equipment which will improve safety in the working environment. Strict safety rules and procedures have been laid down with the sole purpose of safeguarding all who work on the distribution system and these must be observed at all times.

Despite all the efforts that have been made to provide safe appliances such as safety stands for gas torches, compound gloves, etc., accidents still occur. Most of these could be avoided if a little more care and forethought were to be exercised, e.g. gas furnaces should be sited conveniently near to the job but in such a position that they cannot be overturned, and also where they will not cause damage. Items of kit should not be left where they could be tripped over either by persons engaged on jointing work or by the general public. Gloves of the approved type should always be worn when handling hot or cold pour compound or when cutting or handling armour and cleaning cables.

Care should be taken to remove all oversheaths, scrap paper and hessian etc., resulting from cable stripping operations from joint pits as it occurs, to prevent the accumulation of inflammable material and reduce the fire risk in confined places.

When working on the highway appropriate warning notices must be displayed. These warning notices, barriers etc. shall comply with ST: HS14D. All barriers shall be erected and traffic cones positioned before commencement of work. By night obstructions and excavations must be marked by continuously lit yellow danger lamps.

Joint holes must be adequately fenced at all times and the fences must be substantial – not just token fences.

- Note:** -(a) A pile of earth is not a suitable barrier.
- (b) The Company's obligation to safeguard members of the public extends to all users including blind and infirm persons. To discharge this obligation the fencing must be such that it readily detectable by such persons. Approved barriers should therefore be erected around all excavations.

- (c) Where a footpath is substantially obstructed, then fencing must provide a passageway on the carriageway for pedestrians, protecting them from moving vehicles.
- (d) Where positive traffic control is necessary at small obstructions of short duration it must be by means of a manually operated stop and go boards. Flags must not be used for traffic control.

Paving stones must be removed and replaced with great care to avoid breakage. When re-laying paving stones it is essential that they should lie on an even bed, to prevent any rocking, and should be level with the surrounding stones.

When working on private premises care must be exercised to avoid accidental damage to consumers' property or internal decorations. Damage of this nature can often be avoided with a little forethought and particular attention should be paid to the removal of potential fire risks before a blow torch is used.

1.2 RISK ASSESSMENT

The risks when conducting the jointing of cables are principally those of electric shock and burns. Jointing of cables can be achieved without exposure to significant risk but only following appropriate control measures identified in various risk assessments.

A checklist and an on-site risk assessment pad have been produced to assist the process of on-site risk assessment.

1.3 IDENTIFICATION OF LV CABLES

When excavating around cables in the ground all cables must be assumed to be alive. In normal circumstances Jointers will be provided with service forms showing details of both the cable to be worked on and information concerning the position of other HV and LV cables in proximity to the working area, based on drawing office records. See Policy document POL: OS 4A, Location, Identification and Proving Dead of Underground Cables and Standard Technique ST: OS 4A, Location, Identification and Proving Dead of Underground Cables.

Where service forms are not issued a drawing giving similar information should be provided showing clearly what action is required. In cases of emergency or when it is expeditious the Jointers should alternatively be immediately supervised.

It is essential that strict compliance with the Company's Safety Rules, Policy Documents and Standard Techniques are maintained at all times and if any time doubt arises in the Jointer's mind he should cease work immediately and contact the Supervisor who will take appropriate action to positively identify the cable.

1.4 HYGIENE

General

During any tinning or sweating operation involving resins or fluxes, fumes are given off. To certain people these fumes are obnoxious and can cause respiratory irritation. In other people, skin irritation and rash can occur, but this is equally possible with people handling De-Solvit, oil, and other similar substances.

Where the majority of people are concerned these effects can be completely eliminated by taking a few simple precautions.

Avoidance of Fumes

Care must be taken not to char or burn any PVC material as this will cause toxic gases to be given off and tent flaps should be raised to permit the flow of clean air through the tent. At the same time the Jointer should position himself in such a way that the clean air flow carries any possible fumes away from his face.

Care of the Skin

Before commencing work, hands and forearms should be thoroughly washed in cold water, using soap or a skin cleanser and then well dried.

A barrier cream should be applied to the hands taking particular care to rub sufficient in between the fingers and round the nails. Although approved gloves shall be worn while degreasing a cable, if inadvertent contact is made with the hands and the approved degreasing material then the hands must be washed and dried using the routine described above and a further application of barrier cream made.

As an additional precaution approved plastic coated gloves of a distinctive colour are available to Jointers for use during the removal of bitumen and cleaning of cable operations. Jointers are encouraged to use these gloves despite the slight restriction in movement that may be experienced as this can be overcome with practice.

Note: - These gloves are not electrically tested and are not safe for live working.

Work is to be carried out to connect the earth continuity bond on 11kV circuits / cables the normal approved Safety Rubber Gloves shall be worn where necessary, care being taken to keep the gloves clean and after use and to completely dry them using French Chalk.

1.5 FIRST AID

All Jointers should be in possession of a small first-aid kit and items used should be replaced as soon as possible.

Details of the approved methods of artificial respiration are given in the Company's Safety Rules and every employee should familiarise himself with the procedures to be adopted. A knowledge of these methods could be of inestimable value at any time and may assist in saving life. Remember it could be YOURS.

1.6 USE OF PROPANE GAS

General

Gas containers should be stored at a temperature with the range of 13°C (55°F), to 30°C (85°F), and should never be exposed to a temperature higher than 43°C (110°F). Always keep the gas valve on the container turned off except when the gas is being used.

It is possible when turning on the gas to turn the handle several revolutions, this is unnecessary, one revolution being ample. This has the advantage that shutting the valve can be done quickly in an emergency.

The transport of propane gas regulations state that the gas container shall be stored in the upright position and fastened securely in its carrying rack or gas cupboard during transit. The regulations also state that no pipes, gas torches or any other attachment shall be connected to the propane bottle during transit.

Containers, whilst in use, should be placed in position where there is good ventilation and never in a confined and unventilated place or joint pit. If the appliance will not reach the job when the container is in safe position, a longer flexible hose should be used.

For normal jointing work a length of 4m (3 metres minimum) of hose should cover the majority of circumstances without creating hazards of escaping gas or tipped appliance that might result from persons tripping over surplus hose.

Remember that the gas used is heavier than air and will therefore accumulate in pits and trenches in which it may travel along some distance from the point of release.

When the gas is no longer required for use it should be turned off at the valve on the container first, the gas allowed to burn itself out and the burner taps turned off last.

If the flame is accidentally extinguished do not attempt to relight the gas and do not allow any naked flame near, until the accumulated gas has been dispersed by opening ventilators, tent flaps or doors.

Do not meddle with any part of the gas apparatus.

A very small amount of gas can create an explosive mixture with air and small leakages of gas, therefore, are dangerous unless proper precautions are taken.

In Case of Fire

If it is safe to approach the gas cylinder, turn off the main valve and remove the cylinder to a place of safety. If this cannot be done, call the Fire Brigade. In the meantime keep the cylinder as cool as possible by hosing it down from behind cover and keep the public well away.

1.7 USE OF HOT METALS

Hot metals are no longer used in WPD, other than lifting the aluminium sheath on a Consac cable or “burning out” compound cable boxes.

The use of gloves and a face visor is important when handling hot metals or compounds.

1.8 USE OF CLEANING/DEGREASING SOLVENTS

The use of solvents for both cleaning bitumised coated cable sheaths and the removal of grease etc. to provide a good bond and seal for resin encapsulated joints is common to most jointing procedures and practices. It is therefore in the interests of health and safety that adequate precautions are taken when undertaking these processes which are common to both.

Your attention is drawn to the level of PPE required as the matrix given in General Requirement 3 whilst undertaking this operation.

Handling/Storage

Solvents should only be dispensed from small containers; lids are to be tightly sealed whilst not in use and containers are stored secure in the upright position and away from sources of ignition.

Dispense only sufficient solvent onto the dry wipe, it is unnecessary, wasteful and potentially harmful to pour out large quantities which merely splash onto the ground.

Do not smoke whilst using solvents.

Contact of solvents with naked flames and red hot surfaces should be avoided.

Skin Contact

Skin sensitisation or irritation is very infrequent, should contact occur with the degreaser, then immediately wash the area with soap and water. Unless the area to be washed is the hands, **PVC gloves shall be worn** when carrying out this operation.

Remove any contaminated clothing and shoes; do not allow saturated clothing to remain in contact with skin for prolonged periods.

Splashes in the Eye

Flush with water as needed, the use of eye protection may be worn.

Breathing of Vapour

Ensure good ventilation particularly if working in confined areas.

Fire Hazard

Solvents are flammable and should a fire occur then the use of water fog, CO₂, dry chemicals or foam are to be used to extinguish the flames.

Avoid breathing the smoke in and when in confined areas suitable respiratory equipment is to be used.

Spillage

Absorb small spills with dry sand or oil absorbent dispose as dry oil absorbent.

Disposal of empty containers

Before disposal of the container the Jointer shall apply the Waste Disposal Label, available via the WPD corporate print contact using Product code WPD/W400121.

These labels **shall** be used cover ALL the orange and black hazardous Dangerous Substances Directive (DSD) or the new red diamond of the Classification, Labelling and Packaging Regulations (CLP) labels, once the product in the respective container has been used or neutralised, thus allowing the re-labelled empty container to be placed in the normal waste bin.

1.9 GENERAL SAFETY PRECAUTIONS

Attention is drawn to the other General Requirements in this Section which all have safety implications, but in particular to: -

- 8. Moisture Testing of Paper Insulated Cable.
- 38 Degreasing Operation.
- 35 Mixing and Pouring 2 Part Glue (Lovifit).
- 36 Silicon Oil (Lovisil)
- 42 Mixing and Pouring 2 Part Resin (LoviClick).

1.10 COMPETENCE AND ACCOMPANIMENT

Work on live underground cables shall only be conducted by Authorised Persons who hold a current WPD authorisation of LVUG, or by a person who holds LVUG UPS while under the Personal Supervision of an Authorised Person or Senior Authorised Person who holds a current WPD authorisation of LVUG.

Work on the structure and/or incoming cable conductors/connections of live cutouts shall only be conducted by Authorised Persons who hold a current WPD authorisation of COPLA when working on plastic insulated cutouts or COMET when working on metal clad cutouts, or by a person who holds COPLA UPS or COMET UPS while under the Personal Supervision of an Authorised Person or Senior Authorised Person who holds a current WPD authorisation of COPLA or COMET as appropriate.

Any person working on live underground cables and/or cutouts shall be accompanied by a Competent Person holding, as a minimum, a current WPD authorisation of SMLV (a) or SMLV(c) or by a second Authorised Person holding LVUG, or a Senior Authorised Person.

GENERAL REQUIREMENT 2

JOINT BAY PREPARATION

General

It is the responsibility of the jointer to ensure that the execution of his work does not endanger the public in any way. The joint bay must be properly fenced and if it obstructs the pavement, an alternative walkway must be provided. All signing and guarding shall be in strict accordance with ST: HS14D.

The jointer must also ensure that there is a safe ingress and egress to the joint bay for person's and materials. He must ensure that adequate provision is made against adverse weather conditions including, if necessary, providing drainage for storm water and the provision of water pumps.

The jointer must also ensure that the joint bay is large enough for him to complete his work safely and satisfactorily. Ensure that there is no danger of subsidence due to looseness of soil or the movement of traffic adjacent to the joint bay. There should be at least 300mm below the cable to enable jointing work to be completed.

Note: - The Construction (Health, Safety and Welfare) Regulations 1996.

Clause 12(1) states "All practical steps shall be taken, where necessary to prevent danger to any person, to ensure that any new or existing excavation or any part of such excavation which may be in a temporary state of weakness or instability due to the carrying out of construction work (including other excavation work) does not collapse accidentally".

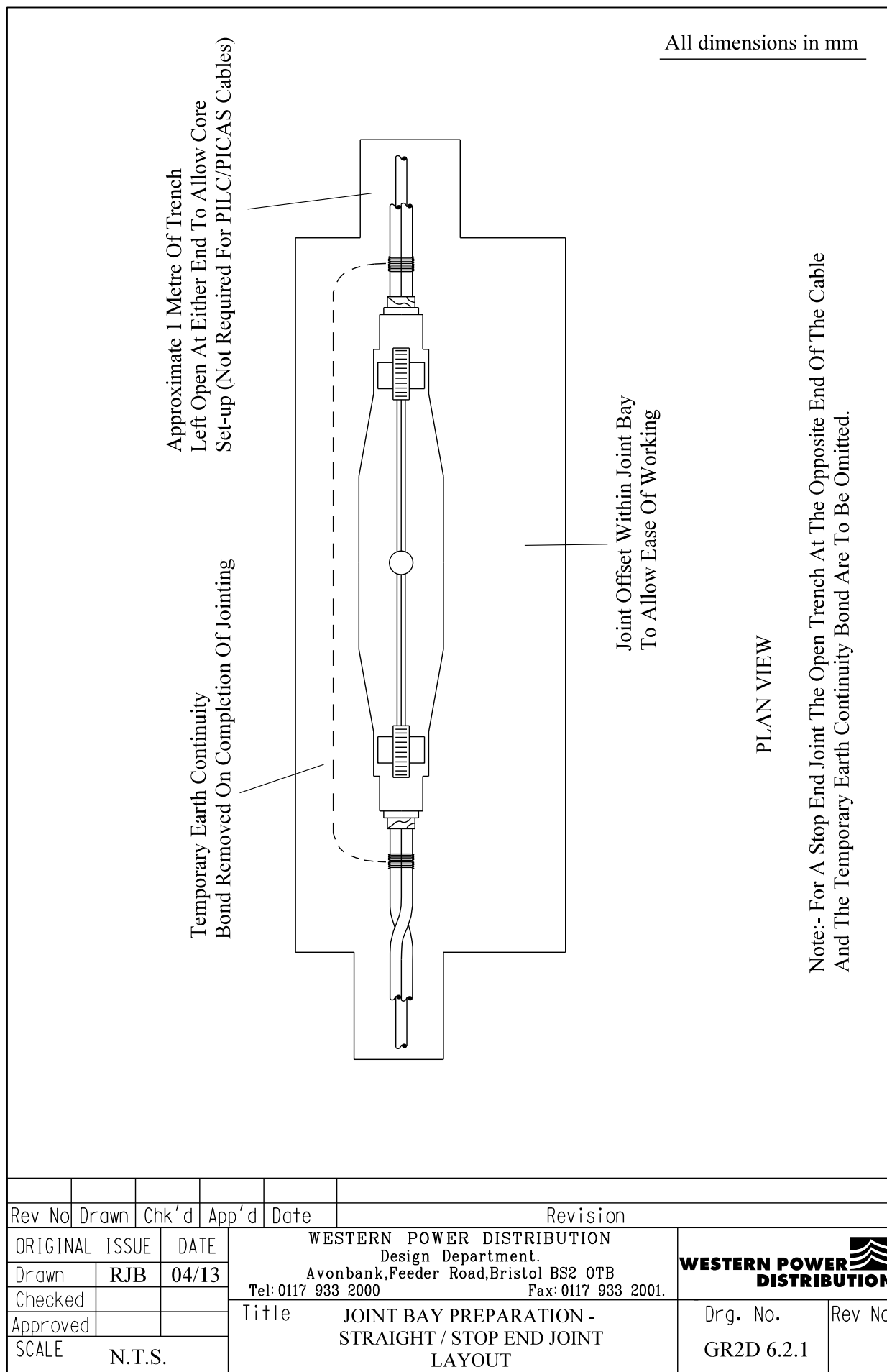
- (2) Suitable and sufficient steps shall be taken to prevent, so far as is reasonably practicable, any person from being buried or trapped by a fall or dislodgement of any material.
- (3) Without prejudice to the generality of paragraph (2), where it is necessary for the purpose of preventing any danger to any person from a fall or dislodgement of any material from a side or the roof of or adjacent to any excavation, that excavation shall as early as practicable in the course of the work be sufficiently supported so as to prevent, so far as is reasonably practicable, the fall or dislodgement of such material.
- (4) Suitable and sufficient equipment for supporting an excavation shall be provided to ensure that the requirements of paragraphs (1) to (3) may be complied with.
- (5) The installation, alteration or dismantling of any support for an excavation pursuant to paragraphs (1), (2) or (3) shall be carried out only under the supervision of a competent person.

- (6) Where necessary to prevent danger to any person, suitable and sufficient steps shall be taken to prevent any person, vehicle or plant and equipment, or any accumulation of earth or other material, from falling into any excavation.
- (7) Where a collapse of an excavation would endanger any person, no material, vehicle or plant and equipment shall be placed or moved near any excavation where it is likely to cause such collapse.
- (8) No excavation work shall be carried out unless suitable and sufficient steps have been taken to identify and, so far as is reasonably practicable, prevent any risk of injury arising from any underground cable or other underground service.

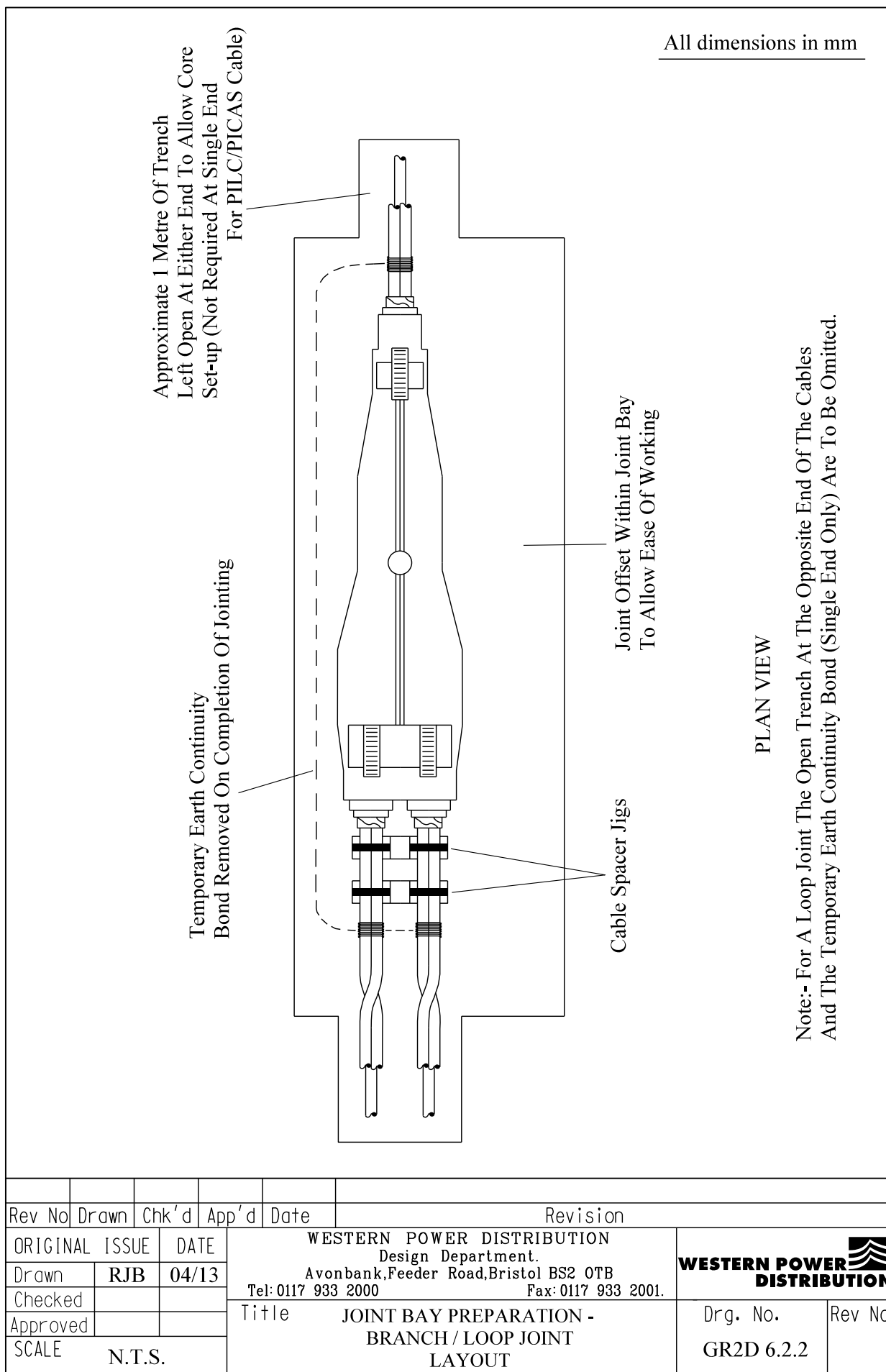
Joint Bay Layout


Drawings GR2D 6.2.1 and GR2D 6.2.2 show a typical joint bay layout (straight/branch) to allow the work to be completed safely and to a satisfactory standard.

Drawing GR2D 6.2.3 gives the minimum joint bay sizes required by the “dig and lay” contract, these are minimum sizes and further enlargement may be required depending on circumstances.

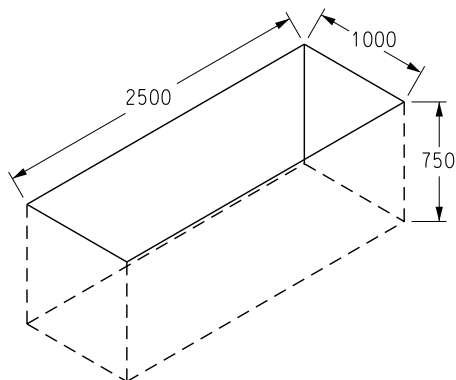


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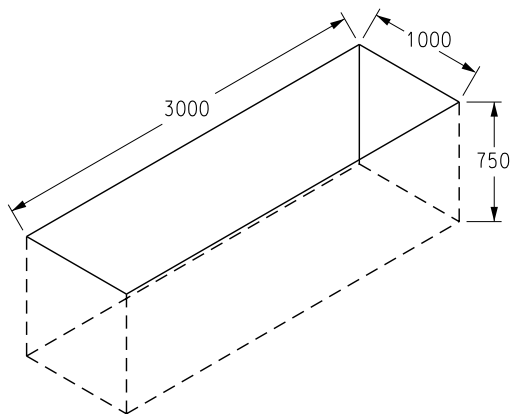


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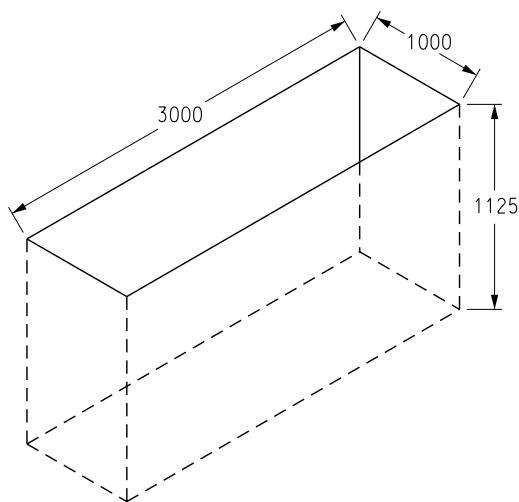
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11kV Straight / Stop End Joint Bay
(JT3)



11kV Branch / Loop Joint Bay
(JT3A)



11kV Joint Bay In Arable Land
(JT4)

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GENERAL REQUIREMENT 3

GENERAL JOINTING PROCEDURE – DEAD CABLES

The provisions detailed in General Requirement 1 are to be applied when jointing 11kV cables.

The following points shall be observed for electrical safety: -

1. When working on 11kV cables all criteria of the Distribution Safety Rules shall be adhered to.
2. Any person receiving instructions to work on 11kV cables shall be certain that he clearly understands the instructions and shall report any objections he may have regarding carrying out such instructions to the person issuing them. This person shall then have the matter investigated and if necessary refer it to the Line Manager.
3. The required level of personal protective equipment and additional safety equipment whilst jointing on 11kV cables is shown in Matrix 1 overleaf.
4. Jointers shall comply with ST: HS8H, if using flame retardant longs and shirt then the shirt shall be tucked into the long trousers and the sleeves shall be down to the level of the wrists. If coveralls are being used then only flame retardant coveralls (one piece boiler suit) E 5 No 41865 with sleeves down to the level of the wrists shall be worn when working on live low voltage cables. Reflective jackets shall be worn as required by the New Roads and Street Works Act.
5. The work and work area shall be kept dry as far as is practicable.
6. Only approved tools and methods of working shall be used when jointing.
7. Tools used whilst jointing shall be kept clean and dry. On PILC or aluminium sheathed cables the metallic sheath shall be bonded across the joint using a temporary earth continuity bond before removal of the metallic sheath and this connection shall be maintained until the permanent continuity bond of the metallic sheath is completed. This shall be done in accordance with General Requirement 10.
8. The jointer must ensure that there is full and safe access and egress to the work site and there is a minimum of inconvenience and no danger to the general public. The Jointer must also ensure, where necessary, that full protection is given against adverse weather conditions.

Single core EPR/XLPE, triplex EPR/XLPE, 3 Core XLPE, PICAS, PISAS and PILC cables should be examined for signs of damage. If damage is limited to the MDPE/PVC oversheath in the single core EPR/XLPE, triplex EPR/XLPE, 3 Core XLPE, PICAS or PISAS, repairs should be carried out in accordance with Jointing Procedures. Any cases of doubt should be referred to the relevant Supervisor.

Cables shall be examined for visible signs of damage. With paper cables where damage is noted and moisture ingress suspected, samples of the filler and the papers from the screen or belt and the outer and inner layers of each core should be tested as specified in General Requirement 8. If moisture is found to be present and it is possible to cut a short length from the end of the cable, this should be done and a further test carried out to determine if moisture has penetrated beyond the surplus length. When a satisfactory result cannot be obtained the matter should be reported to the Supervisor in charge before commencing the joint. The cables should be tested with a 1000V Megger applied between cores and sheath, see General Requirement 7.

Before commencing work, it is incumbent on the Jointer should satisfy himself that all jointing materials supplied are suitable for the work to be carried out, and that they are in a sound condition.

Matrix 1 Minimum PPE Required when carrying out 11kV Jointing Work

Task	Comply with ST: HS8H.	Totectors	Gloves (GP)	Gloves (Kevlar)	Gloves (PVC)	Gloves Electrical Class 1	Gloves (Disp.)	Gloves (Comp)	Visor	Goggles	Ear Defenders	Approved dielectric footwear
Jointing in General (All)	X	X										
Handling cables moving/lifting objects etc.	X	X	X									
Cutting a length of EPR/XLPE of the cable drum	X	X	X									
Removing PVC or MDPE oversheaths on polymeric cables	X				X							X
Removing servings, armour & PVC oversheath on PILC cables	X	X			X				Visor or Eye Prot.			
Temporary Equipotential Bonding whilst Jointing	X					X			X			X
Using Solvents/degreasers	X	X			X				Visor or Eye Prot.			
Removal of Lead Sheaths	X								X			X
Removal of Aluminium Sheaths	X		X						X			X
Handling Individual Copper Screen Wires	X									X		X
Removing insulation on or near Conductors	X			X								X
Application of silicon grease	X						X					X
Dead Conductors – System Fully Isolated	X											X
Setting/Forming of screen wires	X								X			X
Mixing/Pouring Cold Pour Polyurethane Resin	X	X					X		Visor or Eye Prot.			
Mixing/Pouring Cold Pour LoviFit Resin	X	X					X		Visor or Eye Prot.			
Pouring Cold Pour Lovisil Resin	X	X					X		Visor or Eye Prot.			
Handling/Pouring Hot Bituminous or Resin Oil Comp	X	X						X	Visor or Eye Prot.			
Handling Paraffin Wax / Damp Testing Papers	X	X						X	Visor or Eye Prot.			
Installing mechanical earth bonds / roll springs.	X	X		X								
Operation of the “Izumi” Shear Bolt Tool	X	X									X	
Spiking Gun Application	X		X						X			X
Spiking Gun Use	X		X						X		X	X
Spiking Gun Removal	X					X			X			X
Spiking Gun Maintenance	X	X					X			X		

The Matrix details the minimum use of PPE for General Jointing Applications. Where site conditions dictate the use of additional PPE will be required e.g. safety helmet, high-visibility jackets etc.

GENERAL REQUIREMENT 4

EPR/XLPE CABLE INSTALLATION DATA

General

As from 1st March 2015 WPD have changed the specification of Approved cable sizes. These changes will affect all new installations and are aimed at reducing cable losses in accordance with the WPD Losses Strategy. This means that the 95mm² triplex and single core cables are now removed from general use, they can only be used for padmounts and the repair of faults in existing 95mm² circuits.

With the exception of 630mm² EPR/XLPE cable the standard sizes are purchased in a triplex configuration, the reasons are twofold one to ensure the cable is laid in trefoil configuration i.e. electrical reasons and secondly to ensure that where there is more than one circuit/feeder that each has a core of each phase.

Where the cable is laid singly (630mm² EPR/XLPE) it is to be placed into a touching trefoil L1, L2 and L3 formation and two complete turns of Gorilla gaffer tape applied at intervals of not more than 1.5 metres (1 metre on bends), for cables laid to single phase Padmounts (95mm² EPR/XLPE) the cable is to be laid touching trefoil and Gorilla gaffer taped as previously stated.

All cable circuits/feeders must be kept within its designed configuration i.e. triplex/trefoil throughout its complete length and as close to joints/terminations as possible so as not to infringe the 12% rule.

The 12% rule being applied from a point to which the cable is removed from its triplex/trefoil configuration into flat spacing. The distance of flat spacing, within a triplex/trefoil route must not be more than 12% of its total route length.

e.g. Total route length = 250 metres minus 12% (30 metres) = 220 metres. Therefore 220 metres must remain in trefoil/triplex to prevent affecting the electrical characteristics of the circuit /feeder.

Should the 12% rule be broken contact the Company Cable Engineer, Avonbank or the Policy Manager at Avonbank urgently for special procedures.

Method of Installation

The table overleaf gives all the installation data required for all the standard sizes of single and triplex core EPR / XLPE cable used within WPD.

The pulling of the cable shall be undertaken using a triplex pulling device and swivel, the device having a separate entry for each individual core of the triplex cable, this ensures the pulling forces are equally distributed over the three cores. If stockings are to be used then each core shall have a separate stocking.

Single core or triplex EPR / XLPE cable should not be laid if the cable temperature is -5°C or below, otherwise damage will occur.

Capping shall be undertaken to General Requirement 69, the use of PVC tape **does not** constitute capping the cable.

Cable: - Al., EPR/XLPE, Cu-w, MDPE, 11kV.	Std. Length	Drum Size	Weight (kg)		Max Pulling Tension	Minimum Bending Radius (mm)	
	Metres	Metres	Cable	Drum	Kg	Normal	Terminations
# 95mm ² SAC	1000	1.7 x 1.02	1050	385	285	600	540
# Triplex 95mm ² SAC	250	2.0 x 1.02	790	470	855	1190	
185mm ² SAC	1000	2.0 x 1.02	1415	470	555	650	630
Triplex 185mm ² SAC	250	2.2 x 1.02	1065	550	1665	1410	
300mm ² SAC	1000	2.2 x 1.02	1860	550	900	750	720
Triplex 300mm ² SAC	250	2.4 x 1.38	1400	930	2000	1620	
300mm ² Cu.	1000	2.2 x 1.02	3715	550	1500	800	750
Triplex 300mm ² Cu.	250	2.2 x 1.02	2781	550	1500	1620	
400mm ² Cu.	1000	2.8 x 1.48	4450	1240	2000	1000	810
Triplex 400mm ² Cu.	250	2.4 x 1.31	3430	802	2000	1000	
630mm ² Cu.	1000	2.8 x 1.48	7145	1240	2000	1000	970

Note: - 70mm² will be treated as 95mm² EPR/XLPE and 240mm² EPR/XLPE will be treated as 300mm² for the purposes of laying i.e. pulling tension and bending.

- As from 1st March 2015 WPD have changed the specification of Approved cable sizes. These changes will affect all new installations and are aimed at reducing cable losses in accordance with the WPD Losses Strategy. This means that the 95mm² triplex and single core cables are now removed from general use, they can only be used for padmounts and the repair of faults in existing 95mm² circuits.

GENERAL REQUIREMENT 5

CUTTING 11kV EPR/XLPE TRIPLEX AND SINGLE CORE CABLES

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

In order to overcome the nuisance value of receiving a slight electric shock similar to that received when getting out of a car, those persons who cut 11kV EPR / XLPE triplex or single core cable shall adopt the procedures set out in this General Requirement.

The person shall wear the PPE as shown in matrix 3

Using the Company Approved insulated hacksaw the cable shall be cut at the relevant position, once the cable has been cut the person shall then cap both ends of the recently cut cable using the relevant cold/heat shrink caps provided.

The cable end, which is left on the drum, should then be firmly attached to the drum to prevent damage to the cable, at some future date.

GENERAL REQUIREMENT 6

SETTING UP AND MARKING CABLES

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

Joints: – before commencement of jointing sufficient room all around the cable (minimum of 300mm) including the underside of the intended joint position must be available to carry out jointing operations safely and effectively. This requirement is particularly important due to the need to provide clearance for specialised tooling and prevent the ingress of detritus into the various joints.

Terminations: – before commencement of a pole termination the craftsman will require the line phasing and the height to which the termination is to be erected, the reference point, which the height dimensions are given and taken from, will be the pole bolt fixing hole on the crucifix.

Line phasing is important as once the cores have been terminated to the surge diverters no alteration shall be made to the connections, otherwise undue stress will be placed upon the termination conductor and its components.

Prior to commencement of a joint or termination the phasing is to be identified and should any crossing or rolling of the cores be required, then this shall only be undertaken on the triplex or single core EPR / XLPE side of the accessory and clear of the joint outer sleeve or below the cable cleat / gland of a termination.

6.1 All Joints

- 1.1 Check phasing, any crossing or rolling of cores is to be undertaken clear of the joints outer sleeve.
- 1.2 Set cables into position straight and level correctly aligned without undue stress.
- 1.3 Mark the centre / reference line on both cables, allowing a 150mm minimum beyond, cut the cables at this position.
- 1.4 Proceed with the appropriate Jointing Procedure.

6.2 Branch / Loop Joints

Refer to Drawing GR2D 6.6.1 and 6.6.2 whilst undertaking this General Requirement.

- 2.1 Position a cable spacer jig 100mm from the PVC / MDPE oversheath or armour termination point, secure into position with heavy-duty cable ties – Fig 1.

- 2.2 Position a second cable spacer jig at a distance of 100mm from the first and secure into position with heavy-duty cable ties – Fig 1.
- 2.3 The cables must be level through their centres in the horizontal plane; this is achieved by placing a wedge under the smaller cable side, which will allow the jig to rotate until both cables are level through their centres – Fig 2 and 3.
- 2.4 To ensure correct set up for the inner sleeve, the cable at the single end of the joint must be positioned so that it lines up directly to the centre between the cables at the double end.
- 2.5 Secure the cables at this position and ensure the position is maintained throughout the jointing operation.
- 2.6 Proceed with the appropriate Jointing Procedure.

6.3 Pole Termination

Refer to Drawing GR2D 6.6.3, 6.6.4 and 6.6.5 whilst undertaking this General Requirement.

- 3.1 Construct the crucifix as General Requirement 60 and strap to the pole.
- 3.2 Ensure the cable is positioned correctly at the pole base directly under its final erection position.
- 3.3 Using a linen tape fix to the cable at the pole base where the cable leaves the ground, follow along its length until the given height is reached.
At this point place a white PVC tape marker around the cable, at a further 400mm beyond place a second marker and cut the cable at this point.
- 3.4 Ensuring a loop is kept in the cables (do not infringe the bending radius) turn up onto the crucifix.
Check phasing any crossing or rolling of cores is to be undertaken below the cable cleat.
- 3.5 Position with the first applied white PVC tape marker in line with the pole bolt-fixing hole, clamp the cable into the cleat.
- 3.6 Straighten and position each core to its correct connection point.
- 3.7 Proceed with the appropriate Jointing Procedure.

6.4 Cable Box Terminations

- 4.1 Prepare the cable box as General Requirement 50.
- 4.2 Ensure the cable is straight and positioned in line with the centre connection point.

- 4.3 Check phasing, any crossing or rolling of cores is to be undertaken below the cable gland.
- 4.4 At the centre phase connection point place a white PVC tape marker around the cable, at a further 300mm beyond place a second marker and cut the cable at this point.
- 4.5 Straighten and position each core to its correct connection point.
- 4.6 Proceed with the appropriate Jointing Procedure.

6.5 “Live break” Elbow/Dis-connectable Terminations

- 5.1 Prepare the bushing well inserts as General Requirement 61.
- 5.2 Ensure the cable is straight and positioned in line with the centre connection point.
- 5.3 Check phasing, any crossing or rolling of cores is to be undertaken well below the bushing inserts.
- 5.4 At the centre phase connection point place a white PVC tape marker around the cable, at a further 500mm beyond place a second marker and cut the cable at this point.
- 5.5 Straighten and position each core to its correct connection point.
- 5.6 Proceed with the appropriate Jointing Procedure.

6.6 “Dead break” Separable Connectors

- 6.1 Refer to the relevant General Requirement for the separable connector being used.
- 6.2 Ensure the cable is straight and positioned in line with the centre connection point.
- 6.3 Check phasing, any crossing or rolling of cores is to be undertaken well below the cleats and the equipment bushing interface.
- 6.4 At the centre phase connection point place a white PVC tape marker around the cable, at a further 500mm beyond place a second marker and cut the cable at this point.
- 6.5 Straighten and position each core to its correct connection point.
- 6.6 Proceed with the appropriate Jointing Procedure.

All dimensions in mm

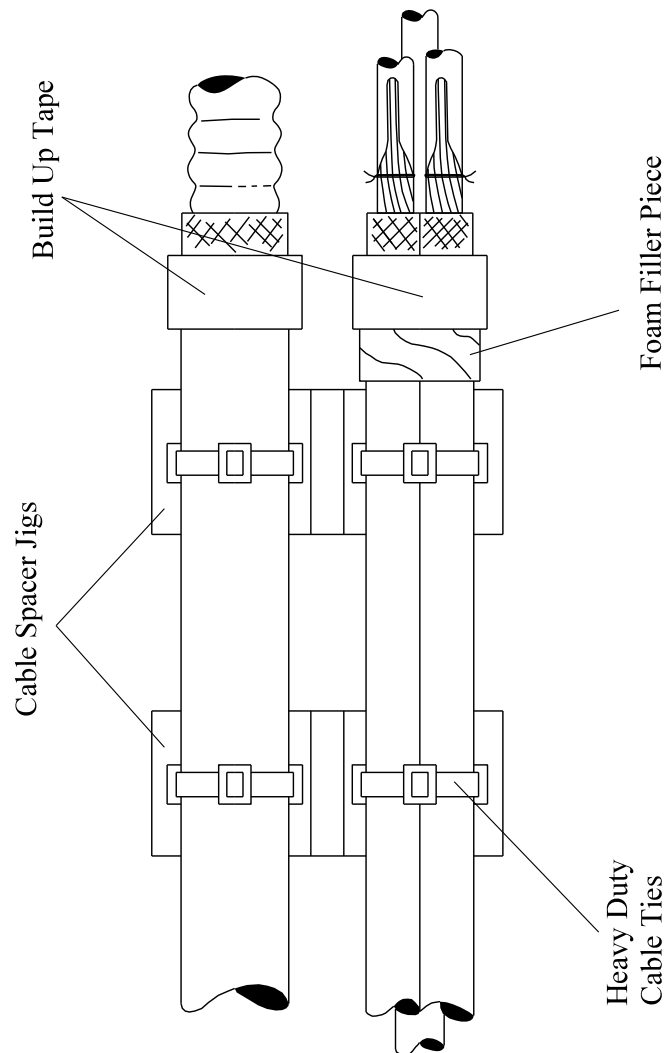


Fig 1

Note:- The Combination Of Cables Will Be PILC / PICAS to EPR or EPR to EPR

PLAN VIEW

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Drawn	RJB	04/13			
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SCALE		N.T.S.		Title	
				SETTING UP BRANCH / LOOP JOINT CABLE SPACER JIGS	
				Drg. No. GR2D 6.6.1	
				Rev No	

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All dimensions in mm

Note:- Cable Centres Are To Be Level Through The Horizontal Plane

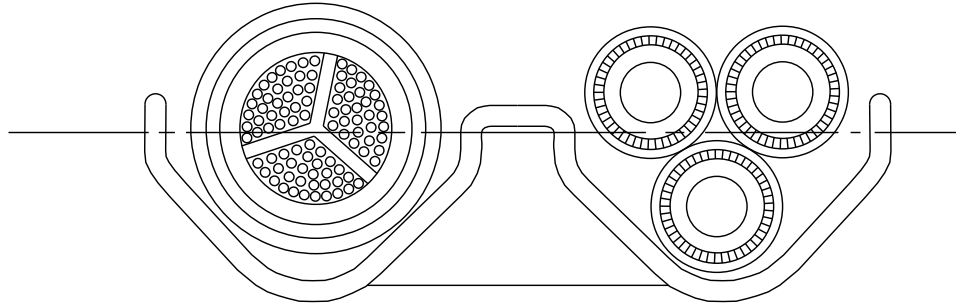
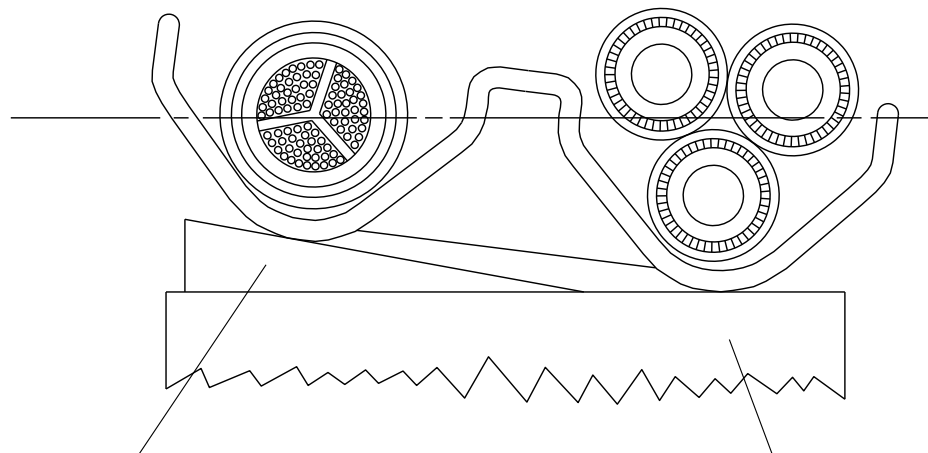


Fig 2




Wedge Packer

Fig 3

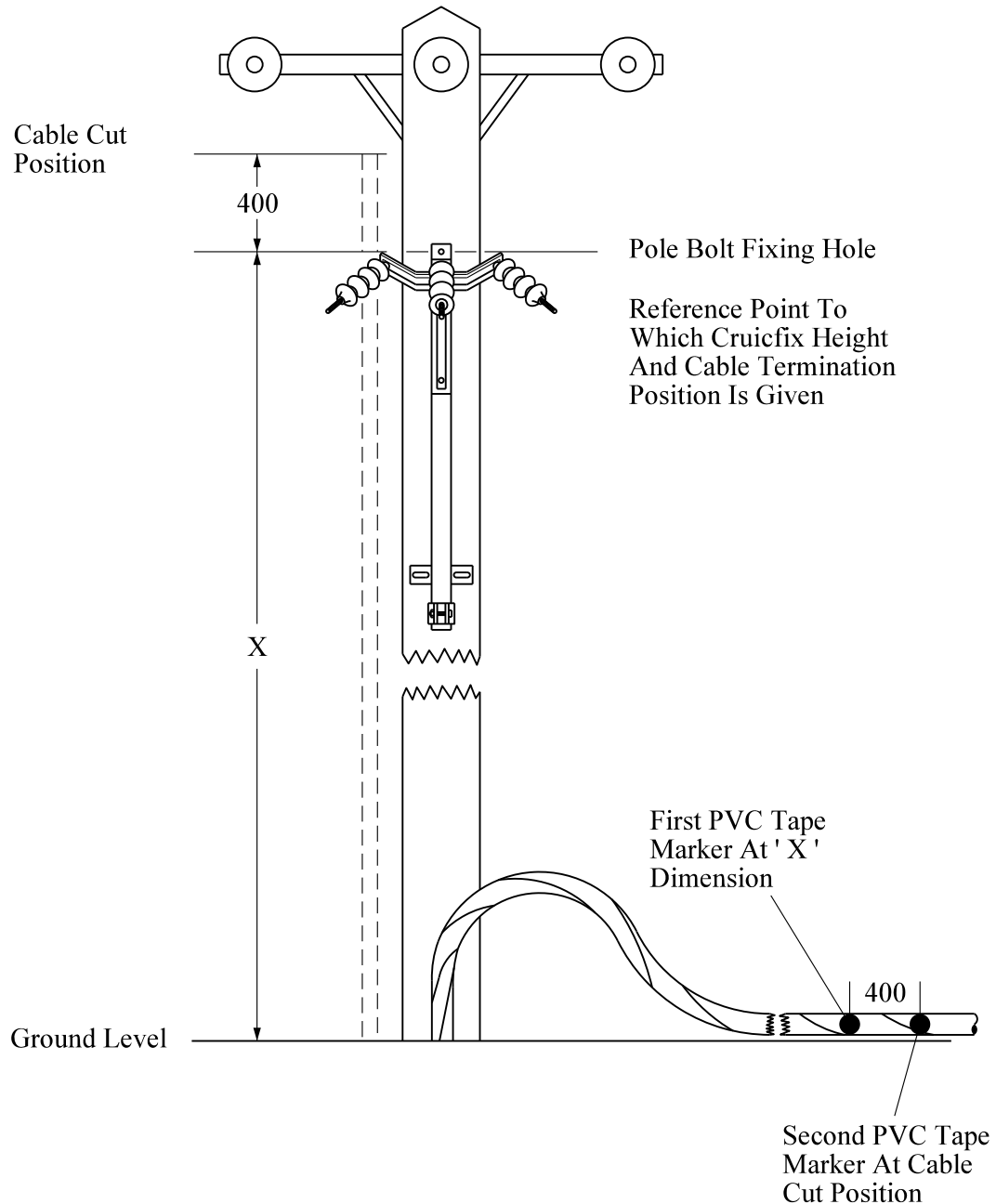
Support Block

END VIEW

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SCALE	N.T.S.		Title SETTING UP BRANCH / LOOP JOINT CABLE SPACER JIGS			Drg. No. GR2D 6.6.2
						Rev No

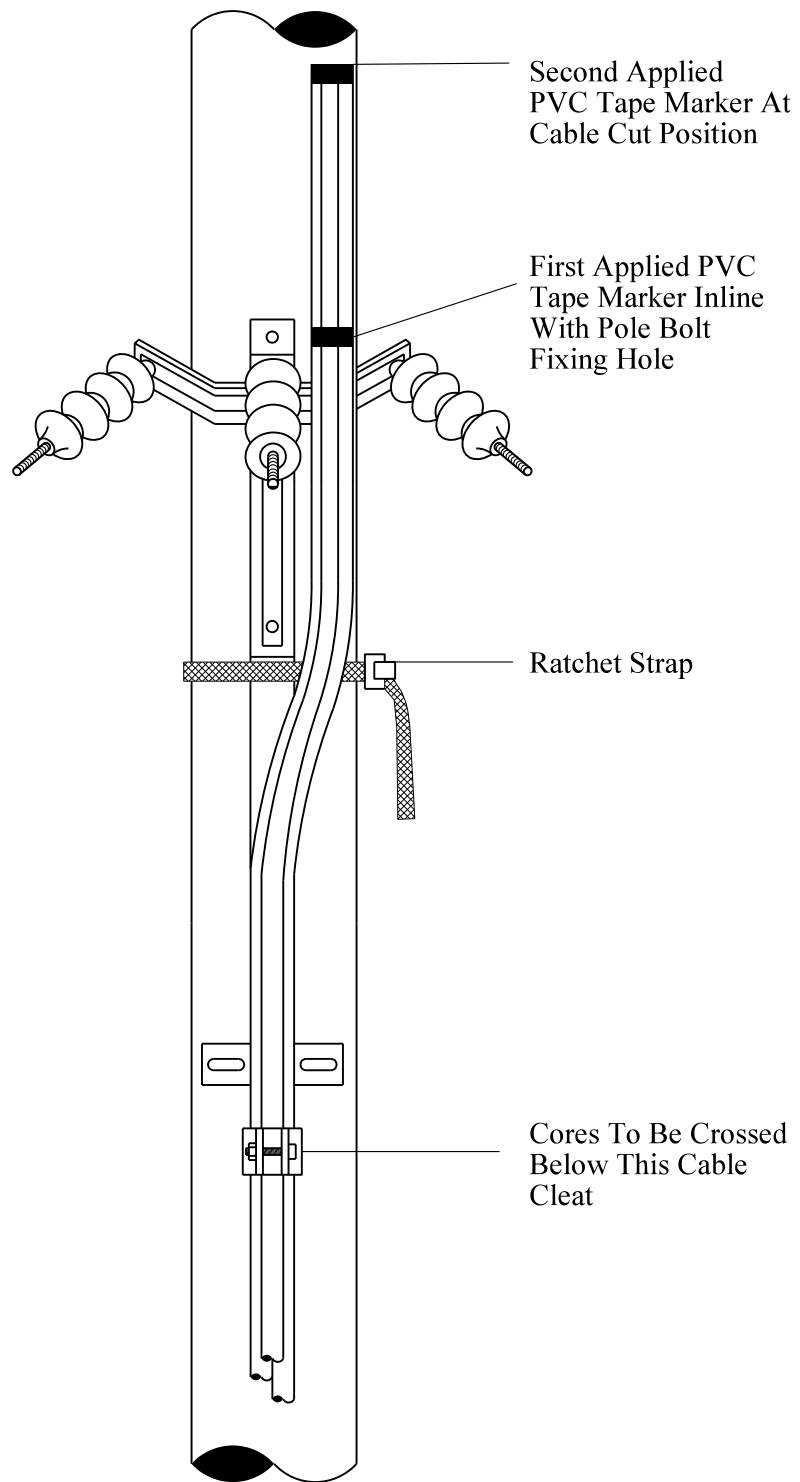
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All dimensions in mm



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Approved					
SCALE		N.T.S.		Title	
				OBTAINING HEIGHT OF 95 to 300mm ² EPR TRIPLEX POLE TERMINATION	

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SCALE		N.T.S.		Title	
				FITTING OF 95 to 300mm ² EPR TRIPLEX CABLE TERMINATION ONTO CRUCIFIX	
				Drg. No. GR2D 6.6.4	
				Rev No	

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All dimensions in mm

11kV Cable Termination Bracket
(Crucifix)

Steelwork Earth Lead

Overhead Line Conductors
To Main Line Connections

Surge Arresters

11kV Cables

Earth Braid On Cable
Sheath To Be Connected To
The Main Steelwork Earth
By Means Of A Lead With
A Lug And Crimp

Cable Cleat

Lid

Troughing

1000

Cable Capping

3000 Min

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SCALE		N.T.S.		Drg. No. GR2D 6.6.5	
				Rev No	

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GENERAL REQUIREMENT 7

INSULATION AND CONTINUITY CABLE TESTS

General

The insulation resistance and continuity of all cables that are to be part of the HV (6.6/11kV) system including previously disconnected and new cables shall be tested before jointing.

These tests will require preparation of the cable ends; any cable end that is undergoing test shall be protected and supervised to prevent accidental contact with a member of the general public or WPD staff.

The “Megger” or insulation resistance test instrument shall be used on the 1000V range and shall be tested for serviceability before use.

Method of Testing

- 7.1 Continuity** – having opened and prepared the cable ends, the remote end of the conductor shall be connected to the earth screen.

With the instrument connected to the conductor and earth screen at the test end a very low reading zero should be obtained, each core being tested in turn.

- 7.2 Insulation Resistance** – having opened and prepared the cable ends the instrument shall be connected to the conductor and earth screen the reading should show the insulation resistance greater than 1000 megohms ($M\Omega$) for lengths up to a drum length.

Where cables have been jointed the cores shall be tested between each in turn, a reading of 1000 megohms ($M\Omega$) should be achieved.

If the test shows an insulation resistance below 1000 megohms ($M\Omega$), the Supervisor shall be advised before carrying out any jointing work.

- 7.3 Phasing Identification** – prior to jointing work being carried out it will be necessary to obtain the phasing of the circuit to which the triplex or single core EPR / XLPE cables are to be connected. The test shall be carried out as the continuity test and as each core is identified it shall be marked with the appropriate PVC phase colour tape.

GENERAL REQUIREMENT 8

MOISTURE TESTING

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

Moisture if it penetrates into a cable will travel along the cable and may be detected many metres from the point of entry.

The moisture can travel along the screen papers, belt papers, wormings, core papers or between the strands of the conductor. It is essential; therefore, when carrying out moisture tests that samples from each part of the cable are tested, the samples must not be touched by hand as the test is so sensitive that the moisture transferred from the hand to the sample will be detected.

The simple on-site method of testing cable papers using hot paraffin wax can be conveniently used for this purpose.

The paraffin wax is heated to a temperature of **140°C** and providing the wax shows no signs of frothing around the dipped items then the items can be assumed to be “**dry**”.

8.1 Safety Precautions

Skin Contact

When the wax is in the motion state at elevated temperatures there is a risk of thermal burns, therefore contact with the skin should be avoided and precautions taken against accidental splashes. Skin sensitization or irritation is very infrequent.

Molten wax on the skin should be cooled rapidly by cold water and removed carefully from the skin in not less than 30 minutes to avoid blistering, preferably under medical supervision to avoid tissue damage.

Splashes in the Eye

In the event of wax entering the eyes these should be flushed immediately with water from 15 minutes and medical attention obtained.

Breathing of Vapour

Paraffin wax poses virtually no hazard to health when used in normal industrial practice. There is no hazard from inhalation of the vapour nor is ingestion considered to be a normal industrial hazard. Wax fumes may cause eye and respiratory tract irritation if present in sufficiently high concentration, in such circumstances adequate ventilation is to be provided to prevent high concentration building up in the work area.

Fire Hazard

Although stable at the usage temperature paraffin wax may catch fire at temperatures above 175°C and in the event of a small fire, foam, carbon dioxide, dry chemical powder, sand or earth may be employed to extinguish the flames.

For larger fires where a high concentration of wax is stored use foam or water fog, anyone tackling the fire must wear suitable respiratory equipment.

8.2 Method of Testing

Heat the paraffin wax to the required temperature **140°C**, monitoring the thermometer to keep the temperature constant throughout the test.

Take samples of the belt paper, outer and inner core papers, wormings and finally the core strands. These samples should be taken using dry knives and pliers.

A foamy bubbling of the compound around the samples will indicate the presence of moisture.

The samples should all be tested singly to avoid air trapped between layers causing bubbles in the compound.

Care must be taken to keep the compound temperature within the temperature range as higher temperatures will cause spurious bubbling and lower temperatures cannot be relied on to give an indication when moisture is present.

If the test shows moisture is present in the cable further tests should be made at 300mm intervals along the cable until it is proved dry in two consecutive tests.

GENERAL REQUIREMENT 9

REMOVAL OF WATER FROM EPR/XLPE CABLES WHILST JOINTING

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents given in General Requirement 1.

General

Due to the MDPE oversheath of EPR / XLPE cables being loosely extruded and the absence of any water blocking between the sheath inner and the copper wires, water travels easily through the cable.

This becomes evident at times when the MDPE oversheath has become punctured and allowed the ingress of water to travel some distance along the cable from the point of damage.

It is of the utmost importance for reliability of the completed joint that resin encapsulation is undertaken whilst the cable is dry; otherwise the resin will not cure and becomes porous, with subsequent failure of the joint.

Having opened the cable at the joint position ascertain from which end the water is draining and adopt the following method, there may be a need to vent both sides of the joint position.

Method

Refer to Drawing GR2D 6.9.1 whilst undertaking this General Requirement.

1. Clean and degrease the MDPE oversheath using an approved degreaser.
2. At a suitable distance (i.e. position of temporary earth continuity bond) from the proposed end of the outer joint sleeve remove a 30mm length of MDPE oversheath – Fig 1.
3. Allow water to drain, dry the interior of the cable at the joint position and complete to the relevant Jointing Procedure.
4. Park a mastic lined heat shrink tube on the cable.
5. Replace the MDPE oversheath and apply two half lapped layers of ‘3M’ 5313 tape the tension of the 5313 tape shall be such to cause the width of the tape to reduce to $\frac{3}{4}$ of its normal width, the tape shall then overlap onto the oversheath by 25mm – Fig 2.
5. Apply two half lapped layers, under tension of ‘88’ black PVC tape over the previously applied ‘3M’ 5313 tape, overlapping onto the MDPE oversheath. – Fig 2.
6. Shrink down the mastic lined heat shrink tube over the ‘88’ tape. – Fig 3.

All dimensions in mm

Mastic Lined
Heatshrink Tube

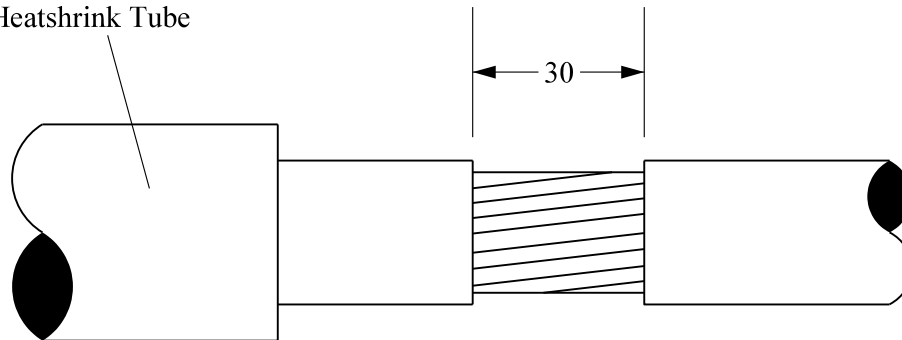


Fig 1.

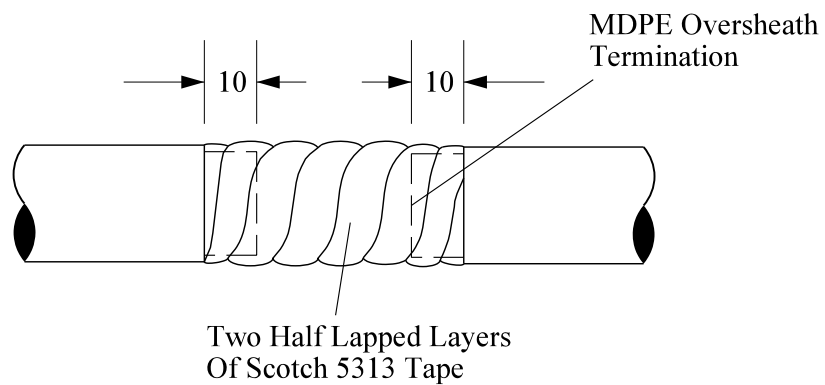


Fig 2.

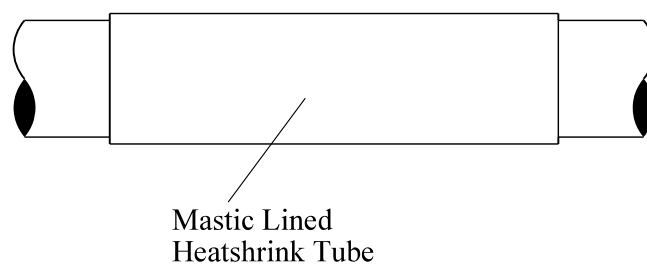



Fig 3.

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SCALE	N.T.S.		Title REMOVAL OF WATER FROM EPR CABLES WHILST JOINTING			Drg. No. GR2D 6.9.1
				Rev No		

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GENERAL REQUIREMENT 10

EQUIPOTENTIAL BONDING DURING JOINTING

Before commencing the level of PPE required for this operation shall be as the matrix 1 given in General Requirement 3.

General

The procedure is designed to provide protection for personnel by maintaining electrical continuity across breaks in the sheathing and or armour during jointing or repair operations on underground cables. This will ensure that the earthing of connected equipment is not impaired; in addition it will bring all exposed metallic cable sheaths/armours to the same potential.

This general requirement applies to straight, branch, loop joints and terminations on 11kV, 33kV, 66kV and Pilot/Scada/Multicore underground cables whether these cables are connected to WPD's electrical network or any other private network. It applies equally to cables having a continuous metallic sheath and those where earth continuity is provided via the armouring of the cable.

High voltage faults resulting in an earth fault on the network can occur at any time. In the short period of time during which the earth fault current is flowing, it is possible for the high voltages to be impressed onto conducting parts of a power cable which may create a hazard to people and equipment.

There are two effects that can cause high voltages to appear on the conductive parts of a power cable.

- 1) Induced Voltage: - is a direct result of the proportion of earth fault current returning through the soil. This longitudinal voltage is proportional to the value of earth fault current and the distance that the two circuits run in parallel.
- 2) Rise Of Earth Potential (ROEP) at the site feeding the faulted circuit. When an earth fault occurs, the entire area of a site where the fault current flows to earth may momentarily rise in potential with respect to the general mass of earth. This rise in potential is due to the fault current flowing through earth system impedance.

During an earth fault and the subsequent ROEP, circuits can import true earth potential into a Hot Site. In a similar way a Hot Site can transfer the ROEP to the remote end of the circuit. In each case the potential difference between the cable and the local earth potential may create a hazard to people and equipment.

Approved Equipment

The temporary continuity connectors consist of cross bonds of flexible tinned copper braid, which are connected to the armour or sheath by special clamps. The braid has a primary insulation of clear polythene tubing.

Class one electrical gloves complete with outer leather protector.

Application of Bonds

The temporary continuity connectors or “Bonds” are used in the following way: -

Examine the Hepbonds to ensure the insulation and connection clamps are clean and serviceable.

After the spiking gun has been released from the cable the cable is then cut using the insulated hacksaw and the class 1 electrical gloves, this cut then becomes the reference line for the new joint. Once the one cable end has been shrouded work on the exposed length of cable can now progress: -

10.1 Straight Through Joints

10.1.1 Triplex

Working on one end of the triplex and with the second end shrouded with either a 1000 gauge pole top bag or by using the LV shrouding, the non-shrouded end of the triplex is then opened out thus separating the cores thus allowing the installation of the various components required to complete the joint.

Where the cores have been cut becomes the reference mark for the joint, wearing the red Mappa gloves the oversheath is cleaned down using the approved degreaser for a distance of 1.5m. Using the reference line and a chinagraph pencil mark where the oversheath termination will be, add an additional mark some 300mm clear of the oversheath termination mark this second mark will be for the earth continuity bond. Park up a medium walled mastic lined tube from SMOE 28003 over each of the cores.

Using the correct size of PG pliers for the cable carefully open a window in the oversheath as per Figure 1 of GRD2D 6.10.1, a clean temporary continuity connector shall be applied and properly tightened to the copper screen wires.

Remove the 1000 gauge pole top bag or LV shrouding from the second end of triplex, apply the shrouding to end which has been prepared and follow the above procedure for the second end. The application and removal of the earth continuity bond requires the use of class 1 electrical gloves as detailed in the matrix of GR 3. **The bond shall not be removed until the permanent earth conductor has been re-established across the joint**, or the normal earth path is restored by the joint sleeve, or by a permanent armour bond in the case of cables where the armour is the only continuity conductor.

10.1.2 PICAS/PISAS

Working on one end of the PICAS and with the second end shrouded with either a 1000 gauge pole top bag or by using the LV shrouding, the non-shrouded end of the PICAS is then set into position.

Where the cable has been cut becomes the reference mark for the joint, wearing the red Mappa gloves the oversheath is cleaned down using the approved degreaser for a distance of 1.5m. Using the reference line and a chinagraph pencil mark where the oversheath termination will be, after the aluminium sheath, has been exposed during the early stages of making a straight joint and before the aluminium sheath, has been cut to the required length, as dictated by the relevant Jointing Procedure, a clean temporary continuity connector shall be applied, see Figure 4 of GRD2D 6.10.2 and properly tightened to the cleaned aluminium sheath, at a position where it will not interfere with the jointing procedure. With a PICAS cable this will be in the location of where the water blocking shall be applied. The application and removal of the earth continuity bond requires the use of class 1 electrical gloves as detailed in the matrix of GR 3. **The bond shall not be removed until the permanent earth conductor has been re-established across the joint**, or the normal earth path is restored by the joint sleeve, or by a permanent armour bond in the case of cables where the armour is the only continuity conductor.

10.1.3 PILC

Working on one end of the PILC and with the second end shrouded with either a 1000 gauge pole top bag or by using the LV shrouding, the non-shrouded end of the PILC is then set into position.

Where the cable has been cut becomes the reference mark for the joint, wearing the red Mappa gloves the oversheath is cleaned down using the approved degreaser for a distance of 1.5m. Using the reference line and a chinagraph pencil mark where the armour termination will be, after the armours have been cut and the lead sheath, has been exposed, cleaned and the armours tied down to the lead sheath during the early stages of making a straight joint and before the lead sheath, has been cut to the required length, as dictated by the relevant Jointing Procedure, a clean temporary continuity connector shall be applied, see Figure 5 of GRD2D 6.10.2 and properly tightened to the cleaned lead sheath, at a position where it will not interfere with the jointing procedure. With a PILC cable this will be in the location of where the water blocking shall be applied. The application and removal of the earth continuity bond requires the use of class 1 electrical gloves as detailed in the matrix of GR 3. **The bond shall not be removed until the permanent earth conductor has been re-established across the joint**, or the normal earth path is restored by the joint sleeve, or by a permanent armour bond in the case of cables where the armour is the only continuity conductor.

In the case of the cables that are disconnected from one another, then all work involving the cable sheath / armour carried out prior to the temporary continuity connector being fitted, shall be undertaken using the approved personal protective equipment (PPE) as detailed in the matrix given in ST: CA2C/9 – General Requirement No. 3. Once the temporary continuity connector has restored the earth continuity then the jointing can proceed in accordance with the relevant jointing procedure.

The third or free end of the temporary continuity connector should be placed safely out of the way, e.g. by putting it around some clean part of the cable.

Once the cable(s) have been cut the Joiner shall park the relevant number of heat shrink mastic lined tubes over the cable(s), so that once the bond has been removed the oversheath can then be sealed using the mastic lined heat shrink tubes, see Figures 2 and 3 of GR2D 6.10.1.

10.2 Branch Joints

In the case of branch joints the procedure to be followed, will be the same as for the straight through joint, with the following exception: -

All work associated with the removal of the PVC oversheath / serving carried out prior to the temporary continuity connector being fitted to the sheath / armour of the cables to be branch jointed, should be undertaken using the approved PPE as detailed in the matrix given in ST: CA2C/9 – General Requirement No. 3. Once the temporary continuity connector has established the earth continuity between the branch cable and main cables, then the jointing can proceed in the normal manner. **This bonding must be carried out before the sheath of the main cable is cut.**

10.3 Loop Joints

In the case of loop joints the procedure to be followed, will be the same as for the straight through joint.

10.4 Terminations

After the cable sheath, or armour, as the case maybe, has been exposed during the early stages of terminating the cable and before the sheath / armour is cut, a clean temporary continuity connector shall be applied to the sheath / armour of the cable and a suitable earth of the switchgear/transformer. The temporary continuity connector shall be properly tightened and at a position where it will not interfere with the jointing procedure. **It shall not be removed until the permanent earth conductor has been established on to the termination** or by a permanent armour bond in the case of cables where the armour is the only continuity conductor.

All work associated with the removal of the PVC oversheath / serving carried out prior to the temporary continuity connector being fitted to the sheath / armour of the cables to be terminated, should be undertaken using the approved PPE as detailed in the matrix given ST: CA2C/9 – General Requirement No. 3. Once the temporary continuity connector has established the earth continuity between the main cable and the switchgear / transformer, then the jointing can proceed in the normal manner.

The third or free end of the temporary continuity connector should be placed safely out of the way, e.g. by putting it around some clean part of the cable.

10.5 Removal of Bonds

Once the joiner reaches the stage where the mechanical earth connection or earth cage has been correctly fitted to the sheaths/armours of all cables within the joint or termination, wearing class 1 gloves the temporary continuity connector can be removed. The class 1 gloves are not needed for the application of the Scotch 5313 tape or shrinking down the previously parked heat shrink tube can then be centralised and then shrunk down over the opened oversheath position.

All dimensions in mm

Mastic Lined
Heatshrink Tube

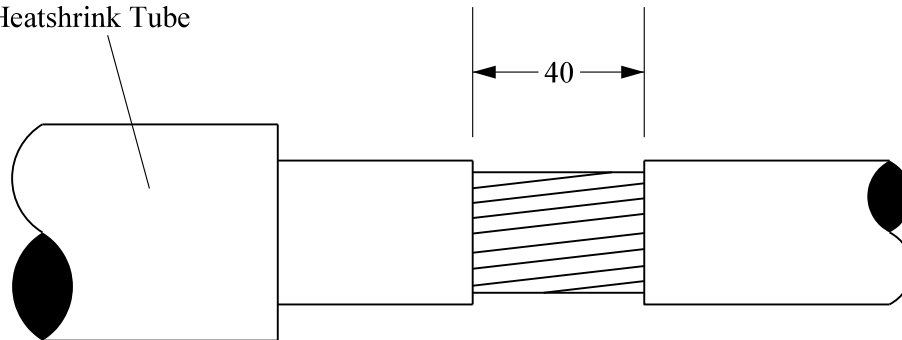


Fig 1.

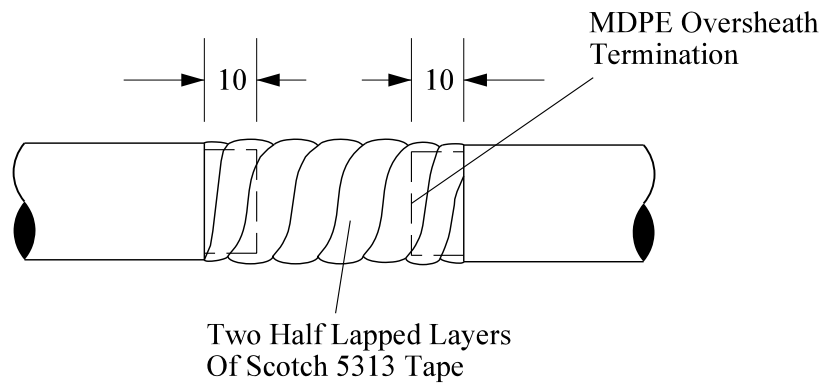


Fig 2.

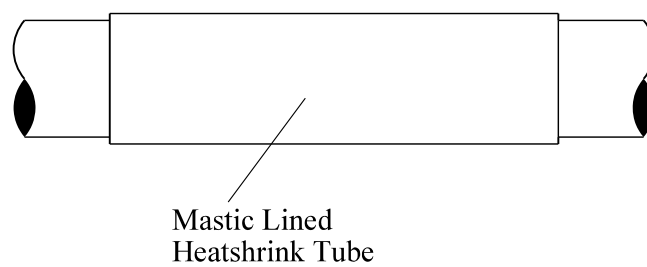


Fig 3.

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Checked					WESTERN POWER DISTRIBUTION	Drg. No. GR2D 6.10.1
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SCALE	N.T.S.				Title APPLICATION OF EARTH EQUIPOTENTIAL BONDS - TRIPLEX	Rev No

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PILC

All dimensions in mm

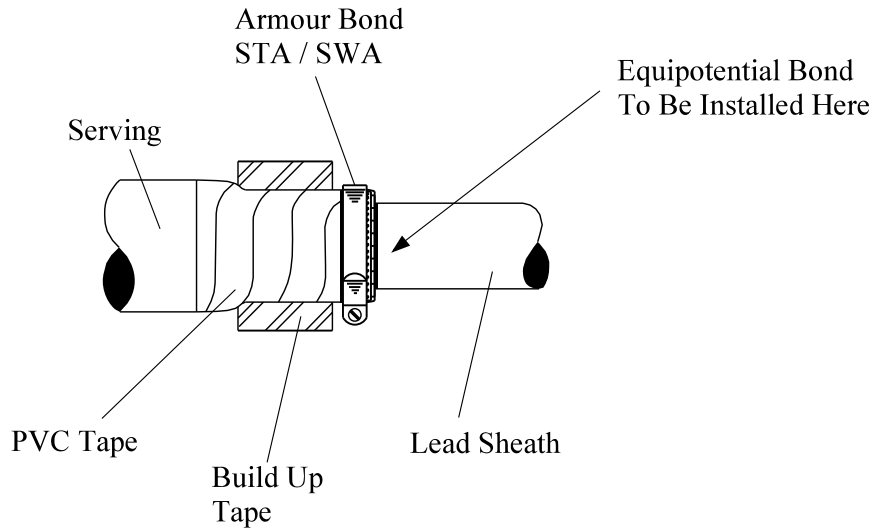


Fig 4.

PICAS / PISAS

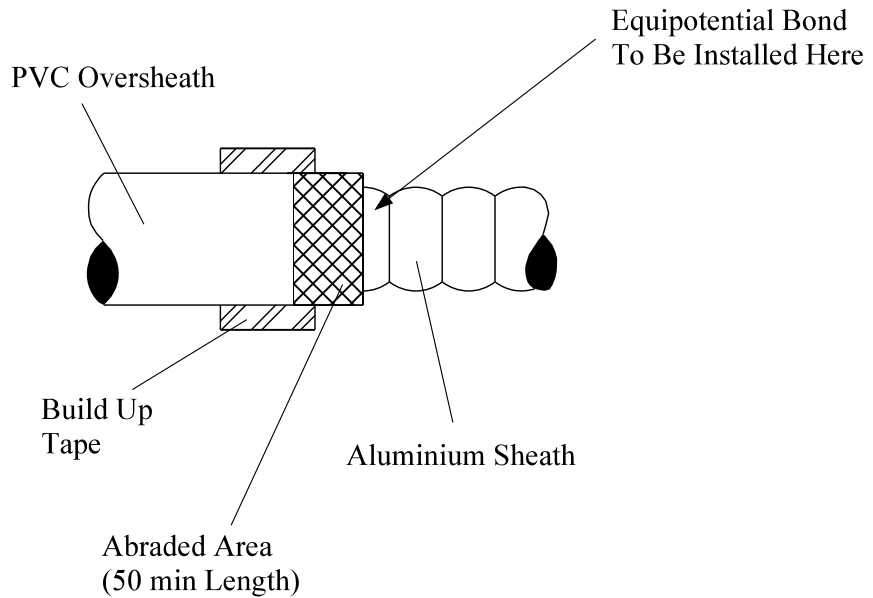



Fig 5.

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GENERAL REQUIREMENT 11

REMOVAL OF SERVING, ARMOUR AND BEDDING

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

Removal of cable servings and protective steel tape or wire armour must be undertaken with care, tape and wire armour are to be terminated using a depth guarded hacksaw.

Bedding tapes require removal with knives and heat (gas torch), careless use of the knife can cause lead sheath damage, whilst excessive localised heat will produce burning and melting of the lead sheath.

Damage to the lead sheath will weaken the sheath of its current carrying capacity or if severed will allow the ingress of moisture.

Method of Removal

11.1 Steel Tape Armour

Refer to the relevant Jointing Procedure for stripping dimensions

- 1.1 At the armour termination position apply a 16 swg wire binder around the serving. Cut around the serving at the binder with a hook knife (E 5 No. 32264) using sufficient force to cut the serving but not to damage the armour.
- 1.2 Remove the serving to the cut position.
- 1.3 At the armour termination position apply a 16 swg wire binder around the armour tapes, cut through the outer armour tape with a hacksaw fitted with a depth guard and remove.
- 1.4 Repeat the operation for the inner armour tape, taking extreme care to ensure that the lead sheath is not damaged.
- 1.5 At the bedding termination position apply a 16 swg wire binder around the bedding. Cut around the bedding at the binder taking care not to damage the lead sheath.
- 1.6 Remove the hessian bedding by cutting with a hook knife along the side of the cable, which will allow the bedding to be unwrapped. Warming the bedding with a gas torch may help this operation.
- 1.7 Warm the paper bedding over the lead sheath and remove.

- 1.8 Warm the bitumastic coating over the lead sheath and the armour tapes until it just begins to melt, with a gas torch. Remove the bitumastic coating and clean the lead sheath and armour tapes with a wipe moistened with an approved degreaser.
- 1.9 Finally clean with a dry wipe.
- 1.10 Before any further work on the lead sheath is undertaken, the sheath should be degreased with an approved degreaser.

11.2 Steel Wire Armour

Refer to the relevant Jointing Procedure for stripping dimensions.

- 2.1 At the serving termination position, apply a 16 swg wire binder around the serving. Cut around the serving at the binder with a hook knife using sufficient force to cut the serving but not to damage the armour.
- 2.2 Remove the serving to the cut position.
- 2.3 At the armour termination position, apply a 16 swg wire binder around the armour wires, partly cut through the armour wires with a hacksaw fitted with a depth guard.
- 2.4 Unwrap and remove the armour a few wires at a time, by bending backwards and forwards to break them away.
- 2.5 Remove the wire binder applied in 2.3, lift and turn the armour wires back at 90° to the lead sheath bedding.
- 2.6 At the bedding termination position apply a 16 swg wire binder around the bedding. Cut around the bedding at the binder taking care not to damage the lead sheath.
- 2.7 Remove the hessian bedding to the armour by cutting with a hook knife along the side of the cable, which will allow the bedding to be unwrapped. Warming the bedding with a gas torch may help this operation.
- 2.8 Warm the paper bedding over the lead sheath and remove.
- 2.9 Warm the bitumastic coating over the lead sheath and the armour wires until it just begins to melt, with a gas torch. Remove the bitumastic coating and clean the lead sheath and armour wires with a wipe moistened with an approved degreaser.
- 2.10 Finally clean with a dry wipe.
- 2.11 Before any further work on the lead sheath is undertaken, the sheath should be degreased with an approved degreaser.

GENERAL REQUIREMENT 12

BONDING OF STEEL TAPE OR STEEL WIRE ARMOUR (PAPER CABLES)

Before commencing the level of PPE required for the operation shall be as the matrix given in General Requirement 3, in addition your attention is drawn to the Use of Solvents given in General Requirement 1.

General

When jointing on PILC cables that are served with steel tape or steel wire armour the armour and lead sheath must be bonded to prevent potential difference between the two, failure to bond between will lead to erosion of the lead at the armour termination point.

Method of Installation

Refer to Drawing GR2D 6.12.1 whilst undertaking this General Requirement.

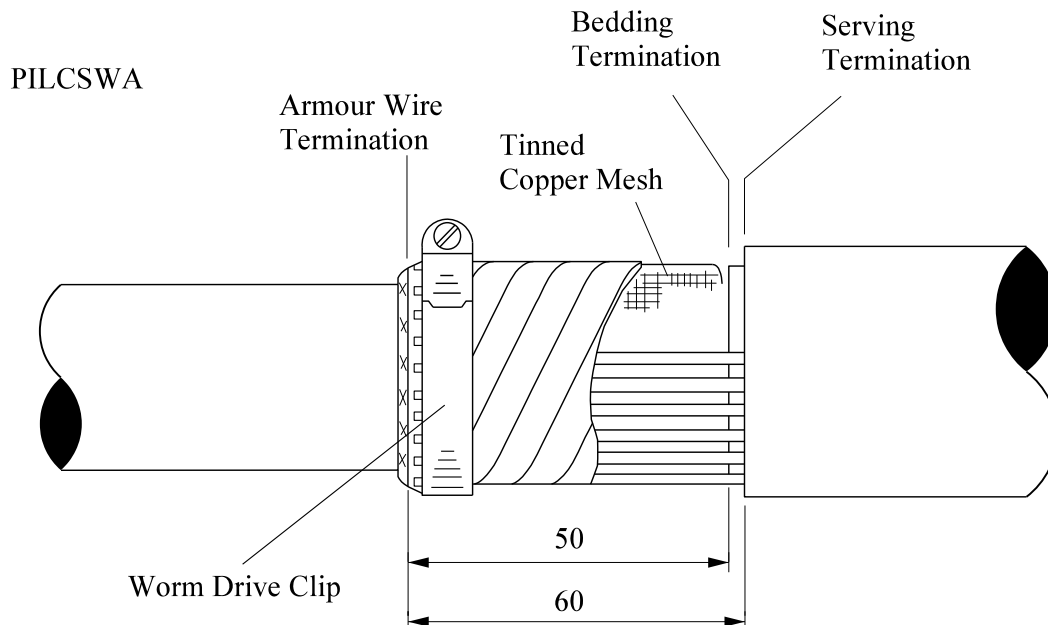
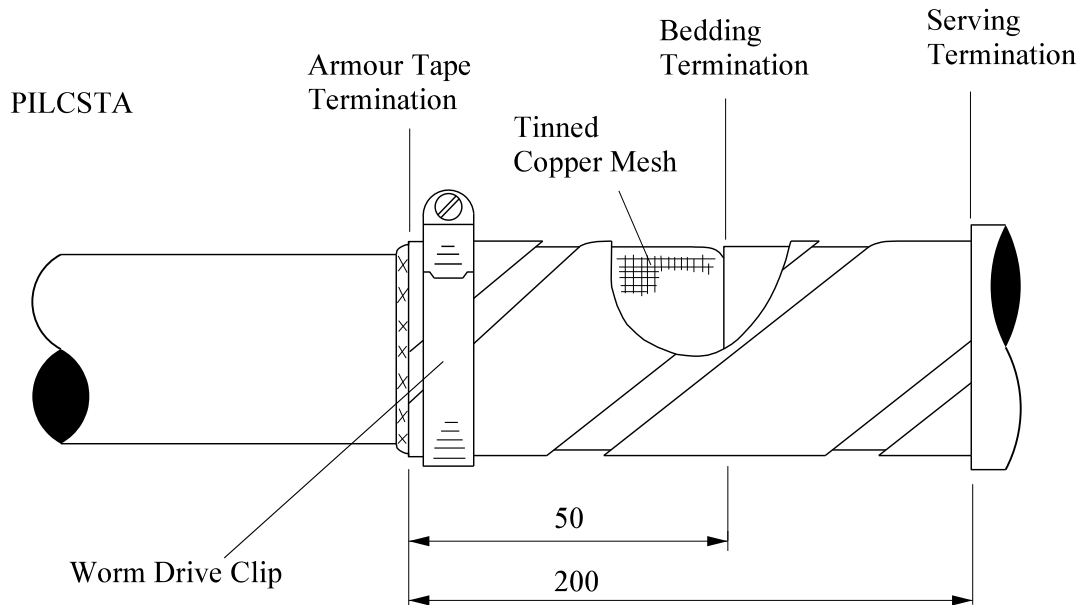
12.1 Steel Tape Armour

- 1.1 Prepare the cable to General Requirement 11 using the stripping dimensions given in the relevant Jointing Procedure.
- 1.2 Thoroughly degrease and abrade the lead sheath giving a final clean after abrading with an approved degreaser.
- 1.3 Wrap tinned copper mesh around the lead sheath so that the leading edge protrudes just beyond the tape armour when laid back onto the lead sheath.
- 1.4 Re-lay the tape armour over the tinned copper mesh securing with a worm drive clip, tighten with a torque driver set at 5Nm.
- 1.5 Starting on the outer serving cover the exposed tape armour with two half lapped layers of Scotch 88 black PVC tape up to the worm drive clip.

12.2 Steel Wire Armour

- 2.1 Prepare the cable to General Requirement 11 using the stripping dimensions given in the relevant Jointing Procedure.
- 2.2 Thoroughly degrease and abrade the lead sheath giving a final clean after abrading with an approved degreaser.
- 2.3 Wrap tinned copper mesh around the lead sheath so that the leading edge protrudes just beyond the wire armour when laid back onto the lead sheath.

- 2.4 Re-lay the armour wires over the tinned copper mesh and secure with a worm drive clip, tighten with a torque driver set at 5Nm.
- 2.5 Starting on the outer serving cover the exposed armour wires with two half lapped layers, applied under tension of Scotch 88 black PVC tape up to the worm drive clip.



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				BONDING OF STA/SWA ARMOUR		GR2D 6.12.1	

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GENERAL REQUIREMENT 13

REMOVAL OF STEEL WIRE ARMOUR OF 3 CORE SWA XLPE CABLES

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

Removal of the cable oversheath or wire armour must be undertaken with care, the wire armour are to be terminated using a depth guarded hacksaw.

When jointing on 3 core SWA XLPE cables that are served with steel wire armour the armour and three individual copper tape screens of the cores must be bonded to prevent potential difference between the two, failure to bond between will lead to damage of the copper tape screens if a trough fault were to be carried by the cable as the steel wire armours are designed to carry the fault current.

Method of Removal

Refer to Drawing GR2D 6.13.1 whilst undertaking this General Requirement.

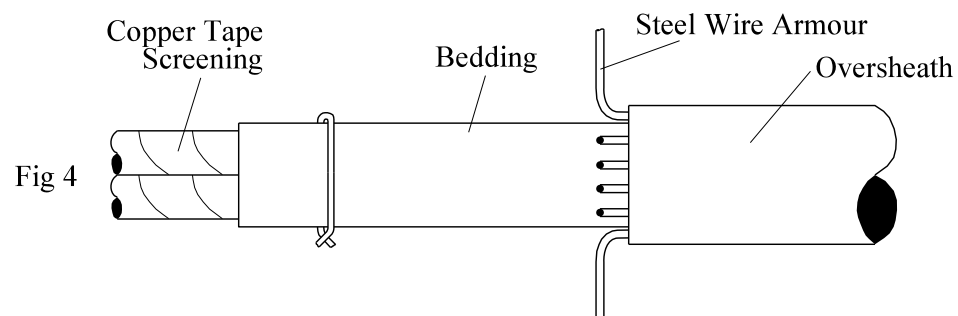
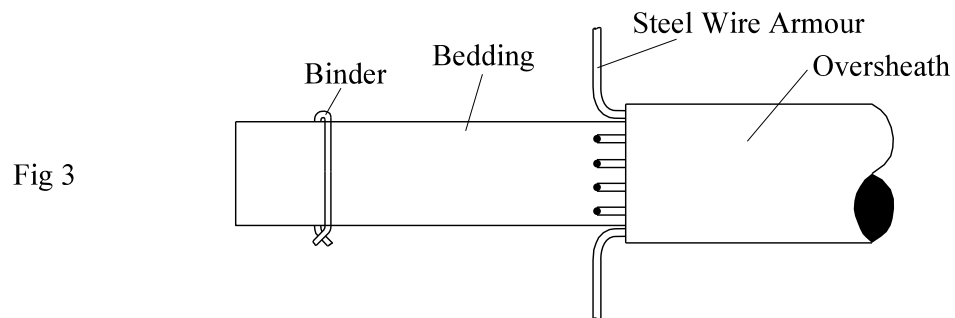
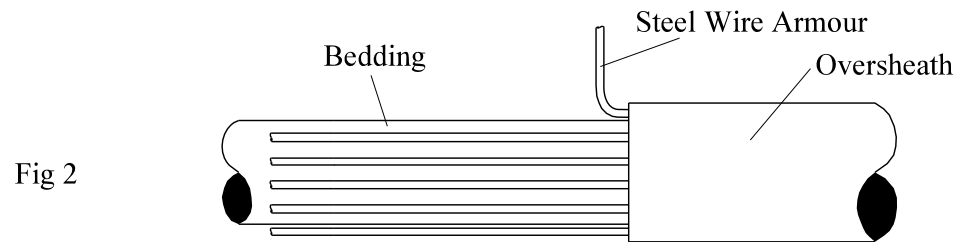
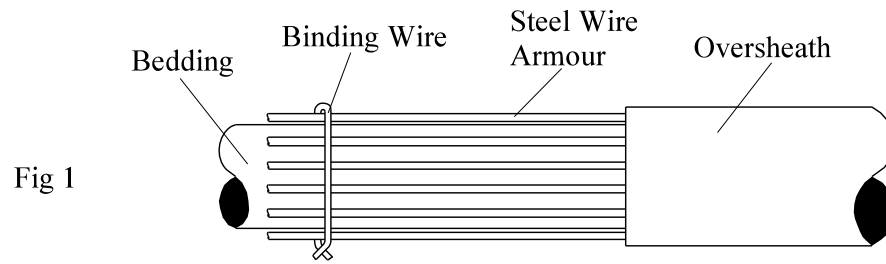
13.1 Steel Wire Armour


Refer to the relevant Jointing Procedure for stripping dimensions.

- 1.1 At the oversheath termination position, apply a circumferential cut to the PVC to cut the oversheath but not to damage the armour.
- 1.2 Remove the oversheath to the cut position.
- 1.3 At the armour termination position, apply a 20 swg wire binder around the armour wires, partly cut through the armour wires with a hacksaw fitted with a depth guard. See Fig 1.
- 1.4 Unwrap and remove the armour a few wires at a time, by bending backwards and forwards to break them away. See Fig 2.
- 1.5 Remove the wire binder applied in 1.3, lift and turn the armour wires back at 90° to expose the PVC bedding.
- 1.6 At the bedding termination position apply a 20 swg wire binder around the bedding. Cut around the bedding at the binder taking care not to damage the copper tape screens on each of the phases. See Fig 3.

- 1.7 Remove the PVC bedding up to the binding wire applied in 1.6, by cutting with a hook knife along the side of the cable, which will allow the bedding to be removed. See Fig 4.
- 1.8 Thoroughly degrease the copper tape screens of the cores and the bedding with an approved degreaser.

All dimensions in mm



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				REMOVAL OF STEEL WIRE ARMOUR ON 3 CORE SWA XLPE CABLE	
				Drg. No. GR2D 6.13.1	
				Rev No	

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GENERAL REQUIREMENT 14

BONDING OF STEEL WIRE ARMOUR (3 Core SWA XLPE CABLES)

Before commencing the level of PPE required for the operation shall be as the matrix given in General Requirement 3, in addition your attention is drawn to the Use of Solvents given in General Requirement 1.

General

When jointing on 3 core XLPE SWA cables that are served with steel wire armour the armour and copper tape screens must be bonded to prevent potential difference between the two, failure to bond between the SWA and the copper tape screens will result in a failure of the copper tape screens under through fault conditions as the copper tape screens can only carry about 3% of the fault current the steel wire armours are designed to carry the fault current.

Method of Installation

Refer to Drawing GR2D 6.14.1 whilst undertaking this General Requirement.

14.1 Steel Wire Armour

- 1.1 Prepare the cable to General Requirement 13 using the stripping dimensions given in the relevant Jointing Procedure.
- 1.2 Thoroughly degrease the PVC bedding layer.
- 1.3 Wrap the stainless steel support ring around the bedding and clip into the required position. As the support ring is range taking, the ring should be clipped into position in such a way that there a snug fit between the ring and the PVC bedding.
- 1.4 Covering the complete support ring apply two layers of copper knit mesh applied under moderate tension.
- 1.5 Lay the steel wire armours onto the stainless steel support ring.
- 1.6 Taking the copper braid from Lovink base module, cut off the copper ferrule.
- 1.7 Splay the end of the copper braid to the diameter of the steel wire armours of the cable.
- 1.8 Lay the copper braid onto the steel wire armours, ensuring all the armours are covered by the braid.
- 1.9 Apply the jubilee clip to the copper braid.
- 1.10 Once the jubilee clip has been applied, torque to 5Nm.
- 1.11 Starting on the oversheath cover the exposed armour wires, braid and roll spring with two half lapped layers, applied under tension of Scotch 88 black PVC tape.

Fig 1

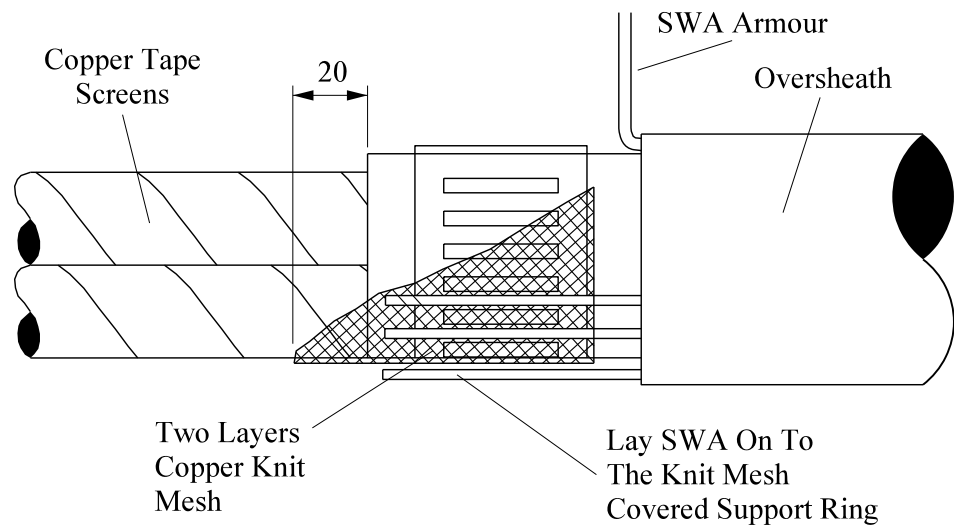


Fig 2

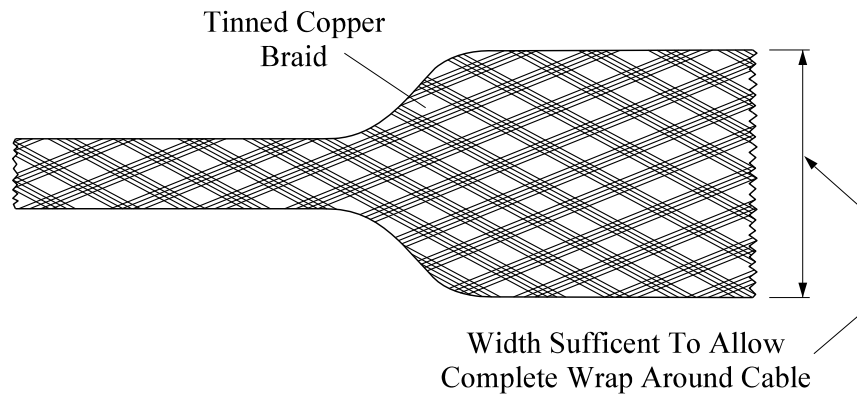
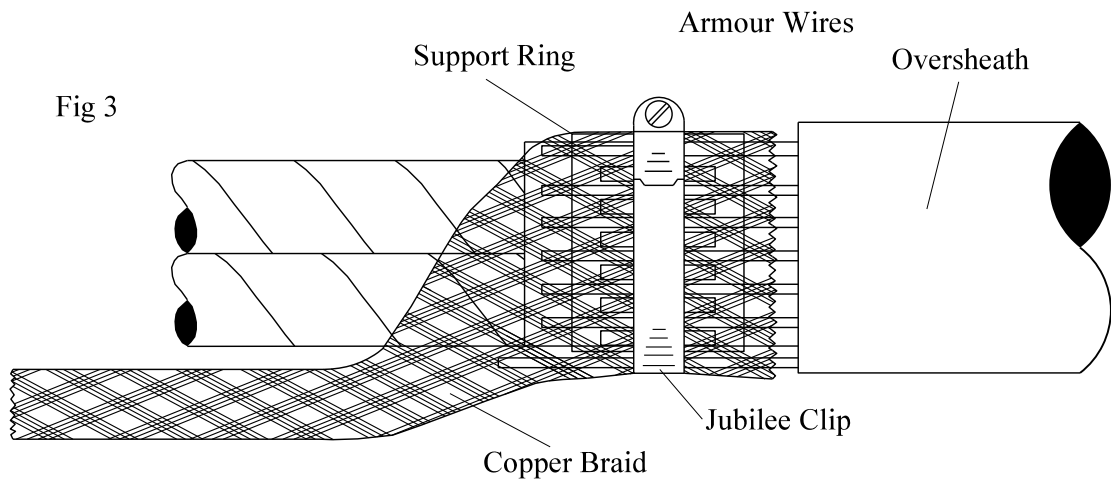



Fig 3



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GENERAL REQUIREMENT 15

REMOVAL OF PVC OVERSHEATHS ON PAPER CABLES

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

PICAS and PISAS cables are oversheathed with PVC and a bitumen layer applied between the PVC and aluminium sheath, the bitumen coating helps prevent corrosion of the aluminium sheath in the event of the PVC oversheath becoming damaged.

PVC oversheaths are sometimes found on SWA PILC (SWA PVC is not commonly found on WPD systems) and PILC single core cables. Removal should be undertaken with care to prevent damage to underlying metallic sheaths and steel wire armour; use of correct depth guarded tooling will prevent accidental damage.

Where heat is required to aid the removal of PVC oversheaths care must be taken whilst heating with a gas torch flame, excessive heat will cause burning of the PVC which in turn will result in the giving off of toxic fumes.

Method of Removal

15.1 PICAS Cable

- 1.1 Make a circumferential cut at its termination point using the Consac aluminium sheath-cutting tool, or the Kevlar string cutting partially through the PVC oversheath.

Note: - The Consac tool will not pass over 300mm² cable; there are two methods of making the cut the first being with Kevlar string at the relevant position or the second is a circumferential cut shall be made with a depth guarded hacksaw.

- 1.2 Carefully warm the length of oversheath to be removed and hook knife blade.
- 1.3 Make two “tramlines” no more than 10mm apart cutting partially through and along the top surface of the oversheath, from the open cable end to its termination point.
- 1.4 Using pliers pick up the 10mm wide strip at the cable end and pull towards its termination point, thus removing the strip.
- 1.5 Using a hook wedge lift the oversheath away from the cable along the length of the straight cut, remove the oversheath by unwrapping from the cable.
- 1.6 Examine the bituminous coating on the aluminium sheath, if there are large areas of the sheath free from bitumen report to your Supervisor before continuing.

- 1.7 Starting at the open cable end warm the bitumen coated aluminium sheath in sections of approximately 300mm long to release the bitumen and thoroughly clean with a approved degreaser.
- 1.8 Check with a mirror on the underside of the sheath to ensure the sheath is completely clean and free of bitumen, especially within the “troughs” of the corrugations.
- 1.9 Repeat on the remaining sections working towards the PVC oversheath termination point until the aluminium is completely clean.

15.2 PISAS Cable

- 2.1 Make a circumferential cut at its termination point using the aluminium sheath-cutting tool, cutting partially through the PVC oversheath.

Note: - If the Consac tool is unavailable then there are two methods of making the cut the first being with Kevlar string at the relevant position or the second is a circumferential cut shall be made with a depth guarded hacksaw.

- 2.2 Carefully warm the length of oversheath to be removed and hook knife blade.
- 2.3 At the cable end and to the cable side hook the knife between the oversheath and aluminium sheath, draw the knife along the length of oversheath to be removed with the blade kept flat to the underlying aluminium sheath.
- 2.4 Using a hook wedge lift the oversheath away from the cable along the length of the straight cut, remove the oversheath by unwrapping from the cable.
- 2.5 Examine the bituminous coating on the aluminium sheath, if there are large areas of the sheath free from bitumen report to your Supervisor before continuing.
- 2.6 Starting at the open cable end warm the bitumen coated aluminium sheath in sections of approximately 300mm long to release the bitumen and thoroughly clean with a approved degreaser.
- 2.7 Check with a mirror on the underside of the sheath to ensure the sheath is completely clean and free of bitumen.
- 2.8 Repeat on the remaining sections working towards the PVC oversheath termination point until the aluminium is completely clean.

15.3 PVC Oversheaths of PILC SWA Cable

- 3.1 Make a circumferential cut at its termination point using the aluminium sheath-cutting tool and cutting partially through the PVC oversheath.

Note: - If the Consac tool is unavailable then there are two methods of making the cut the first being with Kevlar string at the relevant position or the second is a circumferential cut shall be made with a depth guarded hacksaw.

- 3.2 Carefully warm the length of oversheath to be removed and hook knife blade.
- 3.3 At the cable end and to the cable side hook the knife between the oversheath and lead sheath, draw the knife along the length of oversheath to be removed with the blade kept flat to the underlying lead sheath.
- 3.4 Using a hook wedge lift the oversheath away from the cable along the length of the straight cut, remove the oversheath by unwrapping from the cable.

15.4 PVC Oversheaths of PILC Unarmoured Cable

- 4.1 Make a circumferential cut at its termination point using the aluminium sheath-cutting tool and cutting partially through the PVC oversheath.

Note: - If the Consac tool is unavailable then there are two methods of making the cut the first being with Kevlar string at the relevant position or the second is a circumferential cut shall be made with a depth guarded hacksaw.

- 4.2 Carefully warm the length of oversheath to be removed and hook knife blade.
- 4.3 At the cable end and to the cable side hook the knife between the oversheath and lead sheath, draw the knife along the length of oversheath to be removed with the blade kept flat to the underlying lead sheath.
- 4.4 Using a hook wedge lift the oversheath away from the cable along the length of the straight cut, remove the oversheath by unwrapping from the cable.

GENERAL REQUIREMENT 16

REMOVAL OF MDPE OVERSHEATH

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

Medium Density Polyethylene (MDPE) oversheaths must be removed with care using depth guarded tooling, incorrect use of tooling may cause damage to the underlying copper screen wires thus reducing the cross sectional area of the screen and its ability to carry fault current to which its designed.

Thickness of the oversheath should be of equal thickness at any point within the sheath. This may not always be the case and the use of specialised tooling may cause damage to the underlying copper screen wires, it is therefore, advisable to test on a scrap length of cable before jointing commences.

Should this be the case or where the work area is restricted, an alternative method for making the circumferential cut is the use of Kevlar string (or whipping thread).

Method of Removal

16.1 Removal using Prysmian PG Pliers

- 1.1 Hold the PG pliers at 90° to the cable and place on the oversheath termination mark is, apply a **slight pressure** to the plier handle and rotate the pliers through 90°. This will create a full 360° circumferential cut in the oversheath.

Note: -Excessive hand pressure on the handles of the pliers will result in copper wire screen damage. This will place a 360° circumferential cut in the oversheath. Only use replacement blades from the WPD E 5 system.

- 1.2 Remove and turn the pliers so as they are parallel to the cable fit the cable between the support roller and cutting wheel.
- 1.3 Ensure the cutting wheel is placed to the waste side of the circumferential cut, apply a good pressure to the plier handle and pull the pliers longitudinally towards the cable end.
- 1.4 Using the claw blades at 90° to the cable, place the top blade into the cut line, apply pressure and pull down and away from the cut line, this will open the oversheath.

16.2 Alternative Method (Kevlar String)

- 2.1 The Kevlar string is used in the form of a “garrotte” around the cable oversheath, with a sawing action the Kevlar will penetrate through the MDPE oversheath without causing damage to the underlying copper screen wires.

GENERAL REQUIREMENT 17

RASP ABRADING PVC and FLAME ABRADING MDPE OVERSHEATHS

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents given in General Requirement 1.

General

The abrading of PVC and the flame abrading of the MDPE oversheaths must be carried out diligently as the adherence of the resin depends upon it. It must be remembered that this produces the primary moisture seal and if this is not effective the joint will surely fail.

Method of Abrading

17.1 Rasp Abrading of PVC Oversheaths (PVC Only)

- 1.1 At the position at which the abrading is to be carried out thoroughly clean the oversheath with an approved degreaser.
- 1.2 Thoroughly and circumferentially abrade the cleaned surface of the oversheath with a rasp to produce a matt finish, all embossing must be removed.
Check the underside with a mirror.
- 1.3 Clean the abraded area with an approved degreaser to remove all loose particles.

17.2 Flame Abrading of MDPE Oversheaths (MDPE Only)

Polyethylene has a non-polar, nonporous and inert surface. For this reason, adhesives cannot link chemically or mechanically to untreated polyethylene surfaces. For bonding to other materials a suitable surface preparation must be used. This improves the wetting properties and hence the adhesion of the polyethylene oversheath.

Flame treatment is fast and provides a high bond strength; however it requires very careful control to prevent heat damage to the oversheath.

- 2.1 Thoroughly clean the surface of the sheath, for a length of 200mm.
- 2.2 Using the gas torch with a soft blue flame, which is passed over the sheath until the oversheath appears glossy.
- 2.3 Check the underside of the oversheath with a mirror, to check for the glossy surface.

GENERAL REQUIREMENT 18

REMOVAL OF LEAD SHEATHS

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents given in General Requirement 1.

General

Removal of lead sheaths on 11kV cables (as with any voltage) must be undertaken with care and control, failure at the lead sheath termination point will result, should the lead sheath be severed whilst cutting, damage will occur to the belt or screen papers.

All PILC cables within Lovink 11kV joints will have the lead sheath removed from the cable end only.

18.1 Method of Removal

1.1 At the lead cut mark, make a circumferential cut no more than halfway into the sheath using: -

- (i) a curved knife for cables of diameter over the lead, less than 40mm.
- (ii) an **insulated hack knife** and hammer for cables of diameter over the lead, greater than 40mm.

Use a mirror to check that the cut has been correctly made underneath the cable.

1.2 Make two “tramlines” spaced 6mm apart, cutting partially through and along the top surface of the lead sheath from the open cable and to its termination point.

1.3 Using pliers pick up the 6mm wide strip at the cable end and pull towards its termination point, thus removing the strip.

1.4 Using a hook wedge lift the oversheath away from the cable along the length of the straight cut, remove the lead sheath by unwrapping from the cable. Check the edges of the lead cut are raised clear of the belt papers.

1.5 Once the lead sheath has been removed an insulated belling tool shall be used to slightly bell the mouth of the lead sheath, to not more than 10mm of the overall lead sheath diameter, care being taken so as not too damage the belt papers with the belling tool.

GENERAL REQUIREMENT 19

REMOVAL OF ALUMINIUM SHEATHS

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents given in General Requirement 1.

General

There are two cable types which have a sheath of aluminium, PICAS (paper insulated corrugated aluminium sheath) and PISAS (paper insulated smooth aluminium sheath), both have their own method of removal. That is why it is essential to clearly define the type of aluminium cable and not refer to it as PIAS, this leads to confusion.

The tightness of corrugated aluminium sheaths varies, to avoid damage to the underlying belt paper insulation or screen papers they shall be removed in sections not more than 300mm in length.

Method of Removal

19.1 Corrugated Aluminium Sheath (PICAS)

- 1.1 Mark the position at which the aluminium sheath is to be terminated; this must be on the crest of a corrugation.

Note: - Should the termination mark fall between two crests (within the trough) then the mark shall be moved to the next crest towards the joint centre.

- 1.2 Divide the length between this mark and the cable end into lengths approximately 300mm long, placing the mark(s) on the corrugation crests.

- 1.3 Commencing with the position nearest to the cable end and wearing a face visor and protective gloves, score the circumference of the aluminium sheath with a depth guarded Consac aluminium sheath cutting tool, or the Roth & Berger NR7.0030 tool, or a depth guarded hacksaw. Carefully cut through the side of the aluminium sheath away from the Jointer with a depth guarded hacksaw, break the aluminium sheath at this point by bending the cable.

Note 1: - The Roth & Berger NR7.0030 tool (pipe cutting tool) **shall ONLY be used on PICAS cable.**

Note 2: - Care must be taken not to damage the underlying belt paper insulation when making the saw cut, and a clean wipe placed over the circumferential cut when breaking the aluminium sheath will help contain the molten impregnating compound.

- 1.4 Repeat the scoring and breaking of the aluminium sheath at the remaining marked positions, working towards its termination point.
- 1.5 Taking each severed section in turn and working from the cable end, twist the aluminium sheath clockwise as the sheath is removed from the cable.

Note: - If the cable impregnate has cooled enough to hinder the removal gentle warming of the sheath will help, disturbance of the belt paper insulation must be avoided when removing the final section.

- 1.6 Burrs at the aluminium sheath termination should be removed by carefully running a nylon wedge around and under the end of the aluminium sheath.

19.2 Smooth Aluminium Sheath (PISAS)

- 2.1 Mark the position at which the aluminium sheath is to be terminated.
- 2.2 Score the circumference of the aluminium sheath with a depth guarded Consac aluminium sheath-cutting tool at its termination point.
- 2.3 Set the cutting wheel to the 60° angle position, and mark a helical cut from the circumferential cut to the cable end.

Note: - Both the circumferential and helical cut depths are indicated when the shoulders of the cutting wheel are shown on the aluminium sheath either side of the cut.

- 2.4 Using the edge of a second cut half round file, file the cut at the cable end until the belt papers are visible then with a twist action lift the aluminium sheath to form a tag.
- 2.5 Using pliers to grip the tag un-wrap the aluminium sheath away from the cable back to its termination point.

GENERAL REQUIREMENT 20

TERMINATION OF BOARD OF TRADE SHEATH

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3 also your attention is drawn to the Use of Solvents given in General Requirement 1.

General

There are cables on the 11kV underground distribution system, which were constructed with a flat copper strip between the lead sheath and belt papers around the full circumference of the cable; this is commonly known as a “board of trade sheath”.

To ensure the lead and copper strip type sheaths are at the same potential they require bonding, this is undertaken by turning back over the copper strand type sheaths and anchoring them to the lead sheath.

20.1 Method of Removal

Refer to Drawing GR2D 6.20.1 whilst undertaking this General Requirement.

1. Ensure the lead sheath has been abraded and degreased with an approved degreaser – Fig1.
2. Place a mark onto the lead sheath 13mm from its termination point – Fig 2.
3. Taking each copper strip in turn, lift and thoroughly degrease, lay back onto the lead sheath and trim at the 13mm mark – Fig 2.
4. Gently dress the copper strip down onto the lead sheath and secure with a stainless steel cable tie – Fig 3.
5. Apply silicon self-fusing rubber electrical tape (3M Scotch 70 tape) seal ensuring the copper strip termination is completely enclosed, General Requirement 20 – Fig 4.

All dimensions in mm

Fig 1

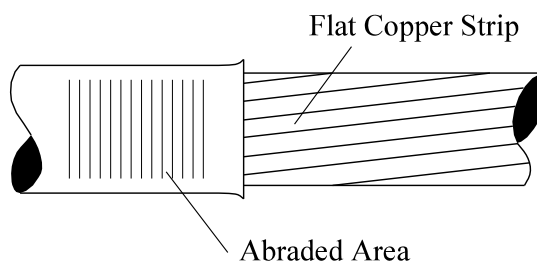


Fig 2

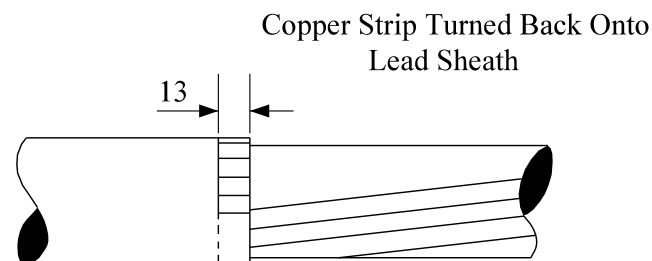


Fig 3

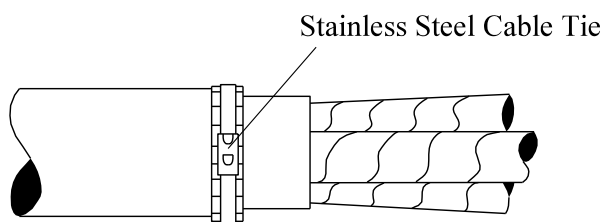
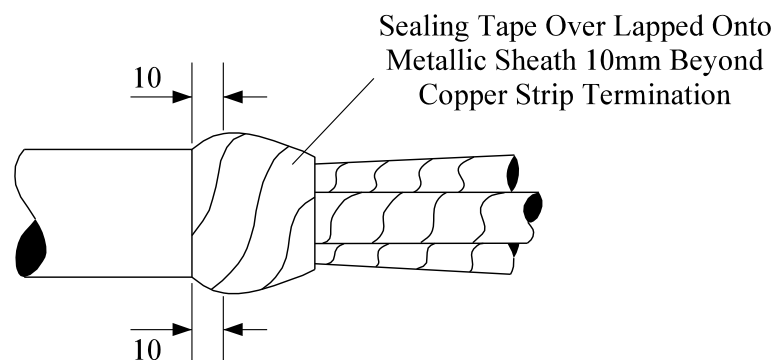



Fig 4



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GENERAL REQUIREMENT 21

TERMINATION of COLLECTIVE SCREEN WIRES on 3 Core XLPE CABLES

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3 also your attention is drawn to the Use of Solvents given in General Requirement 1.

General

Some DNO's changed from PICAS cable to a three-core stranded aluminium conductor, conductor screen, XLPE insulation, easi-strip insulation screen, semi-conducting binder tape, collective copper wire screen and MDPE oversheath cable. With this design of cable the semi-conducting binder tapes should maintain electrical conductivity between each insulation screen and the copper wire metallic screen.

21.1 Method of Installation

Refer to Drawing GR2D 6.21.1 whilst undertaking this General Requirement.

1. Having removed the MDPE oversheath at the designated position.
2. Apply a 20 swg wire binder around the collective copper wire screen wires 70mm up from the oversheath termination.
3. Fold the screen wires back on themselves so that they are laying back from where they came from.
4. Apply a 20 swg binder around the collective copper wire screens 50mm up from the oversheath termination.
5. Form the collective copper screen wires into a single bundle at the wire binder applied in 4.
6. Thoroughly clean the oversheath sheath with an approved degreaser.
7. Apply with light tension two half lap layers of Scotch 5313 black mastic water blocking tape 10mm over the MDPE oversheath and 10mm onto the semi conducting binding tape/collective screens.
8. Ensure the collective copper wire screens and the semi-conducting screens are grease free, cleaning with an approved degreaser.
9. Start at the binder applied in 4 apply 2 layers of 50% overlap of Scotch 13 tape to the collective copper wire screens and apply the tape with a moderate tension, see – Fig 1.

10. Once clear of the outer diameter of the collective copper wire screens apply sufficient lapped turns to form a tapered profile, to the semi-conducting screens of the three cores, see – Fig 2.
11. Overlap the semi-conducting screens by 20mm ensuring a minimum of two layers coverage, see – Fig 3.
12. Finish on the semi-conducting screen area applying the last turn with zero stretch, press down and hold to avoid lifting, fusing will then take place, cut and trim tape.

All dimensions in mm

Fig 1

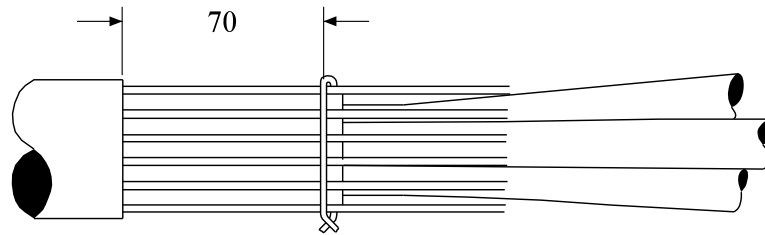


Fig 2

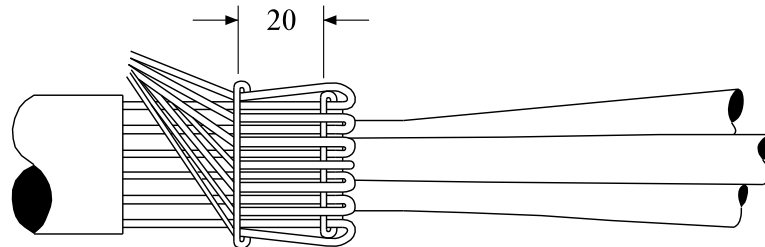
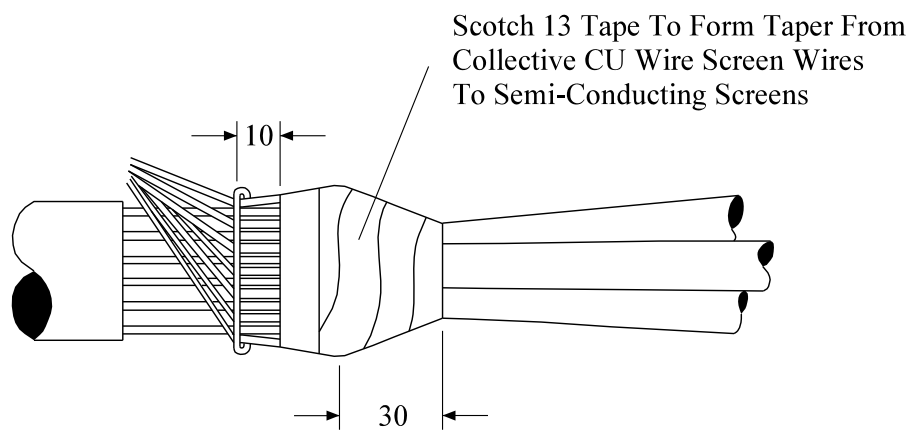



Fig 3



Note:- Application To PILC And PISAS Cables Also As Shown

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GENERAL REQUIREMENT 22

TERMINATION OF BELT PAPER INSULATION

Before commencing the level of PPE required for the operation shall be as the matrix given in General Requirement 3.

1 General

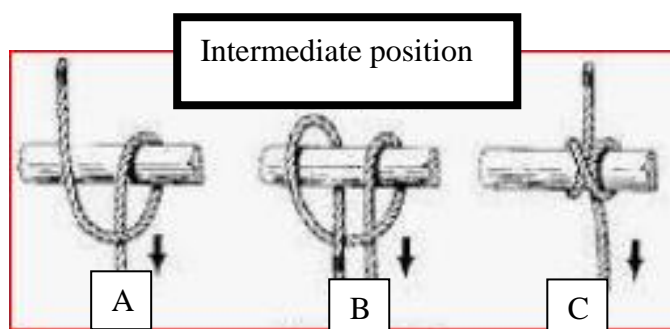
KINDLY NOTE: - When tying off any belt or phase papers on the 11kV system jute string or whipping thread shall only be used, **NO tapes of any form or type shall be used.**

Modern three-core belted cables incorporate a carbon paper over the belt papers, this applies to all PICAS and PISAS and also to some lead sheathed designs of cables, earlier designs of lead sheathed cables can be found without the carbon paper.

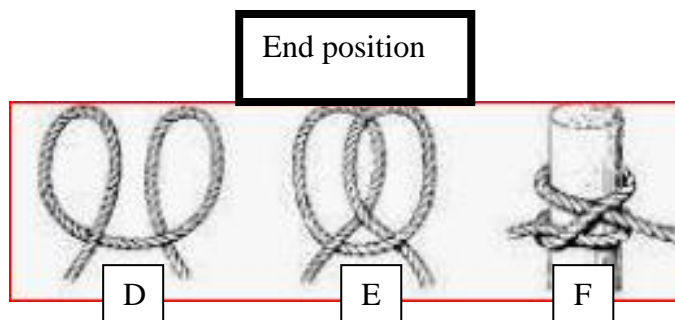
Removal of the carbon and belt paper insulation must be carried out with care, damage to the belt insulation in the form of splits or cuts during the jointing process will cause electrical stress at this critical point, which may result in failure.

2 Tying off Whipping Thread or Jute String

If tying a clove hitch at an intermediate position on a cable, then with a length of jute string or whipping thread of sufficient length, wrap whipping thread around the cable as shown in figure A, being sure to cross over the top of the whipping thread. Loop the whipping thread around the cable being sure to bring the leading end of the whipping thread through the newly created loop as shown in figure B. Pull the whipping thread tight, as shown in figure C, and tie off the whipping thread using a reef knot.



If tying a clove hitch at the end of a cable, then with a length of jute string or whipping thread of sufficient length, put two loops into the whipping thread as shown in figure D this should then give you the configuration as shown in figure E, slip this configuration over the end of the core and slide down to the requisite position as shown in figure F and pull the whipping thread tight and tie off using a reef knot. Figures D, E and F are shown overleaf.



3 Method of Removal

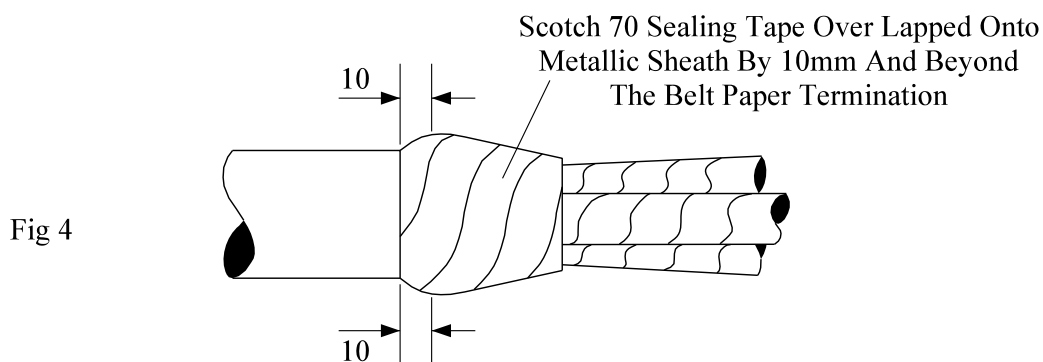
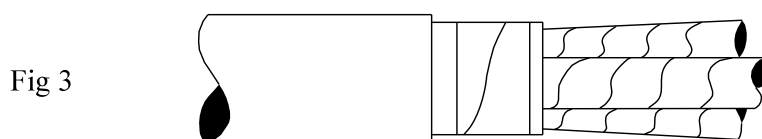
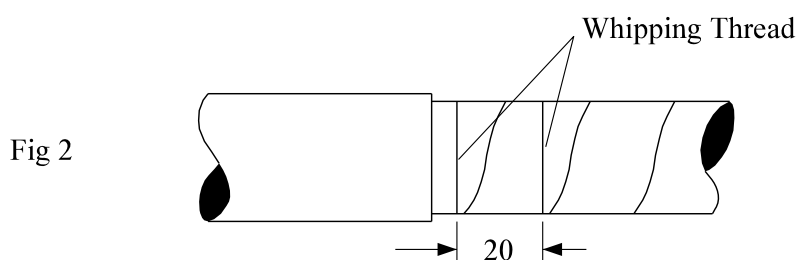
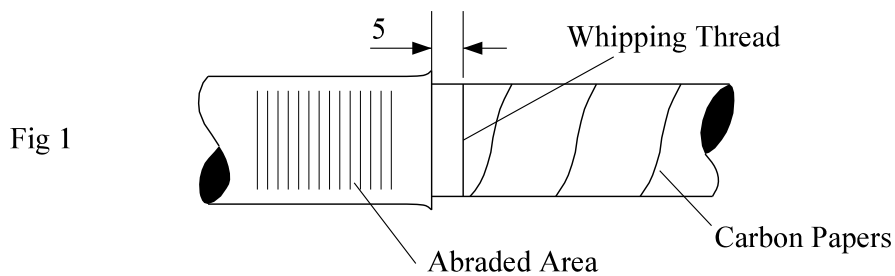
Refer to Drawing GR2D 6.22.1 whilst undertaking this General Requirement.


1. Apply a whipping thread binder over the carbon paper (if present) 5mm from the metallic sheath termination.
2. Unwrap the carbon paper and remove tearing against the whipping thread binder.
3. Apply a whipping thread binder over the belt papers 20mm from the metallic sheath termination.
4. Taking each belt paper in turn unwrap and remove tearing against the whipping thread binder.

Note: - Belt paper insulation must not be cut using a knife or other implement.

5. Apply the 3M Scotch 70 silicon self-fusing rubber electrical tape seal at the crotch position General Requirement 24. **Note:** - The only reason this Scotch 70 tape is applied to the metallic sheath is to prevent the Lovisil draining out of the joints inner sleeve and into the cable. This is especially true with PICAS cables as the PICAS cable is only 50% filled with MIND compound.
6. Pull out and cut off the outer and centre core fillers close to the belt paper termination.

All dimensions in mm



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GENERAL REQUIREMENT 23

TERMINATION OF COPPER WOVEN COTTON TAPES ON SCREENED CABLES

Before commencing the level of PPE required for the operation shall be as the matrix given in General Requirement 3.

General

Modern three-core screened cables the three cores are laid up and then a metalized cotton binder tape over the all three cores; this applies to all PICAS and PISAS and also to some lead sheathed designs of cables.

Removal of the metalized cotton binder tape must be carried out with care, damage to the metalized screen papers in the form of splits or cuts during the jointing process will cause electrical stress at this critical point, which may result in failure.

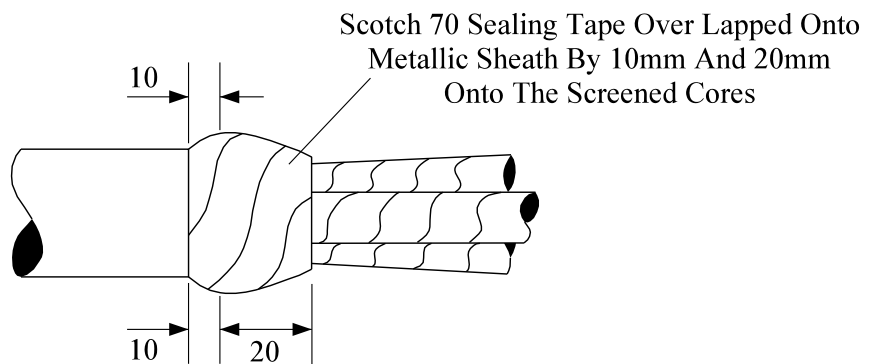
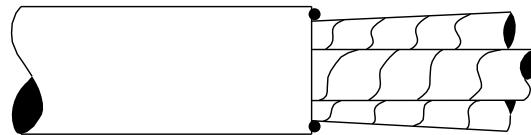
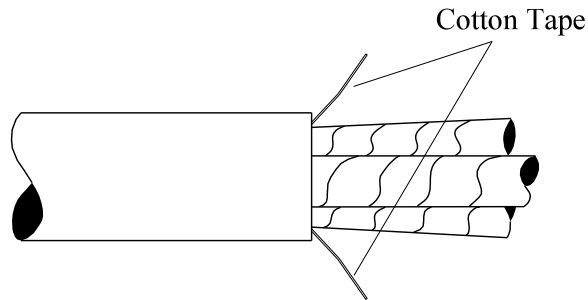
23.1 Method of Removal


Refer to Drawing GR2D 6.23.1 whilst undertaking this General Requirement.

- 1.1 Unwind the copper woven fabric tape and cut off at the termination of the metallic sheath.
- 1.2 Pull out and cut off the outer and centre core fillers close to the copper woven fabric tape.
- 1.3 Apply the 3M Scotch 70 silicon self-fusing rubber electrical tape for a distance of 10mm on the metallic sheath and 20mm from the metallic sheath, see GR2D 6.23.1, on to the metalized screens of the three cores thus forming a seal at the crotch position as detailed in General Requirement 24.

Note: - The only reason this Scotch 70 tape is applied to the metallic sheath is to prevent the Lovisil draining out of the joints inner sleeve and into the cable. This is especially true with PICAS cables as the PICAS cable is only 50% filled with MIND compound.

All dimensions in mm



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GENERAL REQUIREMENT 24

SEALING OF METALLIC SHEATHS WITHIN JOINTS (Lovink)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

To prevent the possible migration of silicon compound (Lovisil) within Lovink joints, a seal is to be placed at the termination point of the metallic sheath.

3M Scotch 70 Self-Fusing Silicone Rubber Electrical Tape is to be used, the tape being compatible with the silicon compound and has the added advantage of providing a support to the belt papers during and after jointing, and to prevent the Lovisil draining out of the joints inner sleeve and into the cable. This is especially true with PICAS cables as the PICAS cable is only 50% filled with MIND compound, **no other tape is to be used in this critical area.**

All cable types with a metallic sheath of either lead or aluminium will require this seal.

When applying this tape DO NOT over tension the tape, when over tensioned it will fail.

24.1 Method of Application

Refer to Drawing GR2D 6.24.1 whilst undertaking this General Requirement.

- 1.1 Ensure the metallic sheath is grease free cleaning with an approved degreaser, dry wipe the belt papers.
- 1.2 Start with the sealing tape butted to the metallic sheath and with the lay of the belt papers apply the tape with a moderate tension – Fig 1.
- 1.3 Apply sufficient lapped turns to form a tapered profile, from the outer diameter of the metallic sheath to the belt paper termination – Fig 2.
- 1.4 Overlap the metallic sheath by 10mm ensuring a minimum of two layers coverage – Fig 3.
- 1.5 Finish on the belt paper area applying the last turn with zero stretch, press down and hold to avoid lifting, fusing will then take place, cut and trim tape.

All dimensions in mm

Fig 1

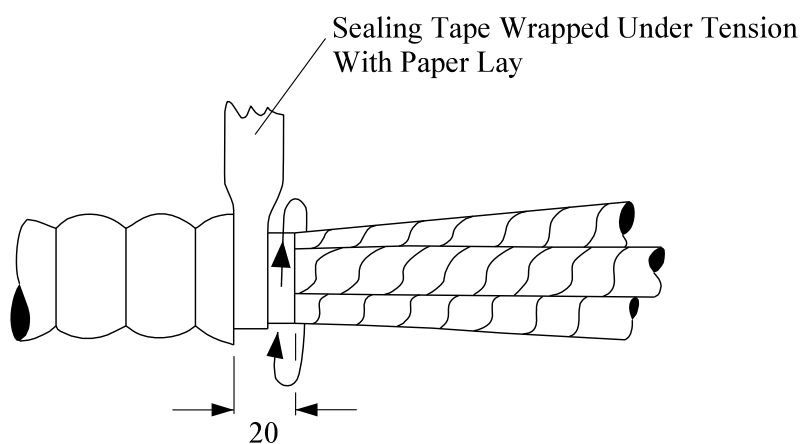


Fig 2

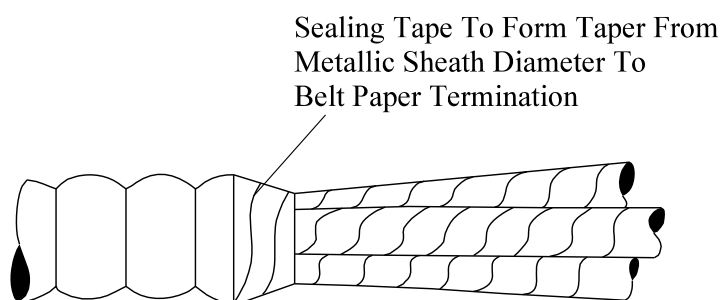
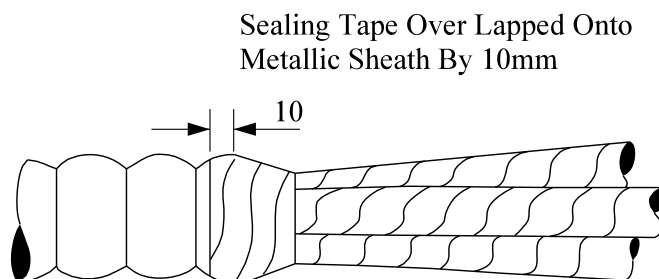



Fig 3



Note:- Application To PILC And PISAS Cables Also As Shown

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GENERAL REQUIREMENT 25

ALIGNING CORES AND CROSSING

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

On all joints, the following procedure must be adopted to ensure correct alignment and spacing of cores. Ensure the cables are in line, straight and level, it is important that this position is maintained throughout the procedure of core alignment and jointing.

Ease the cores to be jointed into their correct positions, taking care not to bend the cores too sharply as this will cause damage, when the cores are aligned they should be level and straight over the length of the mechanical connector and its insulation.

At this stage the cores will overlap by approximately 150mm. The cores are then cut in the manner described in General Requirement 29.

Note: - This General Requirement only applies to Single core and Triplex EPR / XLPE cable.

25.1 EPR / XLPE Straight Joints

All crossing of the cores shall be undertaken on the triplex EPR / XLPE clear of the joint position.

25.2 EPR / XLPE Branch Joints

All crossing of the cores shall be undertaken on the triplex EPR / XLPE clear of the joint position.

25.3 EPR / XLPE Loop Joints

All crossing of the cores shall be undertaken on the triplex EPR / XLPE clear of the joint position.

25.4 EPR / XLPE Cable Boxes

All crossing of the cores shall be undertaken on the triplex EPR / XLPE below the cable box base plate.

25.5 EPR / XLPE Outdoor Terminations

All crossing of the cores shall be undertaken on the triplex EPR / XLPE below the cable cleat attached to the crucifix.

25.6 Transitional Straight Joints

All crossing of the cores shall be undertaken on the triplex EPR / XLPE side of the joint and clear of the joint position.

25.7 Transitional Branch Joints

All crossing of the cores shall be undertaken on the triplex EPR / XLPE side of the joint and clear of the joint position.

25.8 Transitional Loop Joints

All crossing of the cores shall be undertaken on the triplex EPR / XLPE side of the joint and clear of the joint position.

GENERAL REQUIREMENT 26

TEMPORARY SPREADERS

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

Spreaders are available in a variety of sizes and their purpose is to hold the cores of paper-insulated cables in position during jointing.

The spreaders shall be positioned as required in individual jointing procedures and shall be tied in place with varnish nylon tape or other forms, which do not cause damage to the paper insulation.

Unless otherwise stated, spreaders are temporary and should be removed on completion of jointing.

GENERAL REQUIREMENT 27

REMOVAL OF METALLIC SCREENS (PAPER CABLES)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

Paper insulated 11kV cables other than the belted type are manufactured with a metallic screen on each core; the metallic screen effectively makes each core a single core within the lead sheath. Electrical stress patterns at the metallic screen termination if not controlled will result in cable failure.

Metallic screens are manufactured from either a metallized paper or foil (copper or aluminium), normally a identification paper (numbered) is either woven into the metallic screen layers or laid up underneath the metallic screen. Cables made after the introduction of metrification will have a layer of carbon papers between the metallic screen and insulation papers.

It is essential that the metallic screens along with the carbon papers are terminated at the correct distance as given in the Jointing Procedure, and a stress cone applied at its termination point as given in General Requirement 34.

Method of Removal

Refer to Drawing GR2D 6.27.1 whilst undertaking this General Requirement.

27.1 Overlapped Ends

- 1.1 Apply two turns of 20 swg tinned copper binder at the metallic screen termination point.
- 1.2 Unwind each metallic screen and tear off at the termination point against the tinned copper binder.

Note: - To help the metallic screen to tear, place the blade of a sharp knife flat on the core, slide the point under the screen edge, nick and lift the screen away from the core.

- 1.3 Unwind the identification paper, carbon paper(s) (if present) and two conductor papers in turn, tearing against the tinned copper binder.
- 1.4 Once the tinned copper binder has been removed smooth the metallic screen edge carefully down with a wedge.

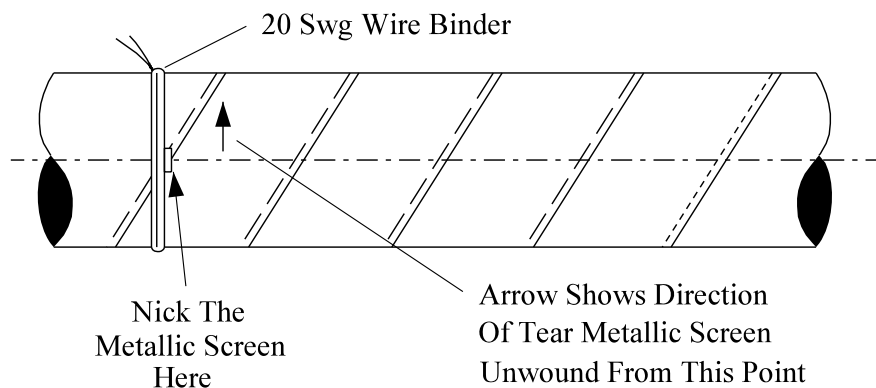
27.2 Under-lapped Ends

- 2.1 Apply two turns of 20 swg tinned copper binder at the metallic screen termination point.
- 2.2 Nick the edge of the metallic screen by placing the blade of a sharp knife flat on the core, slide the point under the screen edge, nick and lift the screen away from the core.
- 2.3 Lift the point made by the nick in the screen edge and tear against the tinned copper binder and unwind to the core end.
- 2.4 Unwind the identification paper, carbon paper(s) if present and two insulation papers in turn tearing against the tinned copper binder.
- 2.5 Once the tinned copper binder has been removed smooth the metallic screen edge down carefully with a wedge.

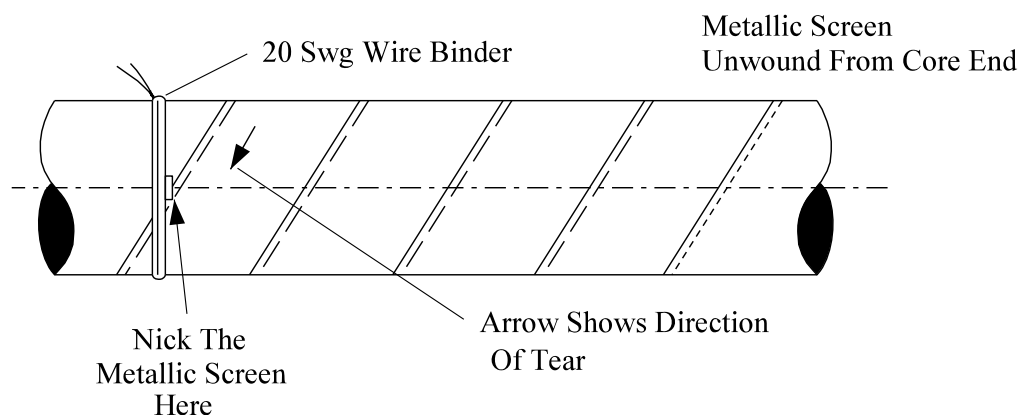
Note: - On no account must the knife be used with the blade towards the core; cuts in the insulation will result in failure.

All dimensions in mm


Underlapped Edge



Overlapped Edge



Note:- The Knife Blade Must Be Kept Flat To The Metallic Screen And Turned Away From The Mataltic Screen When Forming The Nick
Any Cut In The Underlying Insulation Will Result In A Failure At This Position

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GENERAL REQUIREMENT 28

REMOVAL OF SEMI-CONDUCTING SCREENS (POLYMERIC CABLES)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents General Requirement 1.

28.1 General

There are two types semi-conducting screens used on polymeric cables, fully bonded and easi-strip. Virtually all polymeric cables used within WPD South have the easi-strip semi-conducting screen. While WPD Midlands have large amounts of easi-strip and fully bonded semi-conducting screens. The method described here is for the removal of the easi-strip semi-conducting screen, which requires basic but effective tooling and relative ease of removal to the installer.

Cable manufacturers currently supply two types of semi-conducting screen; both manufacturing methods can produce either easi-strip or fully bonded. With easi-strip semi-conducting the material it's important to have a compound such as ethylene vinyl acetate (EVA) which is strippable from the insulation. In order for strippable screens to have sufficient tear strength during the removal from the insulation, it is necessary for the thickness to be approximately 1mm but the screen thickness can be thinner for harder materials. There are no such constraints with bonded screens and because the semi-conducting materials are very expensive, thickness is kept to a minimum, 0.5mm being a typical figure.

The manufacturing methods are described as: -

- Monasil – identified by its smooth appearance.
- CCV (Continuous Catenary Vulcanising) – identified by its heavily ribbed appearance and characteristic acetophenone odour.
- VCV (Vertical Catenary Vulcanising) – identified by its heavily ribbed appearance and characteristic acetophenone odour.

28.2 Easi-strip Semi-conducting Screens

Note: - The method described below shall be **THE ONLY APPROVED METHOD ADOPTED FOR USE within WPD for the removal of the easi-strip semi-conducting screens.**

This phase of the jointing procedure must be undertaken with utmost care throughout this operation, failure to do so can be the cause or be a contributory factor in the failure of the joint or termination.

Cleanliness and attention to detail are vital, it is essential to avoid damaging the insulation at the semi-conducting screen termination, and any cuts or voids etc. will lead to the premature failure of the joint or termination.

2.1 Method of Removal

Refer to Drawing GR2D 6.28.1 whilst undertaking this General Requirement.

- 2.1.1 Mark the semi-conducting screen at its termination point with a white Chinagraph pencil.
- 2.1.2 Using PVC tape, apply (sticky side outermost for one complete turn) around the circumference of the cable at its termination point apply sufficient turns to provide a straight and square edge to guide the Abra file – Fig 1.
- 2.1.3 Using the Abra file with medium pressure, file evenly around the semi-conducting screen until the conductor insulation just shows – Fig 2.

Note: - The insulation must be seen continuously around the cable otherwise the semi-conducting screen may be lifted below its termination point.

- 2.1.4 Use a mirror to check the underside of the cable; there should be a smooth neat chamfer on what will be the remaining circumferential edge.

Note: - Where raggedness of the termination appears, run the Abra file with light pressure to remove high points; take care not to damage the insulation.

Ribbing of the semi-conducting screen may be removed by gently warming with a gas torch until the semi-conducting screen achieves a smooth surface.

- 2.1.5 Using the correct depth guarded knife (0.4mm for Prysmian 11kV & 0.6mm for Tratos 11kV cables) and starting just above the circumferential termination point make longitudinal scores spaced approximately 120° along the core length to its end – Fig 3.

Note: - Depending on cable size the three longitudinal scores may be reduced, two being the minimum otherwise undue stress is applied to the installers hands and cable.

Where there is extreme difficulty of drawing the depth guarded knife from the circumferential termination point to the cable end, and providing a cable tie is placed around the circumferential termination point to protect the shown insulation, the cable may be scored from the open end towards the circumferential termination point.

Utmost care must be given if using this alternative method, damage at the semi-conducting screen termination point will result in failure.

- 2.1.6 Lift the semi-conducting screen at the open cable end and peel back the strips to completely remove – Fig 4.
- 2.1.7 Using aluminium oxide tape abrade the exposed insulation ensuring a smooth finish along its length and at the semi-conducting chamfer (any ribbing within the surface of the insulation must be abraded out to a smooth finish).

Note: - 400 grit is normally sufficient to provide this finish, but a start with 320 grit and finishing with 400 grit may be required.

- 2.1.8 Using an approved degreaser and white wipes, remove all traces of the semi-conducting screen wiping from the cable end towards the termination point.

Note: - After each run change the wipe otherwise contact with semi-conducting material will come into contact with the insulation leaving possible tracking traces.

- 2.1.9 Finally remove the PVC tape applied in 2 and thoroughly check the insulation along its complete length ensuring its contamination free – Fig 5.

28.3 Fully Bonded Screens

This phase of the jointing procedure must be undertaken with utmost care throughout this operation, failure to do so can be the cause or be a contributory factor in the failure of the joint or termination.

Cleanliness and attention to detail are vital, it is essential to avoid damaging the insulation at the semi-conducting screen termination, and any cuts or voids etc. will lead to the premature failure of the joint or termination.

Note: - The stripping tool which has been supplied to all the Midlands Jointers is designed for bonded screen cables ONLY and shall NOT BE USED on any EPR or XLPE EASI-STRIP CABLES.

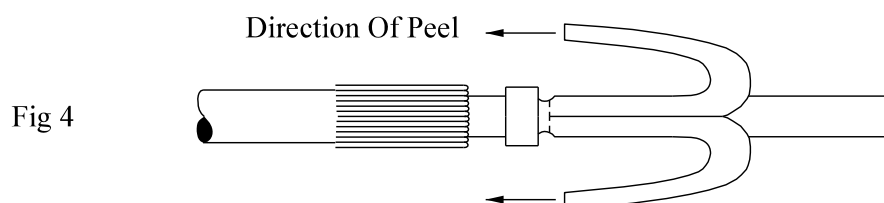
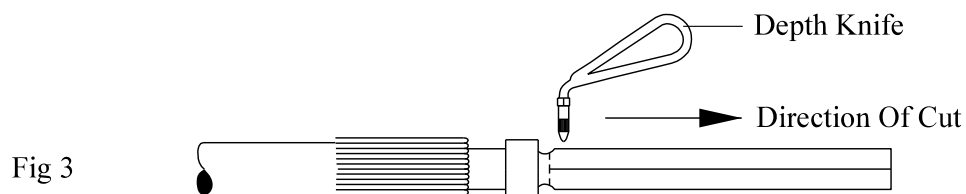
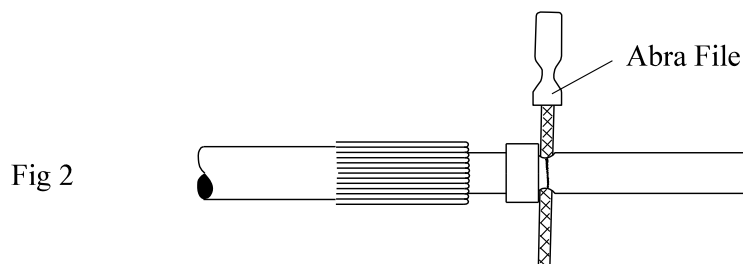
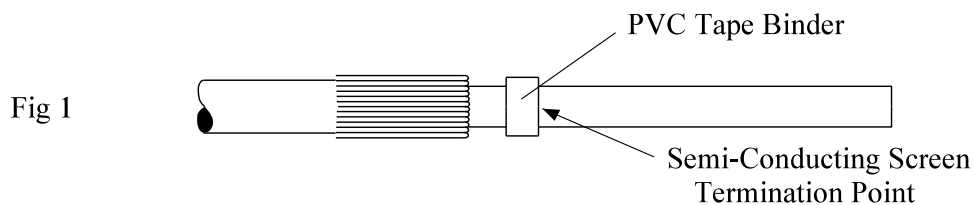
3.1 Method of Removal

Refer to Drawing GR2D 6.28.2 whilst undertaking this General Requirement.


- 3.1.1 Mark the semi-conducting screen at its termination point with a white Chinagraph pencil.
- 3.1.2 Ensure the cable is straight.
- 3.1.3 Close up the tool jaws using the large, black plastic knob marked by a red arrow, to provide a firm grip that will still allow the tool to rotate. At this stage, the button marked by a blue arrow should be in the FRONT position, as shown in Fig 1 of GR2D 6.28.3.
- 3.1.4 Lubricate the surface of the semiconducting screen with Silicone grease. This will allow easier rotation of the tool and a better finish.
- 3.1.5 Position the cutter at the front edge of the screen and set the depth of cut using the small metal knob marked by a green arrow, as shown in Fig 2 of GR2D 6.28.3. The adjustment is anticlockwise to increase the depth of cut, clockwise to decrease. Each click is 0.1mm. If necessary, practice on a scrap piece of cable to obtain the correct depth setting.

- 3.1.6 With the correct depth set, move the button marked by a blue arrow from the FRONT towards the SIDE position – the exact position of this button will depend upon the core diameter (larger sizes need a smaller button movement towards the side), as shown in Fig 3 of GR2D 6.28.3. Now rotate the whole tool using the rear handle – as the tool is rotated it will move progressively down the cable, peeling the screen. Do not apply excess pressure. The selected depth setting should produce a clean, smooth cut free of black semi-conducting material.
- 3.1.7 When the required screen termination position is reached, rotate the button marked by the blue arrow to the FRONT position, as shown in Fig 4 of GR2D 6.28.3. to stop the tool moving down the cable. Continue to rotate the tool until a clean cut screen edge is produced. Open the jaws and remove the tool on completion.
- 3.1.8 After the tool is removed, examine the surface of the insulation to ensure all semi-conducting layer has been removed.
- 3.1.9 Using aluminium oxide tape abrade the exposed insulation ensuring a smooth finish along its length and at the semi-conducting chamfer (any ribbing within the surface of the insulation must be abraded out to a smooth finish).
- Note:** - 400 grit is normally sufficient to provide this finish, but a start with 320 grit and finishing with 400 grit may be required.
- 3.1.10 Using an approved degreaser and white wipes, remove all traces of the semi-conducting screen wiping from the cable end towards the termination point.

All dimensions in mm



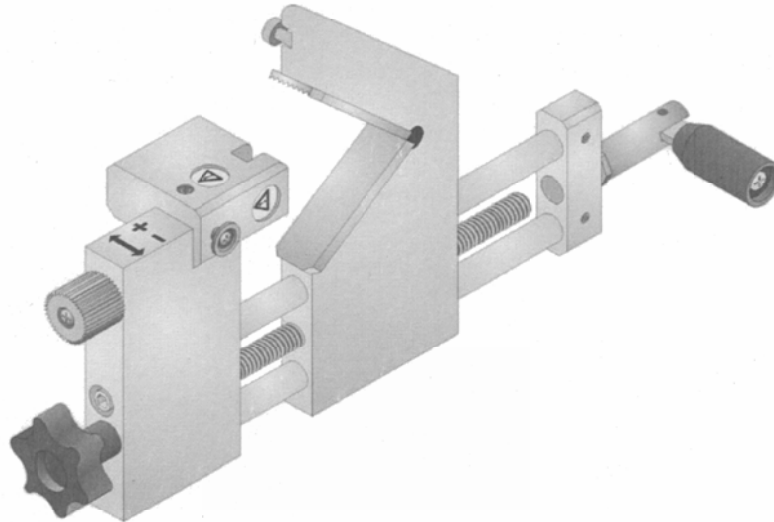
Note :- This Method Is For Easy Strip Screens Only

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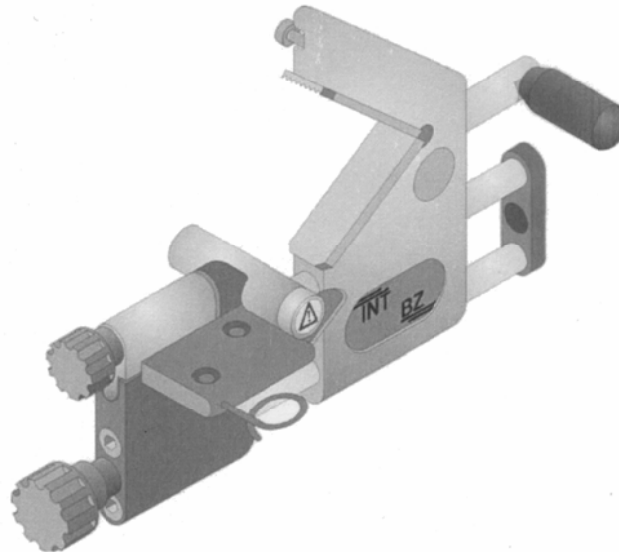
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All dimensions in mm

Stripping tool used by Central Networks in the East



Stripping tool used by Central Network in the West and by some contractors



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All dimensions in mm

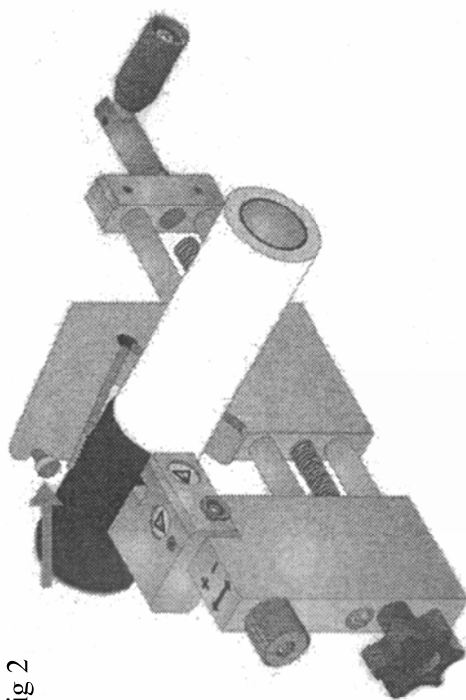


Fig 2

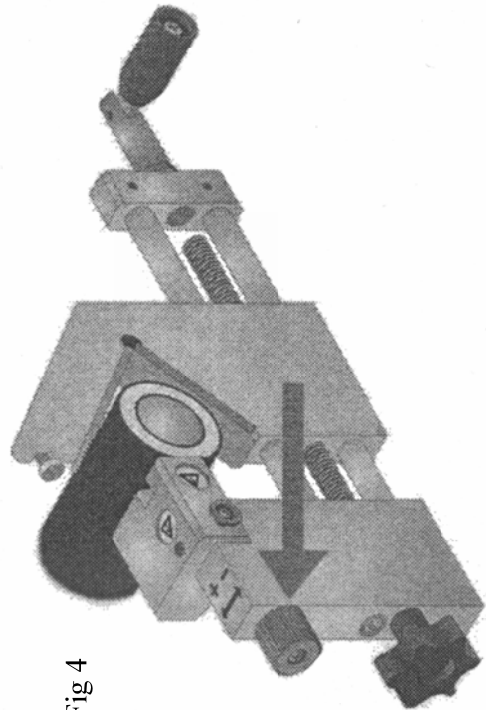


Fig 4

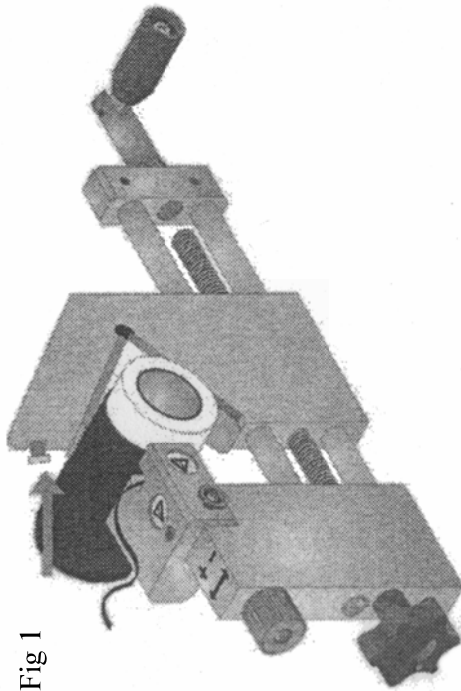


Fig 1

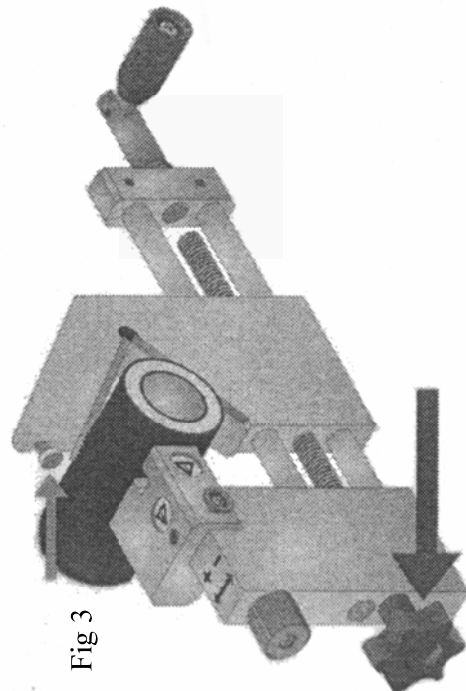


Fig 3

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GENERAL REQUIREMENT 29

TERMINATION OF COPPER TAPE SCREENS ON 3 CORE, XLPE, SWA CABLE

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents given in General Requirement 1.

General

With 3 core constructions of XLPE cable, the application of copper tape screen around each easi-strip semi-conducting screened core is more common. By the use of polypropylene strings to fill the gaps between the laid-up cores, the cable is formed into a circular shape over which is extruded a bedding sheath. The cable is then completed by the use of either steel wire or steel tape armour and an extruded oversheath.

Method of Removal

Refer to Drawing GR2D 6.29.1 whilst undertaking this General Requirement.

29.1 Overlapped Ends

- 1.1 Ensure you have sufficient core available to complete the accessory.
- 1.2 Apply two turns of 20 swg tinned copper binder at the metallic screen termination point.
- 1.3 Unwind each metallic screen and tear off at the termination point against the tinned copper binder.

Note: - To help the metallic screen to tear, place the blade of a sharp knife flat on the core, slide the point under the screen edge, nick and lift the screen away from the core.

- 1.4 Once the tinned copper binder has been removed smooth the metallic screen edge carefully down with a wedge.

29.2 Under-lapped Ends

- 2.1 Ensure you have sufficient core available to complete the accessory.
- 2.2 Apply two turns of 20 swg tinned copper binder at the metallic screen termination point.
- 2.3 Nick the edge of the metallic screen by placing the blade of a sharp knife flat on the core, slide the point under the screen edge, nick and lift the screen away from the core.

- 2.4 Lift the point made by the nick in the screen edge and tear against the tinned copper binder and unwind to the core end.
- 2.5 Once the tinned copper binder has been removed smooth the metallic screen edge down carefully with a wedge.

Note: - On no account must the knife be used with the blade towards the core; cuts in the insulation will result in failure.

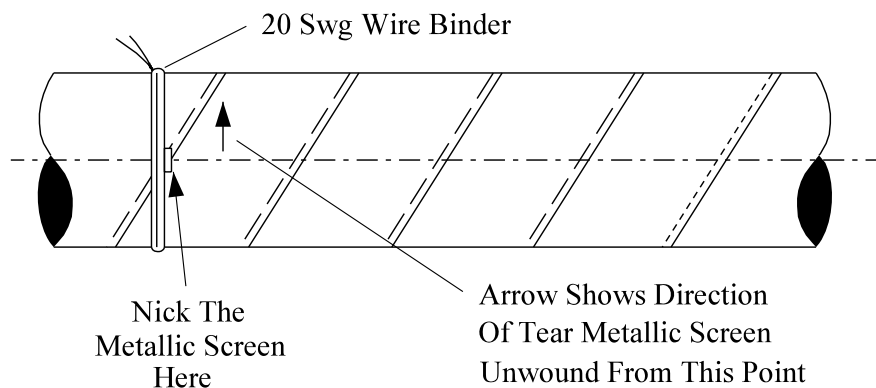
29.3 Application of Copper Braids

Refer to Drawing GR2D 6.29.2 and 6.29.3 whilst undertaking the application of the tinned copper braids.

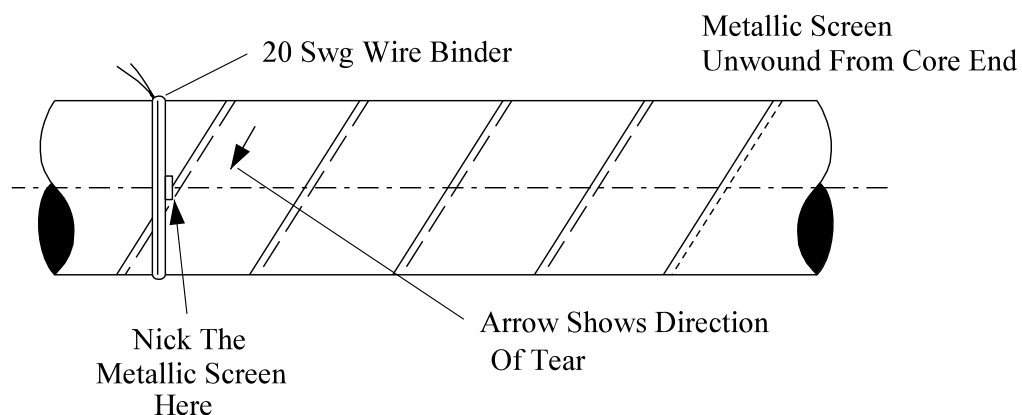
- 3.1 Using tinned copper braid E 5 No. 36802 from the van; cut a 300mm length from the roll. Open out the braid as in Figure 1 of GR2D 6.28.2.
- 3.2 Take one end of the braid and expand to the width of one core, once expanded 20mm from the end of the expanded braid open a hole in one side of the expanded braid, this hole should be large enough for the core to pass through the hole. See figure 2 of GR2D 6.29.2.
- 3.3 Slide the core through the hole in the braid and out the expanded end of the braid as I in Figure 3 of GR2D 6.29.2.
- 3.4 Position the end of the braid with the end of the termination of the copper tape screen, flattening the braid to the diameter of the core.
- 3.5 From the 3 core SWA XLPE module E 5 No. 43479 remove the roll spring and ensuring the braid and the end of the copper tape are level, apply the roll spring to the tinned copper braid. See Figure 4 of GR2D 6.29.2.
- 3.6 Apply two complete half lapped layers of 3M 88 tape, under moderate tension for a distance of 20mm up the tinned copper braid across the roll spring and on to the semi-conducting layer for a distance of 10mm. See Figure 5 of GR2D 6.29.2.
- 3.7 Once all three phase have been completed park up the Lovink the two three holed foam rings on to the semi-conducting layer, ensuring there is at least 50mm of clean semi-conducting material between the 3M 88 tape and the closest foam ring. Thus allowing good purchase of the two part polyurethane resin on to the semi-conducting screen thereby preventing a possible moisture path into the inner shell.

All dimensions in mm


Underlapped Edge



Overlapped Edge

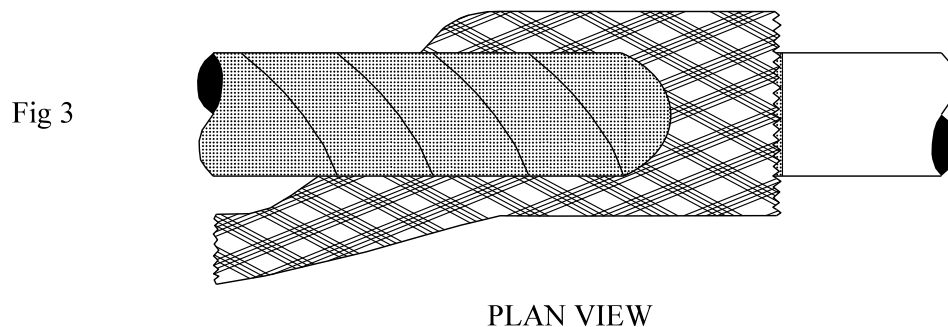
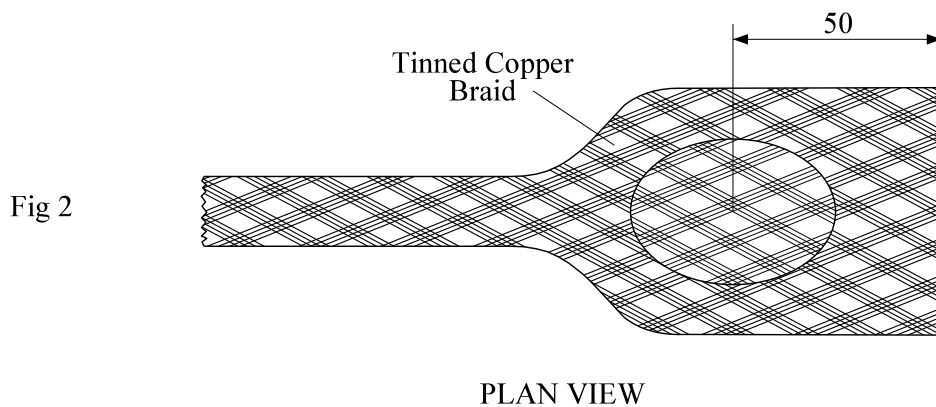
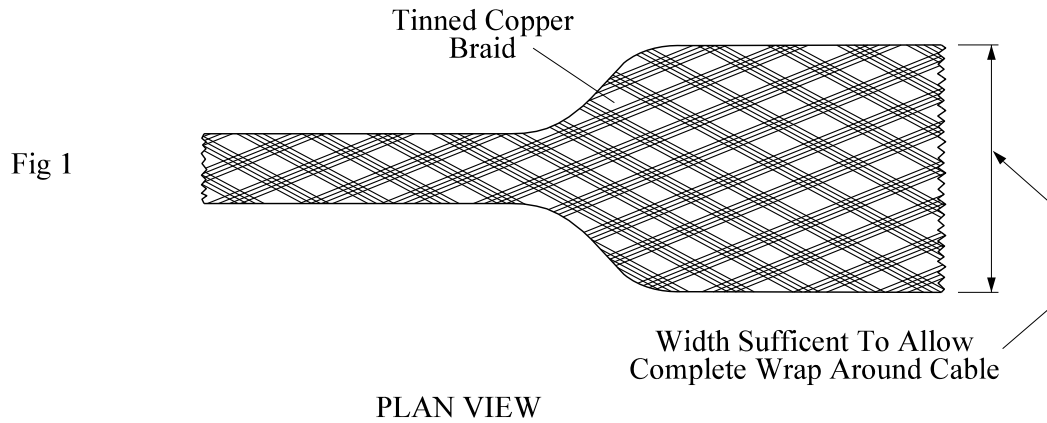


Note:- The Knife Blade Must Be Kept Flat To The Metallic Screen And Turned Away From The Mataltic Screen When Forming The Nick
Any Cut In The Underlying Insulation Will Result In A Failure At This Position

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Fig 4

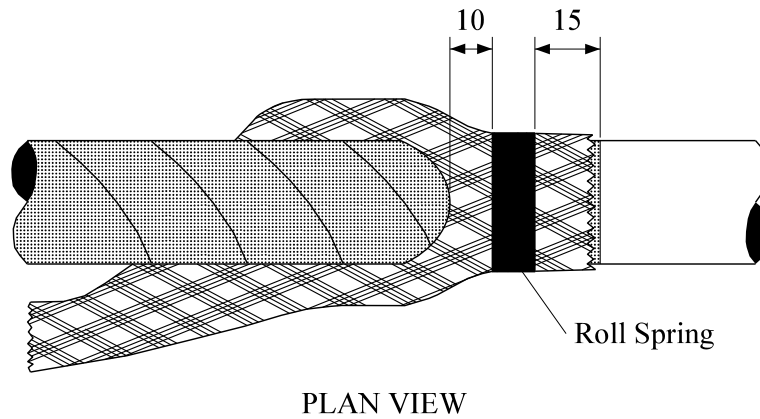


Fig 5

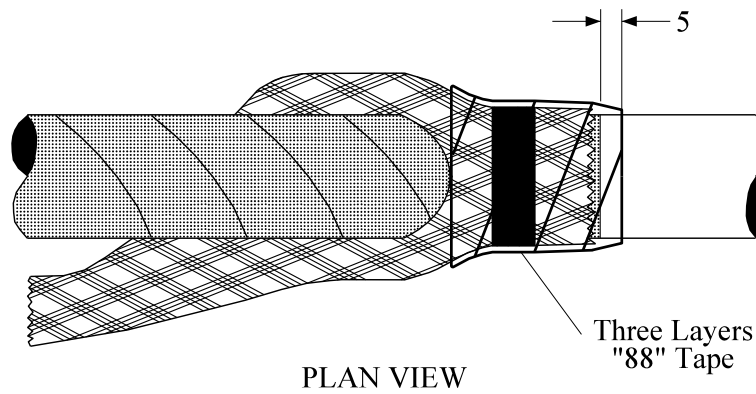
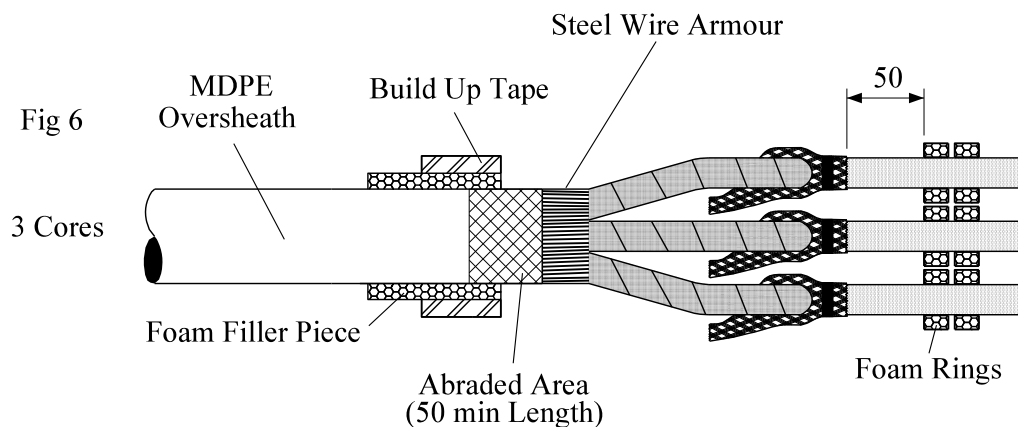


Fig 6



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Approved			TERMINATION OF COPPER TAPE SCREEN OF THREE CORE XLPE SWA CABLES		
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GENERAL REQUIREMENT 30

CUTTING CORES TO LENGTH

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

Due to the reduced internal length of the conductor entry and the closeness of the inner bolt to the conductor end, it is important the conductor is cut and inserted into its full entry length. This will only be achieved providing the conductor is cut square as opposed to the “arrowhead” shape, which occurs with the use of core croppers; therefore, a hacksaw shall be used. **Core croppers shall not be used.**

This procedure should ensure that all cores are correctly aligned and spaced and that the shear bolts of the shear bolt connectors are bearing onto the entire conductor.

30.1 Method of Removal

- 1.1 Mark the centre line of the shear bolt connector on each core.
- 1.2 Measure the depth of the water block or split barrel of the connector.
- 1.3 Take half of the measurement of the water block or split barrel and mark either side of the centre line applied in 1.
- 1.4 Using a hacksaw, cut through each of the marks applied in 3.

GENERAL REQUIREMENT 31

REMOVAL OF CONDUCTOR INSULATION

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents given in General Requirement 1.

General

There are three types of conductor insulation to be found on today's 11kV cables, paper, EPR (Ethylene Propylene Rubber) and XLPE (Cross Linked Polyethylene).

Methods of removal vary and are dependent on the cable type, but the care and principals required whilst removing, each type insulation, are of the same importance.

Damage to a conductor may lead to stress point or at worst a reduction in the cross-sectional area of the conductor, which in turn results in the cables inability to carry the required load (amperes).

Method of Removal

31.1 Paper

1.1 Apply a whipping thread binder 2mm behind the termination point.

1.2 Using a sharp knife make a circumferential cut around the core.

Note: - Ensure that the conductor is not made contact with whilst making the cut.

1.3 Using water pump pliers and working from the core end, carefully round the core up to the paper termination point.

1.4 Remove the paper insulation by unwinding and if required make a further circumferential cut.

Note: - The last few papers should not be cut but be torn against the previously removed paper termination.

1.5 Remove the remaining papers by tearing, and remove the impregnate from the conductor with a dry wipe.

31.2 EPR / XLPE Insulation

2.1 Adjust and set the depth stop to the required depth on the Prysmian supplied U8YR0BRMD1 insulation removing tool.

- 2.2 Apply the tool to the core and adjust the clamping screw until the tool is secure on the core, adjust the blade depth to a point where the conductor semi-conducting screen is just touched.
- 2.3 Rotate the tool in an anti-clockwise direction to remove the insulation.
- Note:** - Check to ensure the conductor is not being damaged during this operation due to incorrect setting of the depth of cut.
- 2.4 Once the depth stop engages the conductor end, slacken the clamping screw and remove the tool.
- 2.5 If any insulation or semi-conducting screen is not removed, using whipping thread as a garrotte at its termination point and with a sawing action cut through to the conductor.

Use a knife with the blade flat to the conductor and slice under and along the remaining insulation semi-conducting screen.

Note: - This method may be used, as an alternative if specialised tooling is not available.

GENERAL REQUIREMENT 32

BUILDING UP CABLES TO MATCH OUTER SLEEVE ENTRIES (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents given in General Requirement 1.

General

To build up the cable entries of the outer sleeve a self-amalgamating build up tape is used, this has two functions, to centralize the inner sleeve within the outer sleeve ensuring a uniform thickness of resin around the inner sleeve end, to prevent the migration of resin during filling and curing.

The build-up tape when applied should be bound under light tension and built to a diameter given by the calliper gauge of the appropriate joint size, should a small weep of resin appear during filling this might be blocked using putty.

Method of Application

32.1 EPR / XLPE Triplex Cables

Refer to Drawing GR2D 6.32.1 whilst undertaking this General Requirement.

- 1.1 Lay the three prepared cables in the foam filler piece; position the foam filler piece so that the internal end to the joint reference line is at the dimension given in the table overleaf, approximately 25mm of abraded MDPE oversheath should be showing.
- 1.2 Bind the full length of the foam filler piece using PVC tape; do not overlap the ends of the foam filler piece.
- 1.3 Apply the self-amalgamating build up tape under light tension in line with the internal of the foam filler piece, bind until the diameter is achieved using the calliper gauge appropriate to the joint size.

32.2 PICAS / PISAS / PILC and PILC / EPR / XLPE Single Core

- 2.1 Place a mark on the oversheath applicable to the dimension taken from the joint reference line given in the table 1 overleaf.
- 2.2 Apply the self-amalgamating build up tape under light tension in line with the mark applied in 2.1, bind until the diameter is achieved using the calliper gauge appropriate to the joint size.

32.3 3 CORE XLPE with COLLECTIVE COPPER WIRE SCREEN and 3 CORE XLPE, COPPER TAPE SCREEN, SWA.

- 3.1 Place a mark on the oversheath applicable to the dimension taken from the joint reference line given in the table 2 below.
- 3.2 Apply the self-amalgamating build up tape under light tension in line with the mark applied in 3.1, bind until the diameter is achieved using the calliper gauge appropriate to the joint size.

32.4 Table 1 - Standard Lovink Joints

Joint Type	K75	K85	K95	KB85/A	KB85/B	KB95/A	KB95/B
Straight	450	490	635	N/A	N/A	N/A	N/A
Branch	N/A	N/A	N/A	490	705	565	845
Stop End	450	490	635	N/A	N/A	N/A	N/A
Loop	N/A	N/A	N/A	N/A	705	N/A	845

Note: - Dimensions given within this table are taken from the reference line (centre line of connector) of the relevant Jointing Procedure to the internal edge of the grey self-amalgamating build up tape.

Branch/Loop joint dimensions: - A = Single End
B = Double End

32.5 Table 2 – Extended Lovink Joints

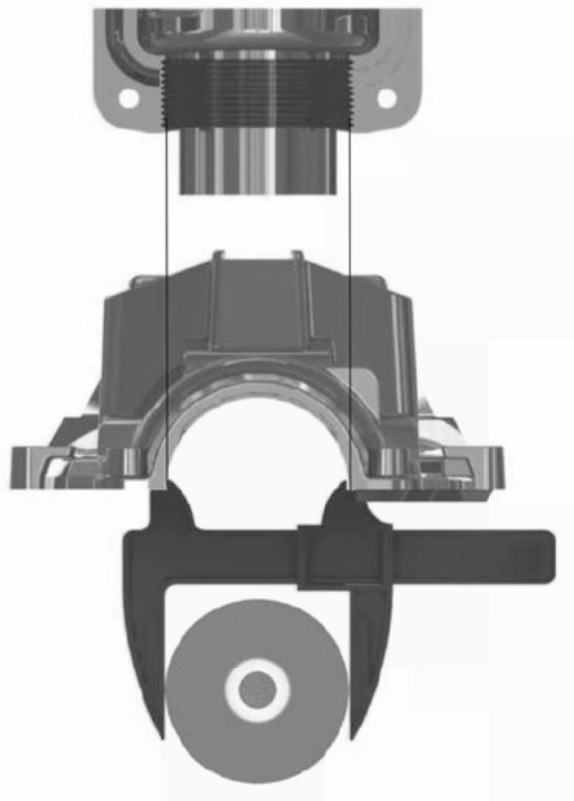
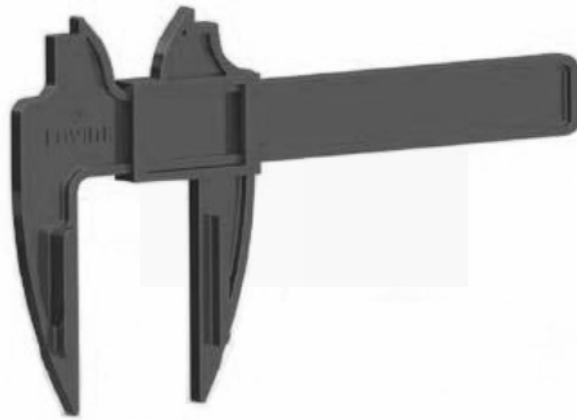
Joint Type	K85	K85 extended	K95	KB95 extended
Straight	490	640	635	785
Stop End	490	640	635	785


Joint Type	KB85/A	KB85/A extended	KB85/B	KB85/B extended	KB95/A	KB95/A extended	KB95/B	KB95/B extended
Branch	490	640	705	855	565	715	845	995
Loop	N/A	N/A	705	855	N/A	N/A	845	995

Note: - Dimensions given within this table are taken from the reference line (centre line of connector) of the relevant Jointing Procedure to the internal edge of the grey self-amalgamating build up tape.

Branch/Loop joint dimensions: - A = Single End
B = Double End

All dimensions in mm



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				BUILDING UP CABLES TO MATCH OUTER SLEEVE ENTRIES		GR2D 6.32.1	1

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GENERAL REQUIREMENT 33

USE OF BUILD UP TUBE MODULE (TYCO)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents given in General Requirement 1.

General

The standard range of the Tyco cold shrink Jointing System covers polymeric cable sizes 70/95 to 185mm² and 185 to 300mm².

Outside of these ranges it is necessary to use one or more build-up kits to supplement the standard joint range; the build-up kit contains a tube to increase the diameter of smaller cables, up to a size within the joints standard range.

Method of Installation

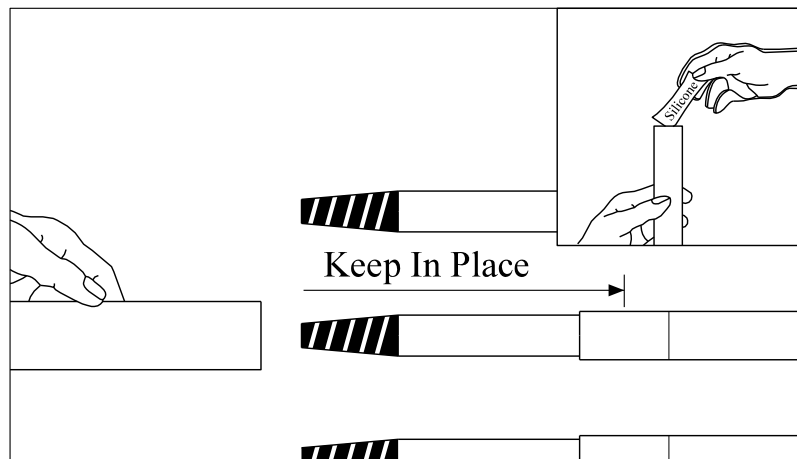
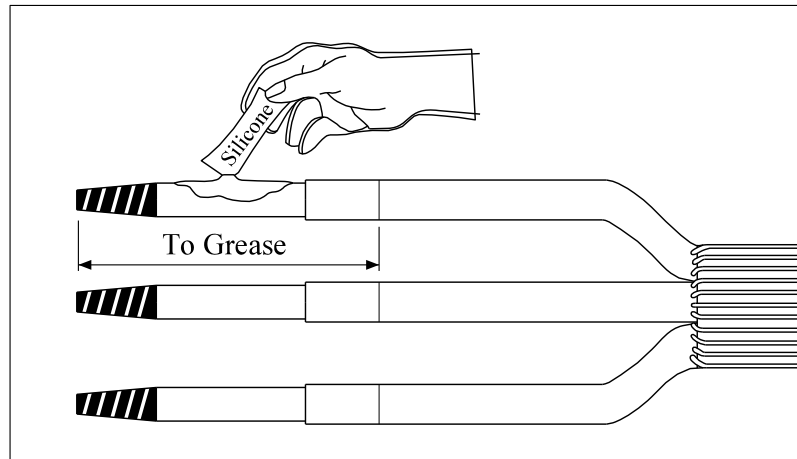
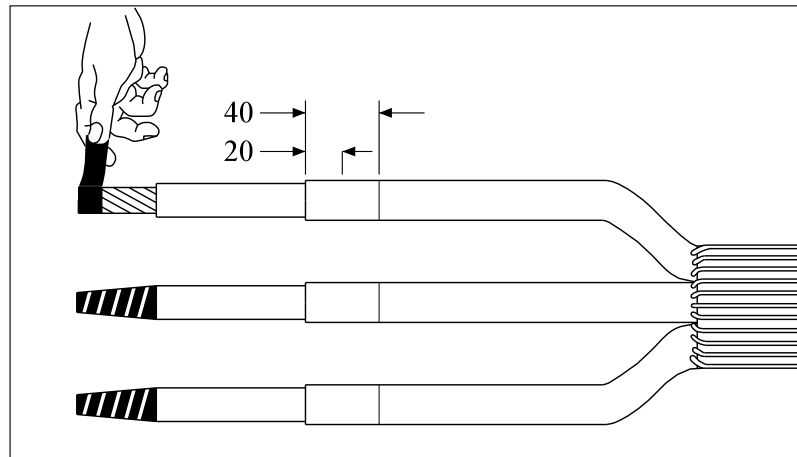
Refer to Drawing GR2D 6.33.1 and GR2D 6.33.2 whilst undertaking this General Requirement.

1. Remove the semi-conducting screens at the required positions.
2. Remove the phase insulation from the conductor as defined by the connector barrel.
3. Make a taper from the conductor to the diameter of the insulation on the core using PVC tape.
4. From the semi-conducting screen termination mark two reference lines on the semi-conducting screen one at 20mm from the screen termination and the other at 40mm.
5. Apply supplied grease into the end of the insulation tube, the taper and up to the 20mm mark on the semi-conducting screen.
6. Slide the insulation tube over the cone and down to the 20mm mark on the semi-conducting screen.
7. Trim the end of the insulation tube so that the tube is level with the core insulation, and remove the PVC insulation tape.
8. Starting at the 40mm reference mark apply two half lapped layers of semi-conducting tape applied with moderate tension, to a point 20mm onto the build-up tube.

Note: - Remove backing tape from the semi-conducting tape prior to application and ensure Semi-con writing is on the outside.

9. Clean and degrease the build-up tube, complete the joint to the relevant jointing procedure.

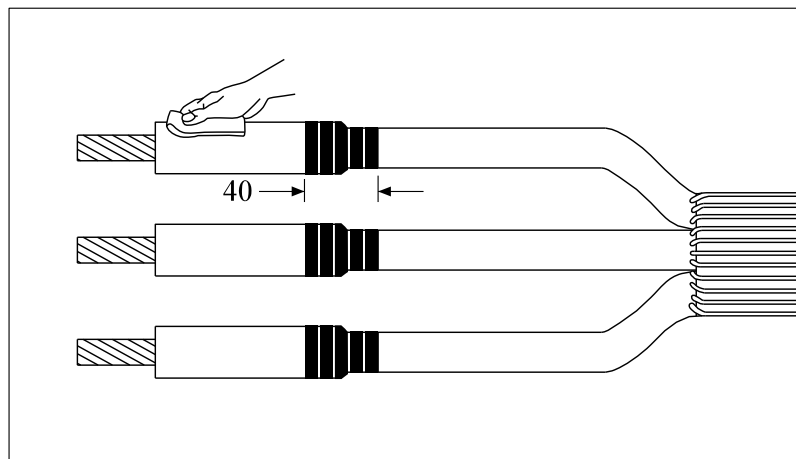
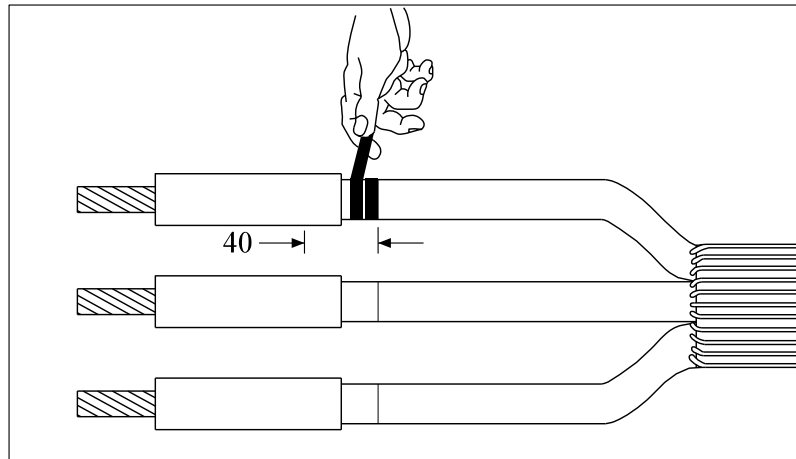
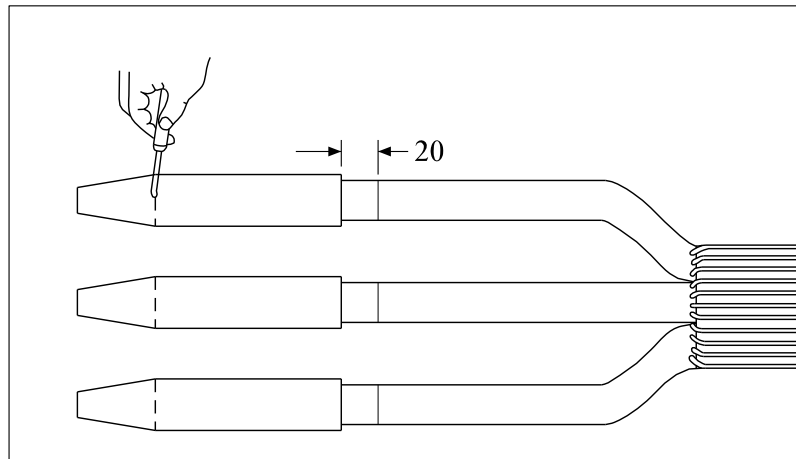
All dimensions in mm



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GENERAL REQUIREMENT 34

INSTALLATION OF FOAM RINGS (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in the General Requirement 3.

General

Foam rings are used within the inner sleeve of the Lovink system to provide centralisation, prevent the ingress of moisture and retain the Lovisil silicon oil insulating compound. Two types of rings are used. For the K series joints 2 foam rings are used to contain the Lovifit glue that is used to bond the inner shell together. For M series joints the foam rings can be installed after the phase connections are made. The M series joints do not need Lovifit glue and use 1 wide foam ring.

Certain cable sizes will require the use of foam tape in place of rings or where a smaller diameter ring is to be used in a larger joint size, the ring will require building up with foam tape. A build up gauge is available to ensure the foam tape is built to the correct diameter.

34.1 Installation Method

Refer to Drawing GR2D 6.34.1 whilst undertaking this General Requirement.

K Series Joints

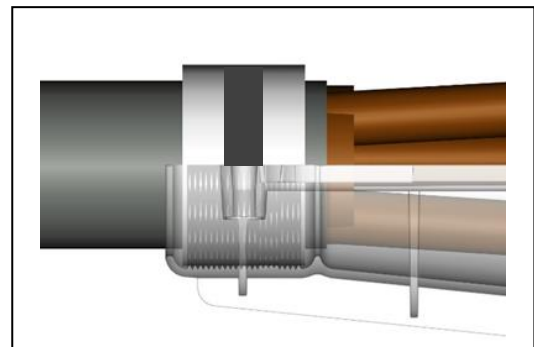
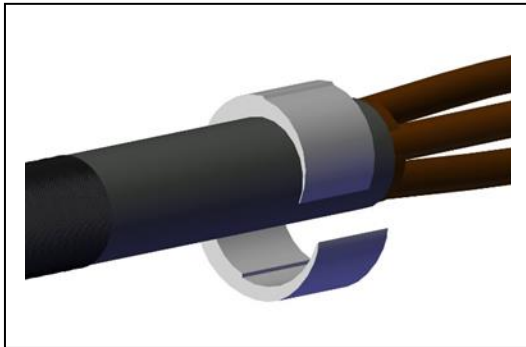
- 1.1 Select and remove the required insert ring from the foam ring.
- 1.2 Carefully open and stretch the rings to allow ease of fitting, this can be by hand or on three hole rings the use of the stress cone applicator may be used. The rings should be of a snug fit to the cable sheaths, overstretching will allow gaps and subsequent leaking of the Lovifit glue either into or out of the inner sleeve. Care should be taken especially with the smaller sized cables i.e. 70mm².
- 1.3 Pass two rings over each cable sheath (or triplex core) and park in a position to avoid interference with the joint construction. These will be moved to their final position when the inner sleeve is installed.

Foam Tape

- 2.1 **Direct to cable sheaths** – offer the inner sleeve to the joint and mark the position of the foam tape, apply the foam tape until the required build-up is achieved to the build-up gauge.
- 2.2 **Direct to foam rings** – apply the foam tape direct to the foam ring until the required build-up is achieved to the build-up gauge.

M Series Joints

- 3.1 Select and remove the required insert ring from the foam ring.
- 3.2 For 3 core cables the foam ring can be carefully wrapped onto the cable and be aligned to the grooves in the inner shell. Once in the correct position the foam ring should be secured with a single width of adhesive tape. The tape should not be too tight as to deform the foam rings.

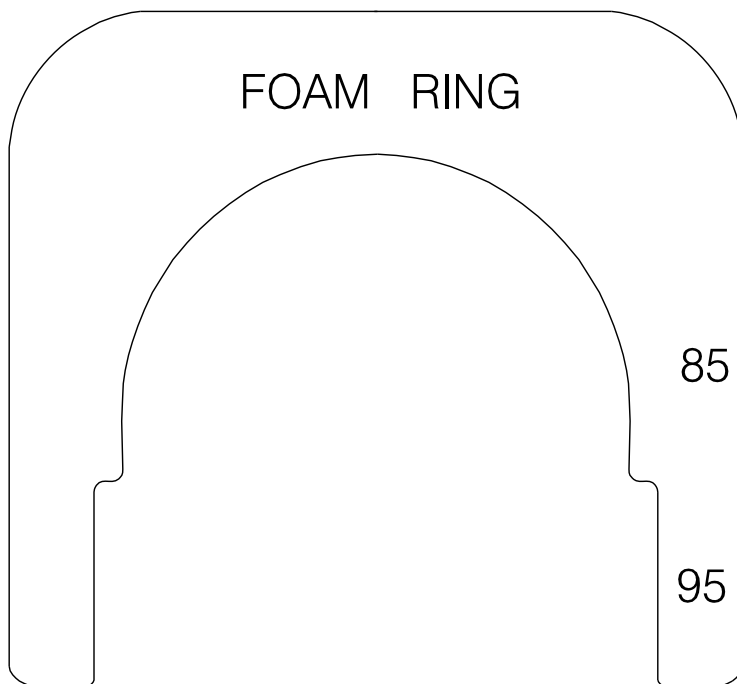


- 3.3 For triplex cables the inner section of the foam ring can be carefully positioned before the outer section of the ring is wrapped over it. The two parts are then aligned to the groove in the inner shell. Once in the correct position the foam rings should be secured with a single width of adhesive tape. The tape should not be too tight as to deform the foam rings



All dimensions in mm


Foam Tape Build Up Caliper



85 = Foam Rings Which Require Building Up With Foam Tape
For Sealing Within K85 & KB85 Inner Sleeves

95 = Foam Rings Which Require Building Up With Foam Tape
For Sealing Within K95 & KB95 Inner Sleeves

Note:- Caliper To Be Also Used Where Foam Tape Is Used In
Place Of Foam Rings

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GENERAL REQUIREMENT 35

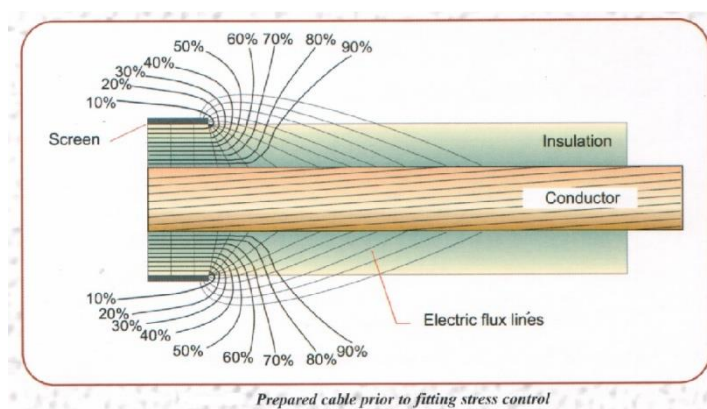
INSTALLATION OF STRESS CONTROL CONES (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents given in General Requirement 1.

General

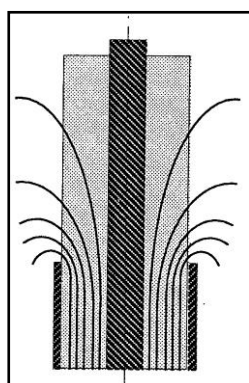
The most common cause of failure of screened cables, be they paper or polymeric cables, is the breakdown of the cable insulation at the end of the screen termination.

When the metallised screen on paper insulated or the semi-conducting screen on a polymeric EPR / XLPE insulated cable is terminated, some form of stress control must be provided to relieve the high stress levels produced at the screen termination point. See the typical stress diagram of a terminated insulation screen, without stress control, of a screened cable below.

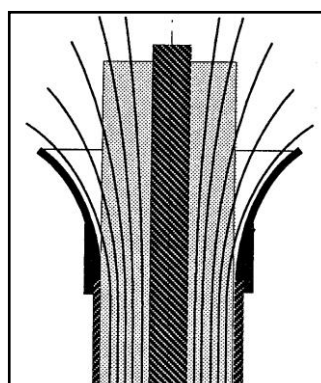


Poor preparation of the screen termination will result in partial discharges and ultimately failure of the accessory.

The Lovink jointing system achieves stress control of the screen termination by using a form of void filling tape and a rubber stress control cone, which provides a geometric control of the stresses. The void filling tape and stress cone is applied to all imperial, metric sized single core or three core screened paper insulated cables or single core polymeric insulated cables. There are four sizes of stress control cones which cover 70mm², 95/185mm², 300/400mm² and 630mm² EPR / XLPE and screened paper cables.



Simple stress drawing showing semi-conducting screen termination without stress control.



Semi-conducting screen termination with geometric stress control as in the Lovink jointing system.

A stress cone applicator is used to install the stress control cones, there are three sizes of applicator available the smallest size covers 70mm², the intermediate size covers 95/185/300 and 400mm² conductors, and the larger size covers 630mm² conductors.

Method of Installation

Refer to Drawings GR2D 6.35.1, 6.35.2 and 6.35.3 whilst undertaking this General Requirement.

35.1 Application of Void Filling Tape on Paper Cables

1.1 **Metallic screens on Paper Cables** – place two white Chinagraph marks on the metallic screen, one at 5mm and the second at 15mm both points taken from the metallic screen termination point – Fig 1 & 2.

1.2 Place a third white china graph mark on the core insulation 10mm from the metallic screen termination point – Fig 1.

Note: - Remove the tinned copper termination binder before applying the void filling tape.

1.3 Take the length of void filling tape and cut into two equal lengths, make a further diagonal cut on each along its length, this will result in four triangular shaped pieces (one being spare).

1.4 Remove both release papers and starting on the metallic screen just forward of the 5mm mark apply a half lapped layer over the termination point and onto the paper core insulation, ensuring a fine edge is achieved, with a long lay return to and onto the metallic screen finishing at the 5mm mark – Fig 2.

A sloping profile is to be achieved from the metallic screen termination to the core insulation, the tape being applied with a 50% stretch – Fig 1.

Note: - It is important not to overbuild and to keep within the dimensions given.

35.2 Application of Void Filling Tape on Semi-conducting Screens of Polymeric Cables

2.1 Semi-conducting Screens on Polymeric Cables – place two white Chinagraph marks on the semi-conducting screens, one at 5mm and the second at 15mm both points taken from the semi-conducting screen termination point – Fig 3 & 4.

2.2 Place a third white Chinagraph mark on the core insulation 10mm from the semi-conducting screen termination point – Fig 3.

2.3 Take the length of void filling tape and cut into two equal lengths, make a further diagonal cut on each along its length, this will result in four triangular shaped pieces (one being spare).

- 2.4 Remove both release papers and starting on the semi-conducting screen just forward of the 5mm mark apply a half lapped layer over the termination point and onto the core insulation, ensuring a fine edge is achieved, with a long lay return to and onto the semi-conducting screen finishing at the 5mm mark – Fig 4.

A sloping profile is to be achieved from the semi-conducting screen termination to the core insulation, the tape being applied with a 50% stretch – Fig 3.

Note: - It is important not to overbuild and to keep within the dimensions given

35.3 Application of Stress Control Cones – Paper and Polymeric Cables

- 3.1 Take the stress cone applicator and liberally grease the removable coned head using Lovisil silicon compound.
- 3.2 Rest the applicator base on a clean dry flat surface, taking a “trumpet” shaped stress control cone with the trumpet end facing towards the applicator coned end slide the stress control cone over and down the applicator body until the straight end of the stress control cone just passes the join of the applicator body and removable end.

Remove the coned end clean and place on a dry clean surface.

- 3.3 Pass the stress cone applicator with the base towards you over and down the core stopping when the body end of the applicator reaches the 15mm mark on the metallic or semi-conducting screen.
- 3.4 Carefully slide the stress control cone off the applicator and onto the metallic or semi-conducting screen so that the end of the stress control cone is parked in line with the 15mm mark. A final adjustment may be made by sliding the stress control cone into position carefully by hand once in contact with the core.
- 3.5 Thoroughly clean the applicator upon completion of the application.

All dimensions in mm

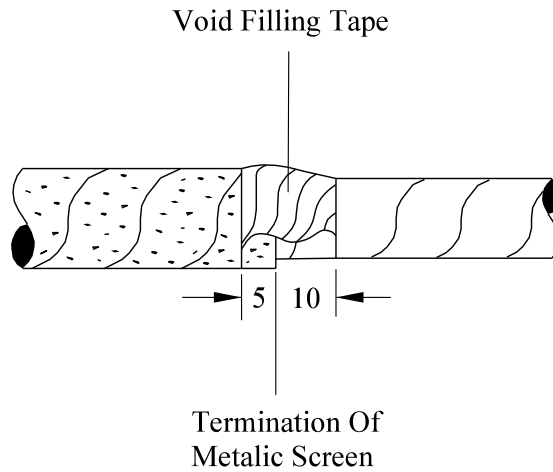


Fig 1

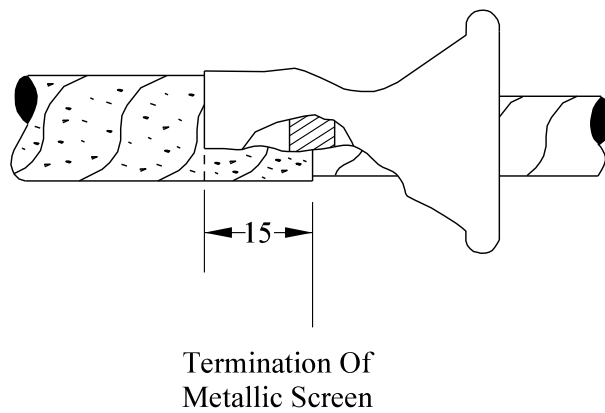


Fig 2

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All dimensions in mm

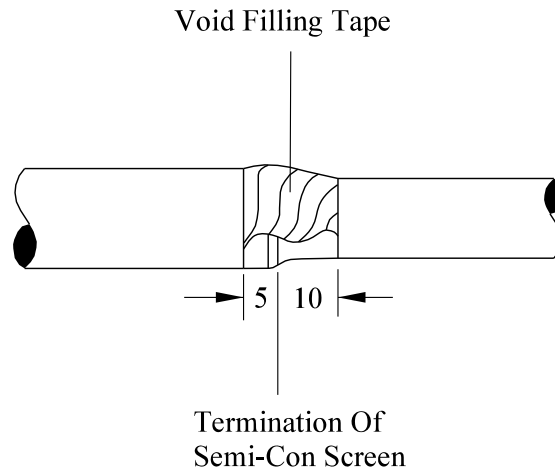


Fig 3

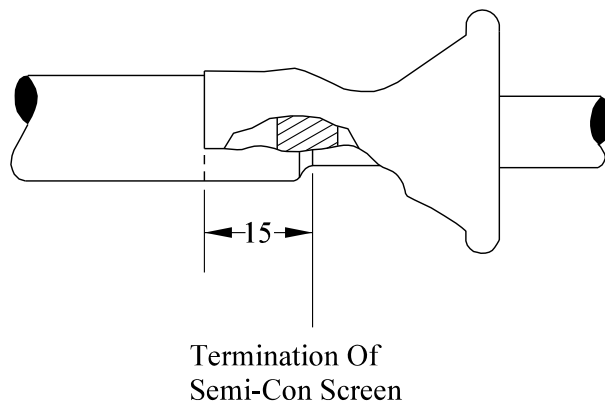
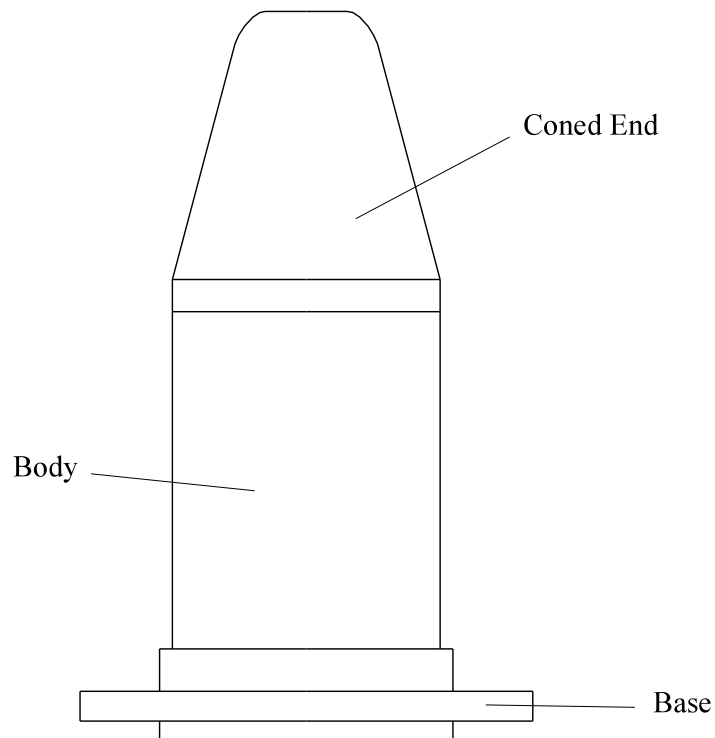


Fig 4

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Stress Control Cone Applicator



Applicator Sizes :-

Small Covers 70mm² Stress Cones
 Medium Covers 95/185/300mm² Stress Cones
 Large Covers 630mm² Stress Cones

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GENERAL REQUIREMENT 36

INSTALLATION OF MECHANICAL CONNECTORS

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents given in General Requirement 1.

General

All connections on the 11kV underground distribution system whether straight, branch, loop joints, indoor and outdoor terminations will be made using a mechanical shear bolt connectors.

They cover all cable types PILC, PICAS, PISAS, EPR and XLPE.

Only those connectors stated in the relevant jointing procedure are to be used.

All connector shall butt up to the phase insulation.

36.1 Straight Joints

Phase connectors: -

16-185mm ² all cable types	- MSFE-0009-0035/0185.
16-300mm ² all cable types	- MSFE-0010-0035/0300.
70-300mm ² solid aluminium conductor	- BAH-02-210-0023
400mm ² PICAS to 300mm ² Cu EPR only	- BAH-02-211-098.
400mm ² XLPE/EPR to 300mm ² EPR/XLPE	- BAH-02-211-098.
500-630mm ² PILC, EPR.	- VTPC36UTB.

Earth connector: -

All cable types	- BCNE-3 UTB
-----------------	--------------

36.2 Branch Joints

Phase connectors: -

16-185mm ² all cable types	- HVBRM 18 SPUTC.
16-300mm ² all cable types	- HVBRM 22 SPUTC.

Earth connector: -

All cable types	- BCNE-3 UTB.
-----------------	---------------

36.3 Loop Joints

Phase connectors: -	
16-185mm ² all cable types	- HVBRM 18 SOUTC.
16-300mm ² all cable types	- HVBRM 22 SOUTC.
Earth connector: -	
All cable types	- BCNE-3 UTB.

The following given connectors are only to be used on EPR/XLPE cables.

36.4 Indoor terminations

Phase connectors: -	
95/185mm ²	- BAH-02-403-0127.
300mm ² Al.	- BAH-02-403-0100.
300mm ² Cu.	- VETB28-12UTB.
630mm ² Cu.	- VETC33-12 UTB.

Earth Connectors: -	
70-630mm ²	- BET 60-12.
70-630mm ²	- BET 120-12.

36.5 Outdoor terminations

Phase connectors: -	
95/185mm ²	- BAH-02-403-0128.
300mm ² Al.	- BAH-02-403-0129.
300mm ² Cu.	- VETB28-OHUTB.
630mm ² Cu.	- VETC33-OHUTB

Earth Connectors: -	
70-630mm ²	- BET 120-12.

36.6 Pin Connectors (compound terminations)

Phase/neutral connectors: -	
70/95mm ²	- BAH-0221307.
185mm ²	- VETB21PxxDyy-UTB.
300mm ²	- VETB28PxxDyy-UTB.
630mm ²	- VETB33PxxDyy-UTB.

Earth Connectors: -	
70-630mm ²	- BET120-12.

APPLICATION OF CONNECTORS – INDEX

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36.1 Straight Connectors

The following connectors are the only approved connectors to be used in 11kV straight joints, they are to be used on aluminium and copper 120° shaped sector stranded, solid round aluminium and round stranded copper conductors, up to their maximum cross section to which they are designed.

All connectors within the range are of the “split V” blocked design which allows the conductor to be entered into the connector conductor entry hole without “springing” the cable. The connectors are constructed of aluminium, brass or copper and are supplied with shear bolts which range take across specific conductor sizes as follows: -

MSFE-0009-0035/185	covers 16-185mm ² conductors
MSFE-0010-0035/300	covers 16-300mm ² conductors
BAH-02-210-0023	covers 70-300mm ² solid aluminium conductors
BAH-02-211-098	covers 300-400mm ² copper conductor
VTPC 36 UTB	covers 500-630mm ² copper conductors

For sector shaped paper insulated stranded conductors, fitting is facilitated if prior to removal of the insulation the conductor is rounded using water pump pliers along its entry length, this is only necessary on the largest conductor size for which the connector is intended.

With the BAH-02-210-0023 straight connector, this connector is supplied as part of the Tyco polymeric cable to polymeric cable single core straight joint, the connector comes with an aluminium insert, this insert is provided to improve the profile between the connector and the insulation thus allowing a 70 and 95mm² conductors to be placed in the BAH-02-210-0023 connector, this insert is to be discarded when the connector is used on 185 or 300mm² solid aluminium conductors as the profile between the connector and the insulation of the conductor is acceptable. Kindly note the BAH-02-210-0023 connector is designed for use with circular solid aluminium conductors only.

Where copper conductors are to be used in an aluminium connectors then the copper conductor shall be wrapped with brass gauze.

Tooling – the connector bolts require either an 18mm A/F or 19mm socket which may be attached to either an approved Izumi power driven tool or ratchet spanner, the connector being held stable whilst shearing with an adjustable holding tool.

Connector Installation

Refer to Drawings GR2D 6.36.1 and GR2D 6.36.2 whilst undertaking this General Requirement.

- 1.1 Overlap the two cores to be jointed together in the positions they will finally occupy.
- 1.2 Place the two halves of the connector together and fit the connector-joining bolt finger tight.

- 1.3 Mark the insertion depth of the conductor entry hole on the outside of each half of the connector body.
- 1.4 Place the connector alongside the two cores arranged in 1.1 above, in the position it will finally occupy.
- 1.5 Transfer the insertion depth mark made on one half of the connector body onto the corresponding core.
- 1.6 Cut the core at the mark made in 1.5.
- 1.7 Remove the insulation from the end of the one core cut in 1.6 for a distance equal to the insertion depth of the connector, remove any impregnate and abrade the conductor.
- 1.8 Remove the centre joining bolt from the connector and insert half of the connector over the conductor bared in 1.7.
- 1.9 Ensure that the conductor extends to the bottom of the entry hole and fit the universal bolts, finger tight.
- 1.10 Support the connector with the holding tool, starting at the bolt nearest to the core insulation; tighten each bolt sequentially by half a turn, until the heads shear off.
- 1.11 Arrange the two cores into the positions they will finally occupy and transfer the insertion depth marks on the second half of the connector body onto the second core.
- 1.12 Cut the second core at the mark made in 1.11.
- 1.13 Remove the connector-joining bolt.
- 1.14 Remove the insulation from the second core for a distance equal to the insertion depth of the connector, remove any impregnate and abrade the conductor.
- 1.15 Insert the bared end of the conductor into the second half of the connector.
- 1.16 Wipe clean the contact faces of the two halves of the connector, once more. Fit the connector joining bolt; finger tight, to join the two halves of the connector together.
- 1.17 Connect the second core into the second half of the connector as detailed in 1.9 and 1.10 above.
- 1.18 Support the connector with the holding tool and tighten the connector-joining bolt until the head shears off.

36.2 Branch Connectors

The following connectors are the only approved connectors to be used in 11kV branch joints, they are to be used on aluminium and copper 120° shaped sector stranded, solid round aluminium and round stranded copper conductors, up to the maximum cross section to which they are designed.

All connectors within the range are of the “split” blocked design, which allows the conductor to be entered into the connector conductor entry hole without undue bending. The solid centre section allows for lost conductor due to “spiking”.

They are constructed of aluminium and are supplied with shear bolts which range take across specific conductor sizes as follows: -

HVBRM 18 SPUTC covers 16-185mm² conductors

HVBRM 22 SPUTC covers 16-300mm² conductors

For sector shaped paper insulated stranded conductors, fitting is facilitated if prior to removal of the insulation the conductor is rounded using water pliers along its entry length, this is only necessary on the largest conductor size for which the connector is intended.

Copper conductors are to be wrapped with brass gauze.

Tooling – the connector bolts require a 19mm socket which may be attached to either an approved Izumi power driven tool or ratchet spanner, the connector being held stable whilst shearing with an adjustable holding tool.

Connector Installation

Refer to Drawing GR2D 6.36.3 whilst undertaking this General Requirement.

Note: - Your attention is drawn for the need to ensure correct connector set up, otherwise ease of application of the connector insulation tubes will not be achieved.

- 2.1 Arrange the three conductors to be jointed together in the positions they will finally occupy.
- 2.2 Place the connector alongside the conductors in the position it will finally occupy and mark the centre line of the connector on all conductors.
- 2.3 Cut off the surplus conductor at a point 15mm from the marks made in 2.2, away from the conductor ends, this will leave a 30mm gap between the conductor ends.
- 2.4 Remove the insulation for a distance of the insertion depth from each core, remove any impregnate and abrade the conductor.
- 2.5 Slide the connector sleeve over the core at the single end of the joint.
- 2.6 Insert the other two conductors into the two entry holes at the branch end of the connector.
- 2.7 Place the end of the single conductor in the open channel of the connector.
- 2.8 Ensure that all the strands are within the channel.
- 2.9 Place the connector insert over the channel.

- 2.10 Slide the connector sleeve over the connector insert and line up the holes, thus locking the connector insert to the connector body.
- 2.11 Ensure that the conductors extend to the bottom of the entry holes and fit the universal bolts, finger tight.
- 2.12 Support the connector with the holding tool, starting at the bolt nearest to the core insulation; tighten each bolt sequentially by half a turn until the heads shear off.

36.3 Loop Connectors

The following connectors are the only approved connectors to be used on 11kV loop joints, they are to be used on aluminium and copper 120° sector shaped stranded, solid round aluminium and round stranded copper conductors up to their maximum cross-section to which they are designed.

All connectors within the range are of the “solid” blocked design.

They are constructed of aluminium and are supplied with shear bolts which range take across specific conductor sizes as follows: -

HVBRM 18 SOUTC covers 16-185mm² conductors

HVBRM 22 SOUTC covers 16-300mm² conductors

For sector shaped stranded paper insulated conductors, fitting is facilitated if prior to removal of the insulation the conductor is rounded using water pump pliers along its entry length. This is only necessary on the largest conductor size for which the conductor is intended.

Copper conductors are to be wrapped with brass gauze.

Tooling – the connector bolts require a 19mm socket which may be attached to either an approved Izumi power driven tool or ratchet spanner, the connector being held stable whilst shearing with an adjustable holding tool.

Connector Installation

Refer to Drawing GR2D 6.36.4 whilst undertaking this General Requirement.

Note: - Your attention is drawn for the need to ensure correct connector set up, otherwise ease of application of the connector insulation tubes will not be achieved.

- 3.1 Arrange the two conductors to be jointed together in the positions they will finally occupy.
- 3.2 Place the connector alongside the conductors in the position it will finally occupy and mark the centre line of the connector on all conductors.
- 3.3 Cut off the surplus conductor at a point 15mm from the marks made in 3.2, away from the conductor ends.

- 3.4 Remove the insulation for a distance of the insertion depth from each core, remove any impregnate and abrade the conductor.
- 3.5 Insert the two conductors into the two entry holes at the branch end of the connector.
- 3.6 Ensure that the conductor extends to the bottom of the entry holes and fit the universal bolts, finger tight.
- 3.7 Support the connector with the holding tool, starting at the bolt nearest to the core insulation; tighten each bolt sequentially by half a turn until the heads shear off.

36.4 Indoor Termination Connectors

The following connectors are the only approved connectors to be used on 11kV EPR indoor terminations; they are to be used on solid aluminium and stranded copper round conductors, up to their maximum cross section to which they are designed.

The indoor connector palm is drilled to accept a M16 stud, for M12 stud connections the brass bush is inserted into the M16 hole. An aluminium sleeve is provided to allow a 95mm² conductor to be placed in the BAH-02-403-0127 connector, this sleeve being discarded when the connector is used on 185mm² conductor.

All connectors within the range are constructed of brass or copper and are supplied with shear bolts which are dedicated to a conductor size as follows: -

BAH-02-403-0127	covers 95/185mm ² Aluminium conductors
BAH-02-403-0100	covers 300mm ² Aluminium conductors
VETB 28 12/16 UTB	covers 300mm ² Copper conductors
VETC 33 12 UTB	covers 630mm ² Copper conductors

Tooling – the connector bolts require an 18mm socket which may be attached to either an approved Izumi power driven tool or ratchet spanner, the connector being held stable whilst shearing with an adjustable holding tool.

Connector Installation

Refer to Drawings GR2D 6.36.5, 6.36.6 and 6.36.7 whilst undertaking this General Requirement.

- 4.1 Mark the insertion depth of the conductor entry hole on the outside of the connector body.
- 4.2 Place the connector onto its connection point.
- 4.3 Place the core alongside the connector and transfer the insertion depth mark onto the core.
- 4.4 Cut the core at the mark made in 4.3.

- 4.5 Remove the insulation for a distance of the insertion depth from the core.
- 4.6 Insert the conductor into the connector.
- 4.7 Ensure the conductor extends to the bottom of the entry hole and fit the connector bolts.
- 4.8 Ensure that the connector palm is in the correct orientation to its connection point and finger tighten the bolts.
- 4.9 Support the connector with the holding tool, starting at the bolt nearest to the core insulation; tighten each bolt sequentially by half a turn until the head shears off.

36.5 Outdoor Termination Connectors

The following connectors are the only approved connectors to be used on 11kV EPR outdoor terminations; they are to be used on solid aluminium and stranded copper round conductors, up to their maximum cross section to which they are designed.

The outdoor connector palm being drilled with a hole and a slot, the slot being for connection to the surge diverter and the hole for overhead line jumper connection. An aluminium sleeve is provided to allow a 95mm² conductor to be placed in the BAH-02-403-0128 connector, this sleeve, being discarded when the connector is used on 185mm² conductor.

All connectors within the range are constructed of brass or copper and are supplied with shear bolts which are dedicated to a conductor size as follows: -

BAH-02-403-0128	covers 95/185mm ² Al. conductors
BAH-02-403-0129	covers 300mm ² Al. conductors
VETB 28 OHUTB	covers 300mm ² Cu. conductors
VETC 33 OHUTB	covers 630mm ² Cu. conductors

Tooling – the connector bolts require an 18mm socket which may be attached to either an approved Izumi power driven tool or ratchet spanner, the connector being held stable whilst shearing with an adjustable holding tool.

Connector Installation

Refer to Drawings GR2D 6.36.5, 6.36.6 and 6.36.7 whilst undertaking this General Requirement.

- 5.1 Mark the insertion depth of the conductor entry hole on the outside of the connector body.
- 5.2 Place the connector onto its connection point.
- 5.3 Place the core alongside the connector and transfer the insertion depth mark onto the core.

- 5.4 Cut the core at the mark made in 5.3
- 5.5 Remove the insulation for a distance of the insertion depth from the core.
- 5.6 Insert the conductor into the connector.
- 5.7 Ensure the conductor extends to the bottom of the entry hole and fit the connector bolts.
- 5.8 Ensure that the connector palm is in the correct orientation to its connection point and finger tighten the bolts.
- 5.9 Support the connector with the holding tool, starting at the bolt nearest to the core insulation; tighten each bolt sequentially by half a turn until the head shears off.

36.6 Pin Connectors

The following connectors are the only approved connectors to be used on 11kV EPR cable box compound filled terminations; they are to be used on solid aluminium and standard copper round conductors, up to the maximum cross section to which they are designed.

They replace the traditional soldered “thimble” socket used in transformer or OCB cable boxes, which have either the two-bolt clamp or four bolt lamination connection arrangement.

Connectors are to be ordered direct from the manufacturer on a “as and when”, with the exception of the 70/95mm² connector the pin length and diameter will need to be given upon placement of the order.

All connectors within the range are manufactured from brass or copper and are supplied with shear bolts which are dedicated to a conductor size as follows: -

Compound Filled Terminations: -

BAH-0221307	covers 70/95mm ² conductors
VETB21 PxxDyy-UTB	covers 185mm ² conductors
VETB28 PxxDyy-UTB	covers 300mm ² conductors
VETB33 PxxDyy-UTB	covers 630mm ² conductors

Tooling – the connector bolts require 13mm or 16mm sockets, which may be attached to either a approved Izumi power driven tool or ratchet spanner, the connector being held stable whilst shearing with an adjustable holding tool.

Connector Installation

Refer to Drawings GR2D 6.36.8 whilst undertaking this General Requirement.

- 6.1 Mark the insertion depth of the conductor entry hole on the outside of the connector body.

- 6.2 Place the connector to its connection point.
- 6.3 Place the core alongside the connector and transfer the insertion depth mark onto the core.
- 6.4 Cut the core at the mark made in 6.3.
- 6.5 Remove the insulation for a distance of the insertion depth from the core.
- 6.6 Insert the conductor into the connector.
- 6.7 Ensure the conductor extends to the bottom of the entry hole and fit the connector bolts.
- 6.8 Ensure that the connector pin is correct to its connection point and finger tighten the bolts.
- 6.9 Support the connector with the holding tool, starting at the bolt nearest to the core insulation; tighten each bolt sequentially by half a turn until the head shears off.

36.7 Earth Bond Connectors

These connectors are the only approved connectors to be used to bond stranded copper screen wires in 11kV joints and terminations; they are to be used on copper to copper screen wires and will include a copper earth braid. They are to bond copper screen wires to the associated earth bars of 11kV switchgear and transformers up to their maximum cross section to which they are designed.

All connectors within the range are constructed of brass and are supplied with bolts which range take across specific conductor sizes as follows: -

Joints

BCNE-3 UTB covers 120-240mm² Cu. conductors

Terminations

BET 60-12 covers 16-60mm² Cu. conductors

BET 120-12 covers 50-120mm² Cu. conductors

Tooling – the connector bolts require 13mm or 16mm sockets which may be attached to either an approved Izumi power driven tool or ratchet spanner, the connector being held stable whilst shearing with an adjustable holding tool.

Connector Installation – BCNE 3-UTB

Refer to Drawing GR2D 6.36.9 whilst undertaking this General Requirement.

- 7.1 Cut the copper earth wires and copper earth braid 15mm beyond the connector centre line.
- 7.2 Position the copper earth wires and copper earth braid so that they overlay one on top of the other.
- 7.3 Position the main body of the connector around the conductors and slide the bridge into place.
- 7.4 Ensure the connector is correctly positioned and aligned, support the connector with the holding tool and tighten the bolt until the head shears off.

Connector Installation – BET Range

Refer to Drawing GR2D 6.36.9 whilst undertaking this General Requirement.

- 7.1a Cut the copper screen wire conductor so that it will occupy the full depth of the connector entry hole.
- 7.2a Insert the copper screen wires into the connector.
- 7.3a Ensure the conductor extends to the bottom of the entry hole and fit the connector bolts.
- 7.4a Ensure the connector palm is in the correct orientation to its connection point and finger tighten the bolts.
- 7.5a Support the connector with the holding tool, starting at the bolt nearest to the bare copper screen wires; tighten each core sequentially by half a turn until the head shears off.

BTC CONNECTOR (Screen wire Connections)

General

These connectors are to be used in all single core 11kV EPR straight joints on stranded copper round conductors up to the maximum cross section for which the connector is designed.

There are two connectors in the range with non-shear socket head grub screws which range take across specific conductor sizes as follows:-

BTC-1-45W covers 4-35mm² conductors

BTC-3-60W covers 4-60mm² conductors

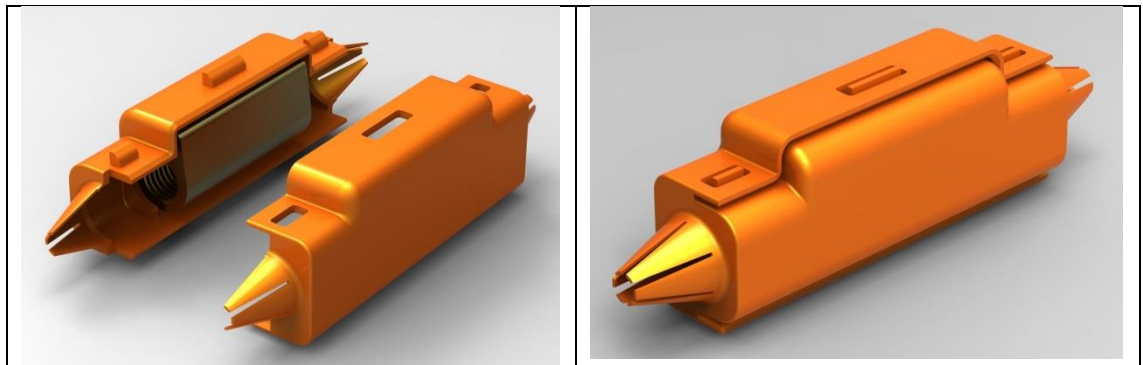
Tooling - the BTC connector requires a 3mm Allen key to tighten the grub screws.

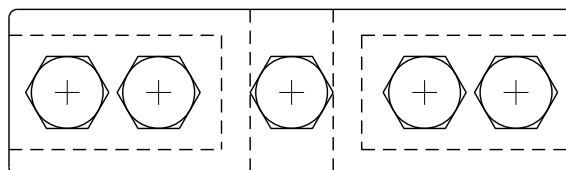
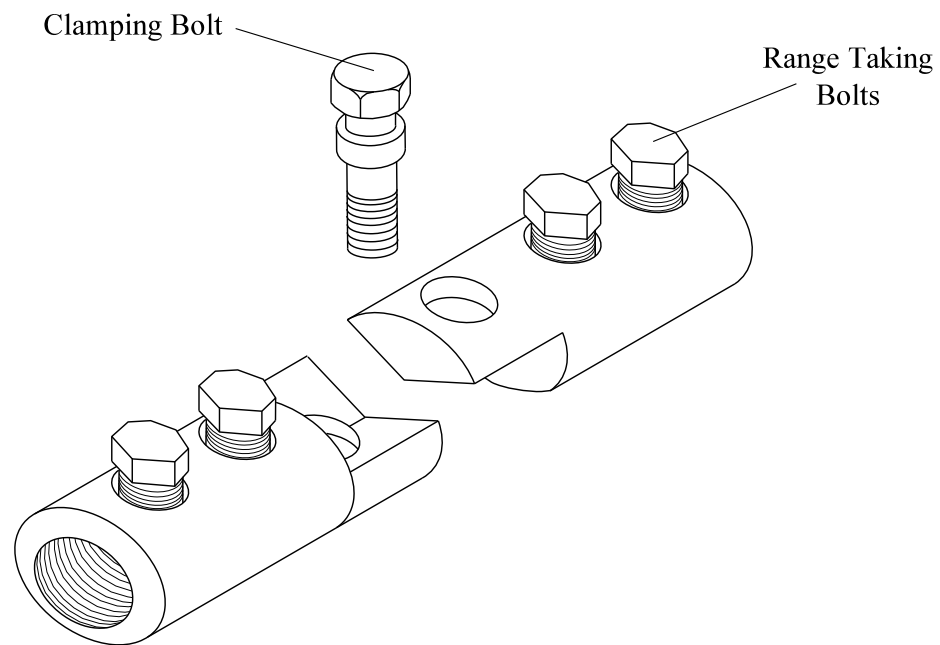
All tooling used is to be fully insulated and Company approved.


Connector Installation (BTC) - Drawing GR2D 6.36.10

When making phase connections each phase must be dealt with in turn. Remove insulation, make connections and reinsulated **before** commencing the operation on the next phase.

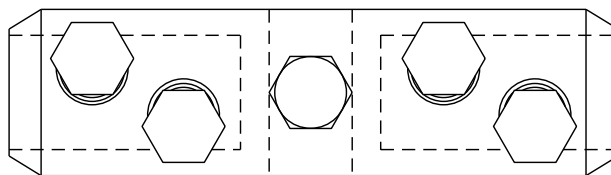
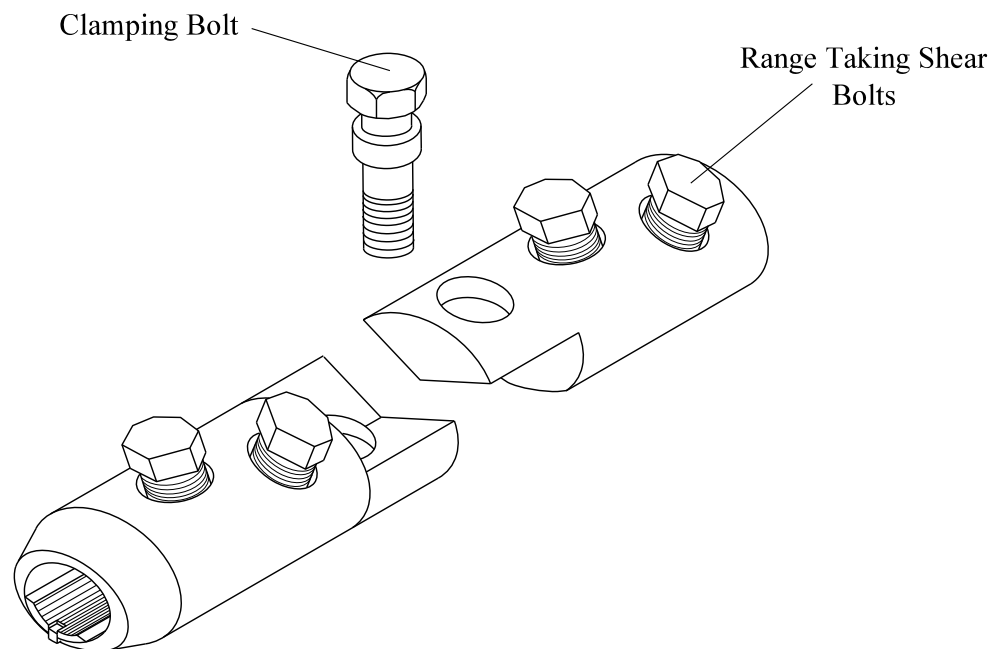
1. Cut each core so that it will occupy the depth of the connector barrel.
2. Remove the insulation from each conductor to a position the depth of the barrel plus 5mm.
3. Degrease the conductor if necessary.
4. Using a file card abrade any aluminium conductors.
5. Install the connector on one conductor and tighten the grub screws.
6. Insert the remaining conductor into the connector and tighten the grub screws.
7. Most BTC connectors now come with a pre-made polypropylene two piece insulation which is clipped around the BTC connector, as shown below. For the 11kV this pre-made insulation can be discarded.






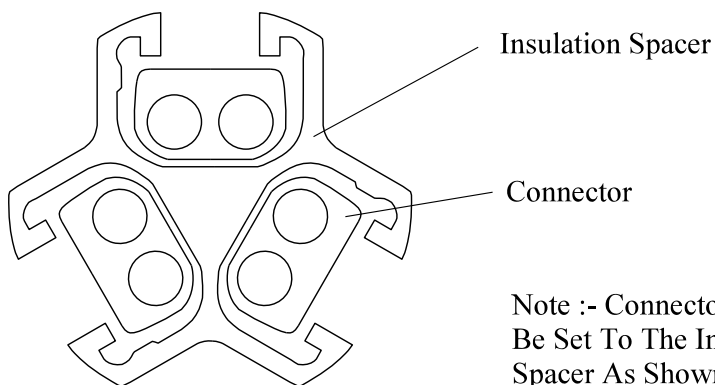
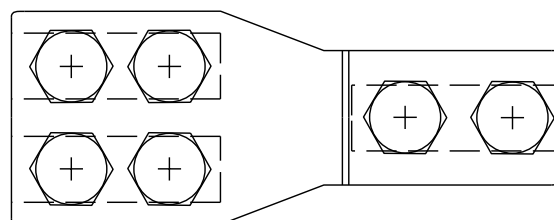
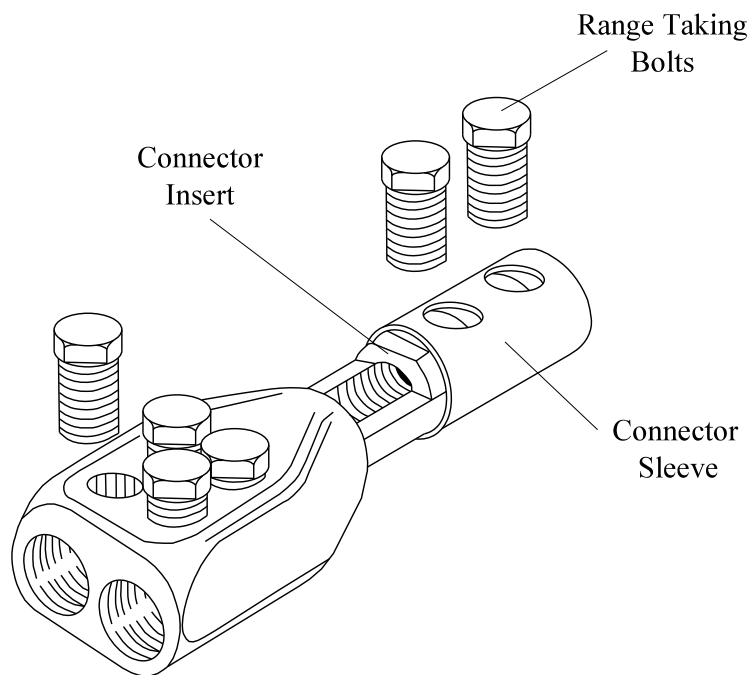
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Drawn	RJB	04/13			
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Approved					
SCALE		N.T.S.		Title 95 to 400mm ² STRAIGHT JOINT CONNECTOR	
				Drg. No. GR2D 6.36.1	
				Rev No	

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SCALE	N.T.S.		Title 70 to 300mm² STRAIGHT JOINT CONNECTOR USED FOR SINGLE CORE POLYMERIC JOINTING			Drg. No. GR2D 6.36.2 Rev No

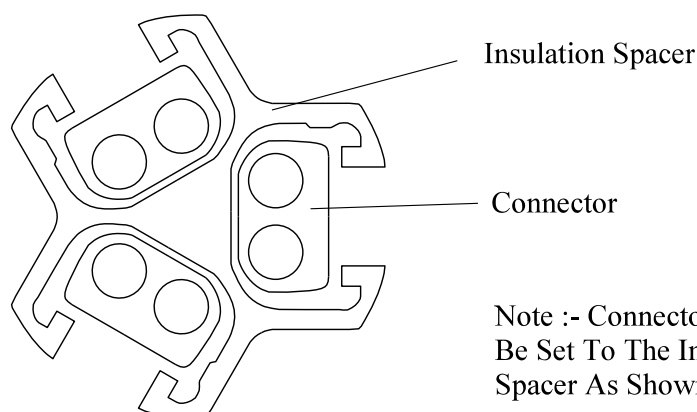
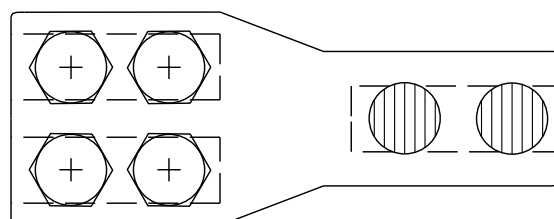
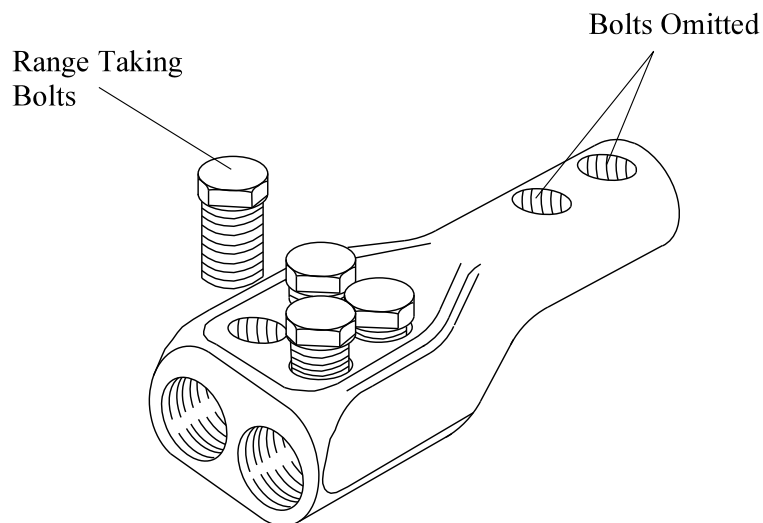
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Note :- Connectors Must
Be Set To The Insulation
Spacer As Shown

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Drawn	RJB	04/13	Title 95 to 300mm ² BRANCH JOINT CONNECTOR		
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Approved			95 to 300mm ² BRANCH JOINT CONNECTOR		
SCALE	N.T.S.				
					
			Drg. No. GR2D 6.36.3 Rev No		


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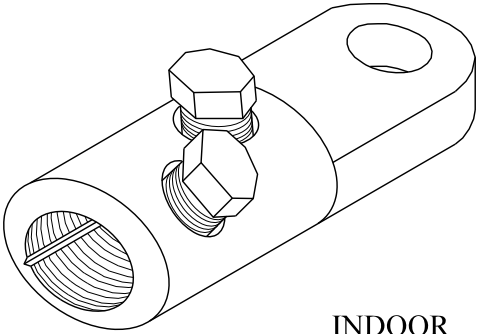
Note :- Connectors Must
Be Set To The Insulation
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Drawn	RJB	04/13			
Checked				<div>Title</div> <div>95 to 300mm² LOOP JOINT</div> <div>CONNECTOR</div>	
Approved					
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				<div>Rev No</div>	

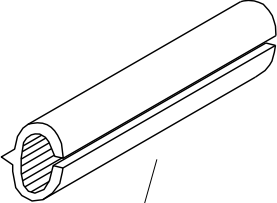
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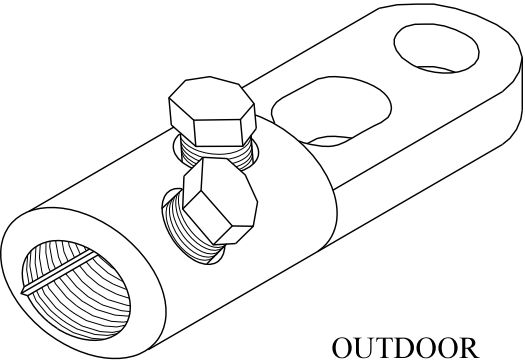
Brass
Bush



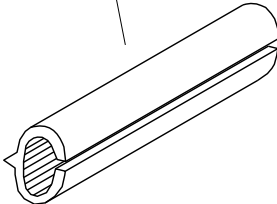
INDOOR




Aluminium Build Up
Sleeve For 95mm²
Conductor



OUTDOOR

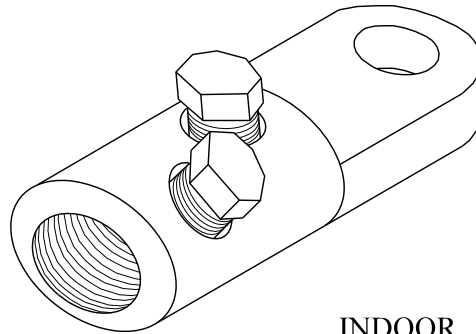


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Approved					
SCALE		N.T.S.		Title <div style="text-align: center;"> 95 to 185mm² INDOOR AND OUTDOOR TERMINATION CONNECTOR </div>	
				Drg. No. GR2D 6.36.5	
				Rev No	

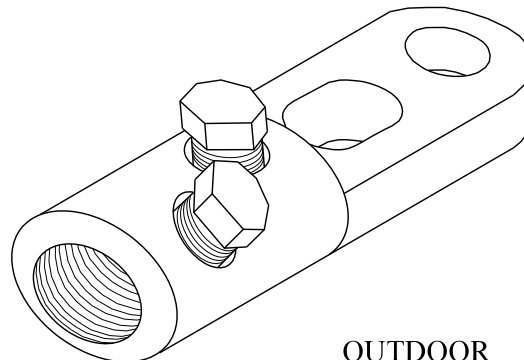
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Brass
Bush



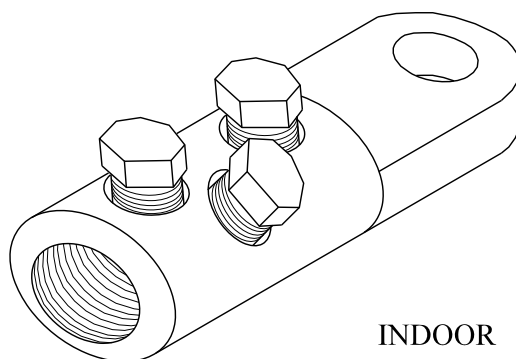
INDOOR



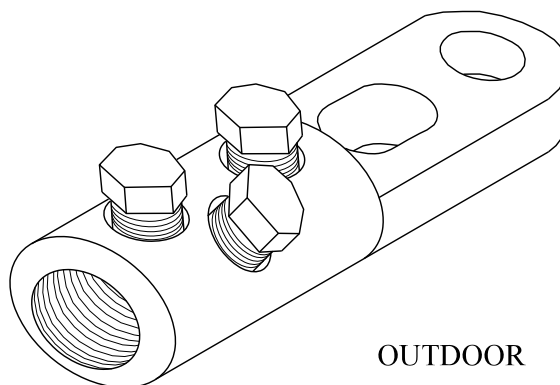
OUTDOOR

Rev No	Drawn	Chk'd	App'd	Date	Revision		
ORIGINAL ISSUE		DATE		<div>WESTERN POWER DISTRIBUTION Design Department. Avonbank,Feeder Road,Bristol BS2 0TB Tel: 0117 933 2000 Fax: 0117 933 2001.</div> <div>WESTERN POWER DISTRIBUTION</div>			
Drawn	RJB	04/13					
Checked							
Approved							
SCALE		N.T.S.		Title		Drg. No.	Rev No
				300mm ² INDOOR AND OUTDOOR TERMINATION CONNECTOR		GR2D 6.36.6	


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INDOOR



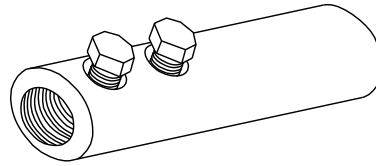
OUTDOOR

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ORIGINAL	ISSUE	DATE	WESTERN POWER DISTRIBUTION Design Department. Avonbank, Feeder Road, Bristol BS2 0TB Tel: 0117 933 2000 Fax: 0117 933 2001.			 WESTERN POWER DISTRIBUTION
Drawn	RJB	04/13				
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Approved						
SCALE	N.T.S.		Title 630mm ² INDOOR AND OUTDOOR TERMINATION CONNECTOR			Drg. No. GR2D 6.36.7
						Rev No

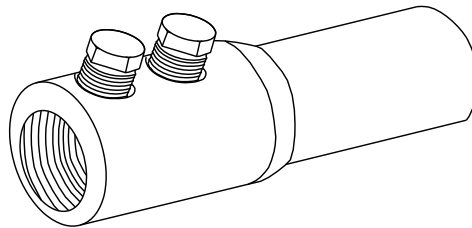
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All dimensions in mm

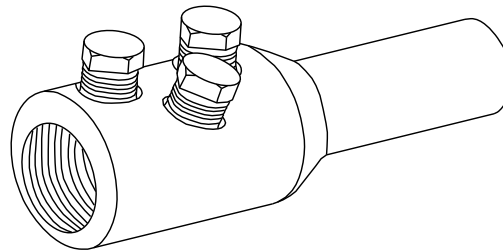
70 / 95mm² Conductor



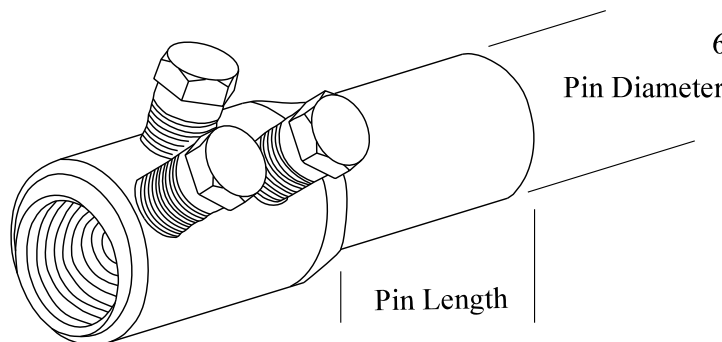
185mm² Conductor




300 / 400mm² Conductor



630mm² Conductor



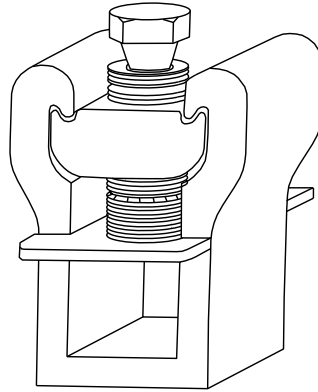
Note:- Pin Diameter And Length Machined To Size By The Manufacturer When Placing Order

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Drawn	RJB	04/13			
Checked					
Approved					
SCALE		N.T.S.		Title	
				70 to 630mm ² PIN TERMINATION CONNECTORS	
				Drg. No.	
				GR2D 6.36.8	
				Rev No	

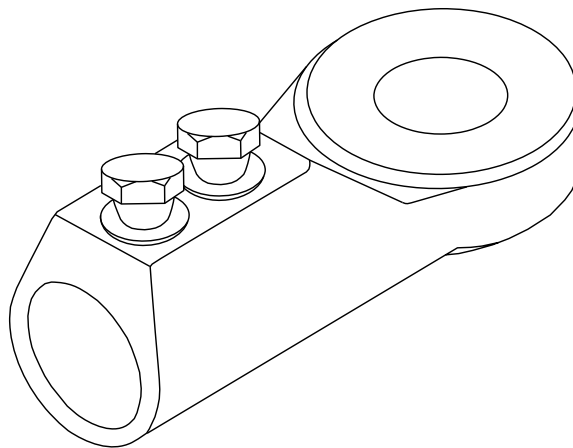
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All dimensions in mm

BCNE Connector



BET Connector

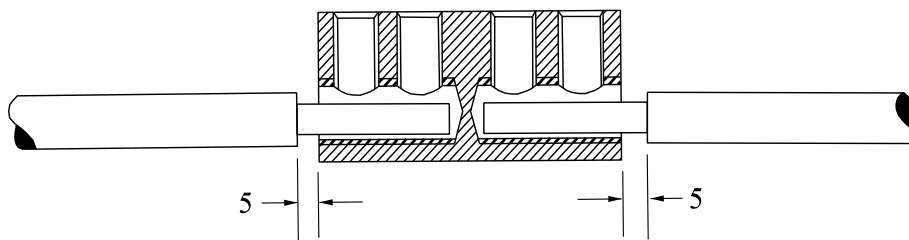
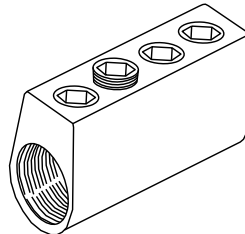



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Drawn	RJB	04/13					
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SCALE		N.T.S.		Title		Drg. No.	Rev No
				EARTH BOND CONNECTORS		GR2D 6.36.9	

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All dimensions in mm

BTC Connector



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Drawn	RJB	04/16				
Checked						
Approved						
SCALE	N.T.S.		Title INSTALLATION OF BTC CONNECTOR - SERVICE STRAIGHT JOINT			Drg. No. GR2D 6.36.10
						Rev No

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GENERAL REQUIREMENT 37

INSTALLATION OF CONNECTOR INSULATION (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents given in General Requirement 1.

General

Primary insulation of connectors within the Lovink system is undertaken using Polypropylene tubes and spacers, each tube is split down one side to allow ease of fitting so preventing the need to park the tubes on the cores before final connection.

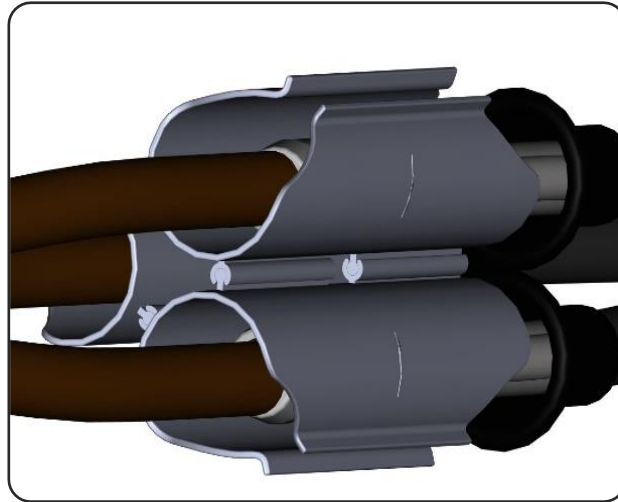
The spacers provide clearance between the tubes allowing a flow of silicon compound (Lovisil), and also to facilitate the correct installation of the tubes. Using slots and or a key way prevents the split of the tube facing each other with the possible result of a phase-to-phase flashover; the one inner sleeve also plays a part in the joint insulation.

Method of Installation

Refer to Drawings GR2D 6.37.1, 6.37.2 and 6.37.3 whilst undertaking this General Requirement.

37.1 Straight Joints / Pot ends – triplex and transitional (M Series)

- 1.1 Using an approved degreaser clean the full length of EPR core insulation and the connectors; do not apply degreaser to paper insulation, dry wipe only.
- 1.2 Fit the insulation shrouds over the connectors with the opening facing outwards
- 1.3 Snap together the two locking keyways to the adjacent shroud.
- 1.4 Centralise the insulation tube assembly to the connectors and check that the keyways are still locked together



37.2 Straight Joints – Single Core

- 2.1 Using an approved degreaser clean the full length of EPR core insulation and the connector; do not apply degreaser to paper insulation, dry wipe only.
- 2.2 Slide the ring spacer over the connector and position with the spacer face against the inner sleeve cam within the bottom half of the inner sleeve.

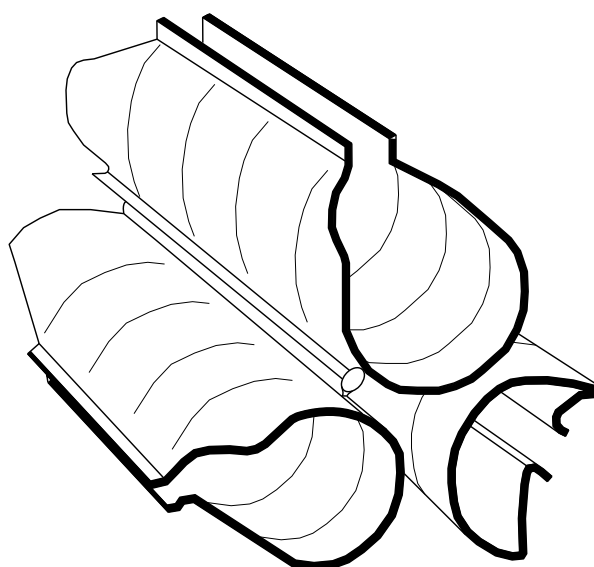
37.3 Branch Joints – triplex and transitional


- 3.1 Using an approved degreaser clean the full length of the EPR core insulation and the connectors, do not apply degreaser to paper insulation, dry wipe only.
- 3.2 Ensure that the two insulation spacers are positioned either side of the connectors.
- 3.3 Open the insulation tubes and place over the connectors; slide the spacers over and into the tube key ways and slots.
- 3.4 Centralise the insulation tube assembly to the connectors.

Notes: - Ease of fitting may be helped by fitting a spacer at one end and securing with a temporary tie, the second spacer can now be fitted at the opposite end. Ensure all temporary ties are removed after fitting.

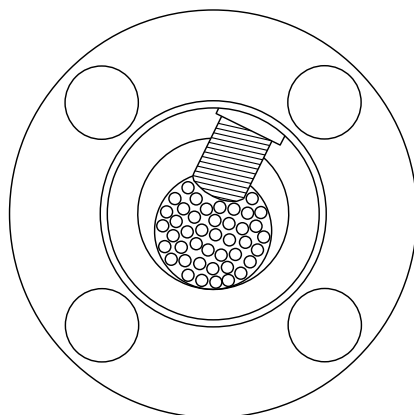
37.4 Loop Joints – triplex and transitional

- 4.1 Using an approved degreaser clean the full length of the EPR core insulation and the connectors, do not apply degreaser to paper insulation, dry wipe only.
- 4.2 Slide the spacers into the insulation tube keyway and slots, taking the complete assembly position over the connectors.
- 4.3 Centralise the insulation tube assembly to the connectors.

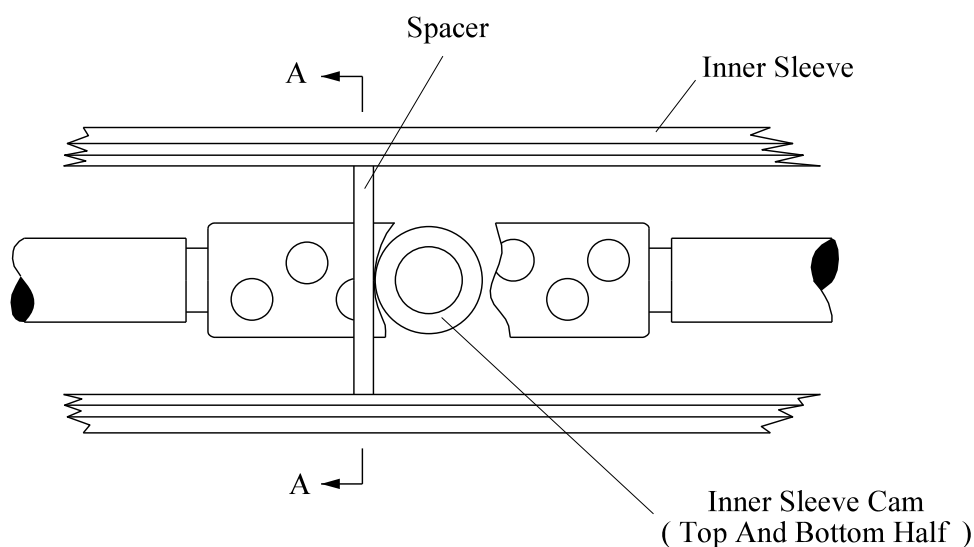


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Drawn	RJB	04/13			
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Approved					
SCALE		N.T.S.		Title	
				INSULATION SET FOR STRAIGHT AND STOP END JOINTS (LOVINK)	
				Drg. No. GR2D 6.37.1	
				Rev No	


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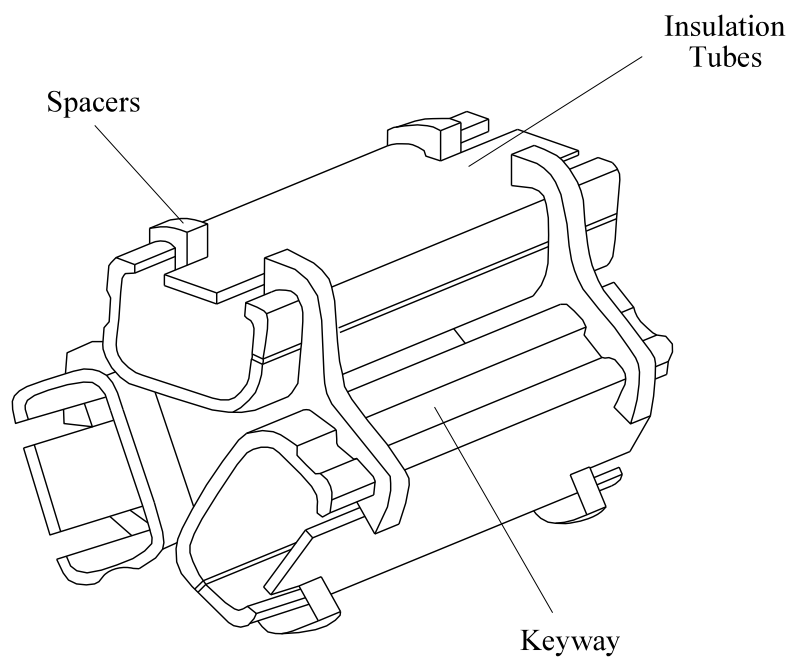
Section Through A-A




PLAN VIEW

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Drawn	RJB	04/13			
Checked					
Approved					
SCALE		N.T.S.		Title	
				INSULATION SPACER FOR SINGLE CORE STRAIGHT JOINTS	
				Drg. No. GR2D 6.37.2	
				Rev No	

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Checked				<div>WESTERN POWER DISTRIBUTION</div>	
Approved					
SCALE		N.T.S.		Title	
				INSULATION SET FOR BRANCH AND LOOP JOINTS	
				Drg. No. GR2D 6.37.3	
				Rev No	

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GENERAL REQUIREMENT 38

INSTALLATION OF STOP END MODULES (LOVINK / TYCO)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents given in General Requirement 1.

General

Both the Lovink and Tyco systems use base straight joint modules to provide a stop end, the loop joint is provided by the use of the branch joint base module.

Both systems convert existing base modules to a stop end/loop joint by the introduction of a polymer-insulated rod.

Method of Installation

Refer to Drawing GR2D 6.38.1 whilst undertaking this General Requirement.

38.1 Lovink Stop End / Loop Joint

- 1.1 Ensure the insulation rod is thoroughly cleaned using an approved degreaser.
- 1.2 Slide two foam rings over the rod.
- 1.3 Offer the rod to the inner sleeve and position the foam rings to their required position.

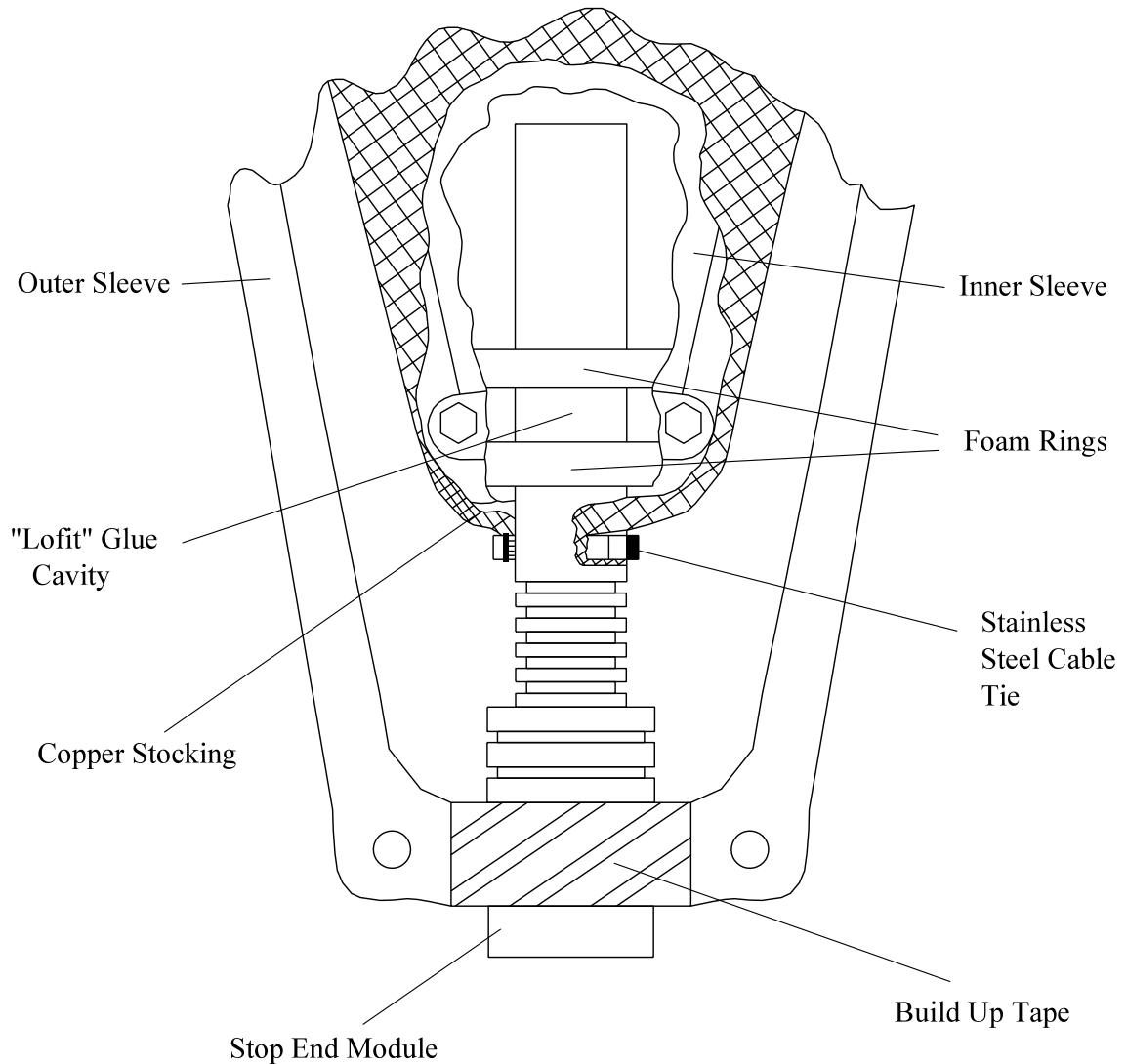
Note: - When the top half of the inner sleeve is fitted ensure the funnel filling holes are clear.

- 1.4 Complete the joint to the relevant jointing procedure.


38.2 Tyco Stop End

- 2.1 Fit the polymer rod to the cable conductor.
- 2.2 Thoroughly clean the polymer rod and conductor insulation, using an approved degreaser.
- 2.3 Complete the joint to the relevant jointing procedure.

All dimensions in mm



PLAN VIEW

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Approved						
SCALE	N.T.S.	Title INSTALLATION OF STOP END AND LOOP JOINT MODULE				Drg. No. GR2D 6.38.1
						Rev No

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GENERAL REQUIREMENT 39

INSTALLATION OF INNER SLEEVE (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents given in General Requirement 1.

General

The correct installation of the inner sleeve is of the utmost importance, the inner sleeve has the following roles in the joint design which is to provide insulation, retain the insulating compound and prevent the ingress of moisture.

It is therefore important the cables are set correctly in line and straight to the joint position, they must be free from grease and any temporary binders are to be removed, the foam rings are intact (free from splits etc.) and close fitting to the cable sheaths.

Should these areas not meet the requirements then the Lovifit glue compound will not seal or at worst leak into or out of the sleeve, therefore not providing a moisture seal or retention of the Lovisil silicon compound.

39.1 Method of Installation

- 1.1 Remove all temporary binders, and ensure the joint is grease free.
- 1.2 Offer the lower half of the inner sleeve to the joint, ensure the insulating tube set is positioned between the sleeve location “stand offs”, and is equi-distant from the grey build-up tapes.
- 1.3 Adjust the foam rings at the joint ends until they are positioned into their respective ribbed rings and butted against their sealing ridges.
- 1.4 **Depending on cable sizes foam rings or metallic sheaths will at times thus requiring building up with foam tape to the respective joint size.**
If this is not a requirement move to step 5.
Remove the backing paper and apply the tape sticky side to the foam ring under light tension, ensuring each layer is directly over the previous layer, the correct diameter is achieved when the calliper is a ‘snug’ fit to the foam tape calliper.
- 1.5 Offer the upper half to the lower half of the inner sleeve ensuring the funnel holes are clear of the foam rings.

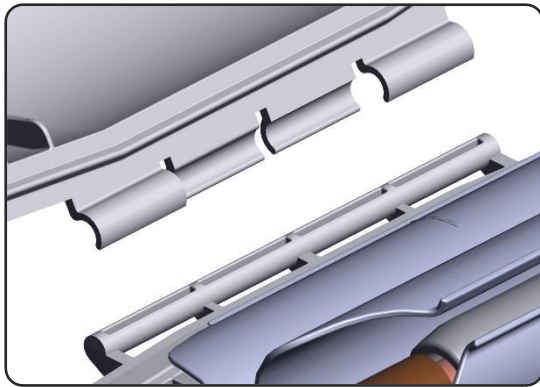
K Series Joints

- 1.6 Fit and tighten the fixing screws across the diagonal using a torque driver set at 5Nm.
- 1.7 Insert the funnels into the upper half of the inner sleeve.

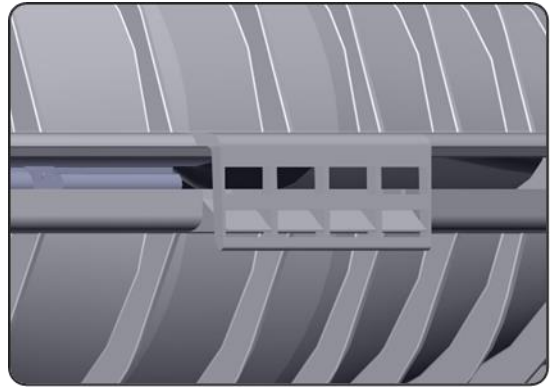
- 1.8 Mix the Lovifit glue compound for one minute until a uniform colour is achieved, the compound must be above 10°C before and whilst mixing, General Requirement 37.
- 1.9 Pour the mixed compound into **one** funnel until it appears in the other funnel(s).

Note: - For branch/loop joints the compound is to be poured into **one** funnel at the double end until it reaches the single end.
- 1.10 Once the Lovifit glue compound has cured (normally after the inner sleeve has been filled with silicon compound) saw off the funnels between the stem flange rings close to the inner sleeve.

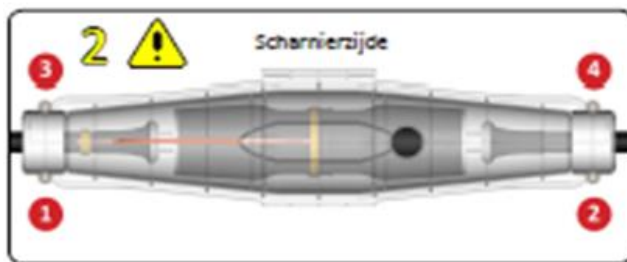
M Series Joints



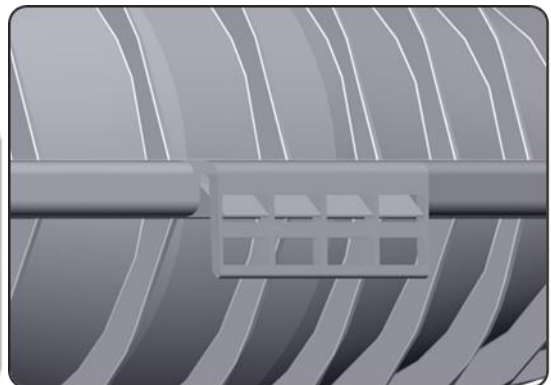
Having positioned the foam rings, connect together the two halves of the inner shell



Wrap the shell around the cable and snap together – **FIRST POSITION ONLY**



Tighten the 4 fixing bolts to 5Nm in the order shown above



Close the shell to the second position

GENERAL REQUIREMENT 40

MIXING AND POURING OF TWO-PART LOVIFIT GLUE (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the Use of Solvents given in General Requirement 1.

General

The Lovifit glue is used to provide a watertight seal between the cable sheaths and inner sleeve. To ensure adhesion and subsequent sealing to metallic sheaths the sheaths must be abraded and thoroughly degreased, semi-conducting screens must be kept free of grease or other contaminates.

The liquid components of the two-part Lovifit glue used in Lovink cable joints are contained in a foil pack, which forms an enclosed system. This ensures that mixing of the resin and hardener components are completed without exposure to the mixer.

Although the enclosed system should be effective in preventing contact with harmful materials, the following basic precautions shall be taken when using two-part Lovifit glue.

40.1 Safety / First Aid

Skin Contact

The hardener is irritating to the skin. The use of the disposable plastic gloves provided should eliminate any contact, but if it occurs, the affected area should be washed immediately with plenty of soap and water.

Splashes in the Eye

The hardener is irritating to the eyes. Suitable protection such as goggles or a face visor shall be worn when pouring or stirring. In case of contact with the eyes, rinse immediately with plenty of water and seek medical advice.

Breathing of Vapour

Ensure that adequate ventilation is provided to prevent high concentrations of vapour building up in the working area. Pay particular attention to this requirement when working in confined areas.

If adequate ventilation cannot be provided, suitable respiratory equipment shall be worn.

Fire Hazard

The resin and hardener have low flammability but, if a fire occurs in an area where the hardener is stored; a dangerous vapour will be produced. Anyone tackling the fire must wear suitable respiratory equipment.

Decontamination/Disposal of Containers

Isocyanate containers must be neutralised before disposal, this is unnecessary with the foil pack. The internal mixing bag can be disposed of as non-harmful after the contents have been mixed.

A WPD label stating the contents are inert and safe to handle, must be applied to the DSD or CLP label before disposal.

40.2 Method of Mixing

Safety and handling information is printed on the outside of the pack and must be observed.

- 2.1 Examine the foil pouch containing the hardener and polyol to ensure it is free of damage.
- 2.2 Support the foil pouch and using scissors make a small cut to the bag top, carefully tear the top edge along its length starting at the cut position.
- 2.3 Remove the contents from the foil pouch checking the two compartments for damage.
- 2.4 Support the two compartments with the rubber cord uppermost, take the free end of the rubber cord and pull gently this will release the green channel.
- 2.5 With the bag extended to its full length and with a tumbling action allow the two components to mix thoroughly until a uniform colour is achieved.

Mixing thoroughly for one minute only ensuring all components are removed from the seams of the bag.
- 2.6 Cut a corner of the bag and pour into the inner sleeve.
- 2.7 Pour the mix slowly into the funnel at one end of the inner sleeve, mixing and pouring should be continuous so that delays are kept to a minimum.
- 2.8 Apply decontamination labels to all hazardous warning signs and remove to WPD depots for correct disposal, drawing GR2D 6.40.1.

Note: - If the white substance in the resin compartment of the mix has hardened and become lumpy do not attempt to mix into the two-part mix, bits may breakaway and block the channels of the inner sleeve.

All dimensions in mm

Adhesive Backed Label


WESTERN POWER 
DISTRIBUTION

Serving the Midlands, South West and Wales

THE CONTENTS OF THIS PACKAGE
HAVE BEEN RENDERED INERT AND
ARE NO LONGER HARMFUL

Note :- This Label Is To Be Placed Across The Black
Warning Cross On The Orange Background
Of The Suppliers Harmful Warning Label

This Is To Be Undertaken On All Harmful Substance
Containers / Packaging Used Within WPD
Once The Substance Has Been Rendered Inert

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Drawn	RJB	04/13				
Checked						
Approved						
SCALE	N.T.S.		Title DECONTAMINATION LABEL FOR HARMFUL SUBSTANCE CONTAINERS / PACKAGING			Drg. No. GR2D 6.40.1
						Rev No

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GENERAL REQUIREMENT 41

FILLING OF INNER SLEEVE (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3

General

The inner sleeve is filled with Lovisil silicon cold pour compound, which provides insulation and helps to prevent electrical stress within the joint. It is important to protect the compound from the elements i.e. moisture, dust etc. throughout the filling operation. Due to the silicon compound being cold pour a little time should be given to allow for settlement and to ensure air voids are expelled.

During filling and throughout its service the joint must be maintained in a level position, a tolerance of two degrees maximum out of level is the most acceptable.

41.1 Method of Filling – K Series

Refer to Drawing GR2D 6.41.1 whilst undertaking this General Requirement.

- 1.1 Adjust and position the jerry can stand onto the inner sleeve. Place the jerry can into the stand with the small pouring hole (red cap) over the inner sleeve-filling hole.
- 1.2 Remove the small cap (red) and using the larger cap open and close to control the flow of the Lovisil silicon compound into the inner sleeve.

Fill to 2mm below the end of the threaded hole for the plug, fit and tighten the plug.

- 1.2 Thoroughly clean and degrease the inner sleeve.

41.2 Method of Filling – M Series

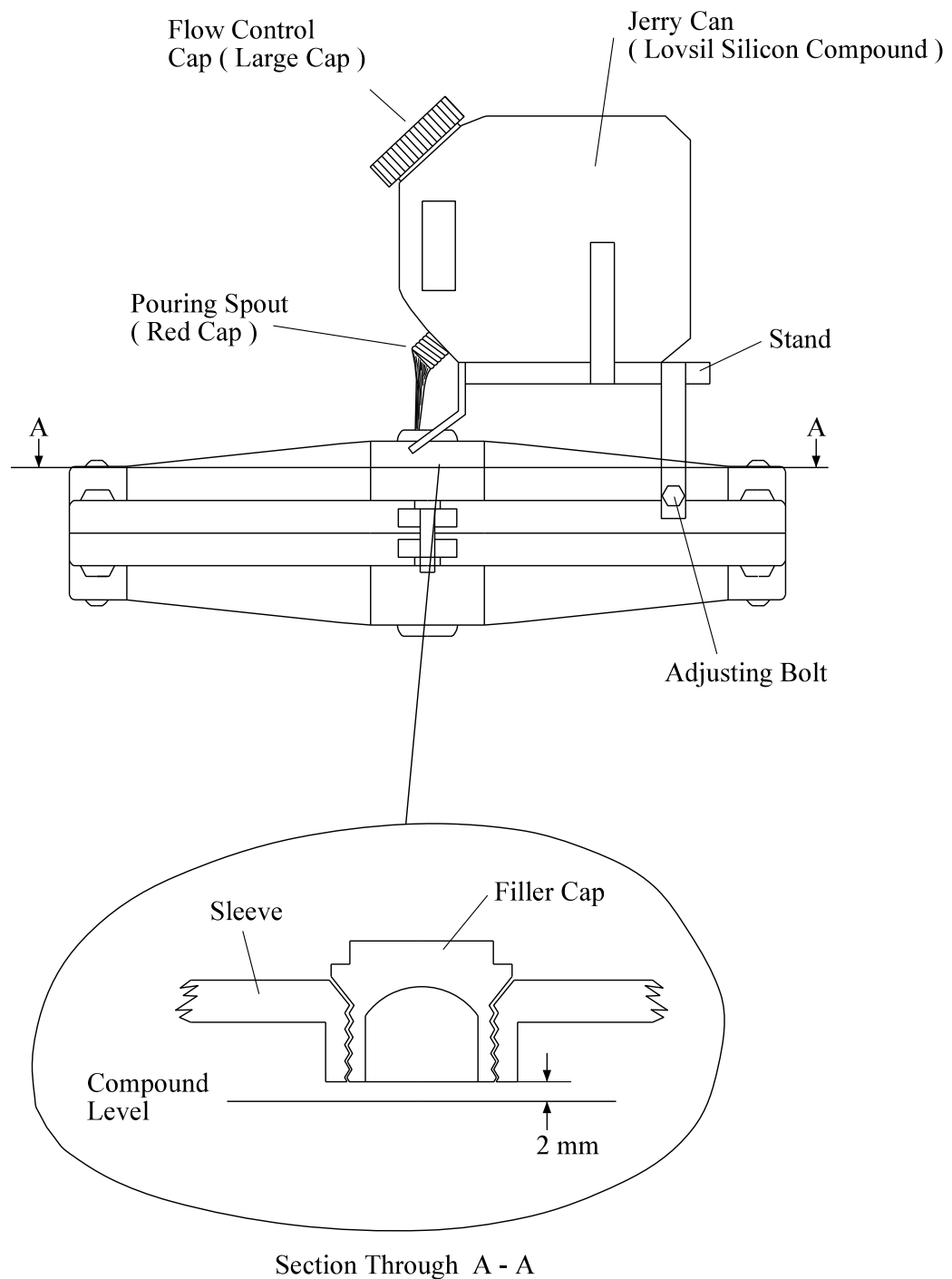



1.1 Position the bag on the filling hole as indicated

1.2 Hold spout firmly in the fill hole

1.3 Fill the inner shell to between the min and max lines

1.4 Tighten plug with a 19mm spanner



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SCALE		N.T.S.		Title	
				FILLING OF INNER SLEEVE	
				Drg. No. GR2D 6.41.1	
				Rev No	

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GENERAL REQUIREMENT 42

INSTALLATION OF METALLIC SHEATH / CSW EARTH BONDS (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

The application of any earth bond connection within a joint is very important, the necessary care of preparation and installation will ensure continuity through the joint and its associated cable system.

Wherever a fault occurs due to third party damage, lighting strikes or for other reasons, high fault currents flow, therefore the materials and installation must be able to sustain this change until the system trips.

Incorrect use of materials or poor installation can lead to failure of the bond, in the form of heat being produced causing possible burn of the connection or melting of the metallic sheath, it is therefore of the utmost importance that the assembly is installed correctly.

CAUTION: – Roll springs may have sharp edges and where possible gloves shall be worn.

Method of Installation

Refer to Drawings GR2D 6.42.1, 6.42.2, 6.42.3, 6.42.4 and 6.42.5 whilst undertaking this General Requirement.

42.1 EPR / XLPE Cables

1.1 Birdcage the copper screen wires of each cable and form into a single conductor, offer the copper earth braid to the earth connector and cut off the excess copper screen wires.

1.2 Make off the connector.

42.2 3 Core XLPE Cables

1.1 Birdcage the copper screen wires of each cable and form into a single conductor, offer the copper earth braid to the earth connector and cut off the excess copper screen wires.

1.2 Make off the connector.

42.3 PICAS Cables

- 2.1 Abrade the aluminium sheath circumferentially along its complete length using a stainless steel bristle wire brush, and clean with an approved degreaser – Fig 1a.
- 2.2 Using tinned copper mesh wrap and fill the trough and cover two crests of the corrugated aluminium sheath to ensure a flat profile under the intended position of the roll spring assembly – Fig 2a.
- 2.3 Lay the earth braid directly onto the tinned copper mesh ensuring there is sufficient tail to allow the earth braid to be turned back over the roll spring – Fig 3.
- 2.4 Starting with the end of the roll spring opposite the earth braid apply one complete turn **over** the earth braid wrapping in the same direction as the tinned copper mesh – Fig 4.
- 2.5 Turn the earth braid tail back over the roll spring and gently dress down to flatten – Fig 4.
- 2.6 Apply the remaining turns of the roll spring; tighten by hand using a twisting action – Fig 5.
- 2.7 Cover the complete assembly using 19mm wide “VM” tape, first fold 50mm of the tape end in half with the mastic side to the outside.

Lay the folded end between the earth braid and aluminium sheath abutting the roll spring; wrap the tape in the same direction as the roll spring with the mastic side down.

Apply a half lapped layer over the assembly overlapping 10mm onto the metallic sheath either side of the roll spring ensuring the assembly is completely covered see – Fig 6.

- 2.8 Make off the connector

42.4 PISAS Cable

- 3.1 Abrade the aluminium sheath circumferentially along its complete length using a stainless steel bristle wire brush, and clean with an approved degreaser – Fig 1.
- 3.2 Take the length of tinned copper mesh and fold in half along its length (thus reducing the width) wrap two layers around the aluminium sheath – Fig 2.
- 3.3 Lay the earth braid directly onto the tinned copper mesh ensuring there is sufficient tail to allow the earth braid to be turned back over the roll spring – Fig 3.
- 3.4 Starting with the end of the roll spring opposite the earth braid apply one complete turn **over** the earth braid wrapping in the same direction as the tinned copper mesh – Fig 4.

- 3.5 Turn the earth braid tail back over the roll spring and gently dress down to flatten – Fig 4.
- 3.6 Apply the remaining turns of the roll spring; tighten by hand using a twisting action – Fig 5.
- 3.7 Cover the complete assembly using 19mm wide “VM” tape, first fold 50mm of the tape end in half with the mastic side to the outside.

Lay the folded end between the earth braid and aluminium sheath abutting the roll spring; wrap the tape in the same direction as the roll spring with the mastic side down.

Apply a half lapped layer over the assembly overlapping 10mm onto the metallic sheath either side of the roll spring; ensuring the assembly is completely covered – Fig 6.

- 3.8 Make off connector

42.5 PILC Cables

- 4.1 Abrade the lead sheath circumferentially along the complete length using a file card, and clean with an approved degreaser – Fig 1.
- 4.2 Take the length of tinned copper mesh and fold in half along its length (thus reducing the width), wrap two layers around the lead sheath – Fig 2.
- 4.3 Lay the earth braid directly onto the tinned copper mesh ensuring there is sufficient tail to allow the earth braid to be turned back over the roll spring – Fig 3.
- 4.4 Starting with the end of the roll spring opposite the earth braid apply one complete turn **over** the earth braid wrapping in the same direction as the tinned copper mesh – Fig 4.
- 4.5 Turn the earth braid tail back over the roll spring and gently dress down to flatten – Fig 4.
- 4.6 Apply the remaining turns of the roll spring; tighten by hand using a twisting action – Fig 5.
- 4.7 Cover the complete assembly using 19mm “VM” tape; first fold 50mm of the tape end in half with the mastic side to the outside.

Lay the folded end between the earth braid and lead sheath abutting the roll spring; wrap the tape in the same direction as the roll spring with the mastic side down.

Apply a half lapped layer over the assembly overlapping 10mm onto the metallic sheath either side of the roll spring ensuring the assembly is completely covered see – Fig 6.

4.8 Make off connector

42.6 3 Core XLPE SWA Cables

5.1 Prepare the cable as per General Requirement 14.

5.2 Prepare the copper tape screens as per General Requirement 29.

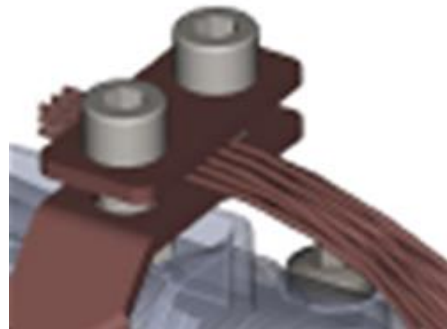
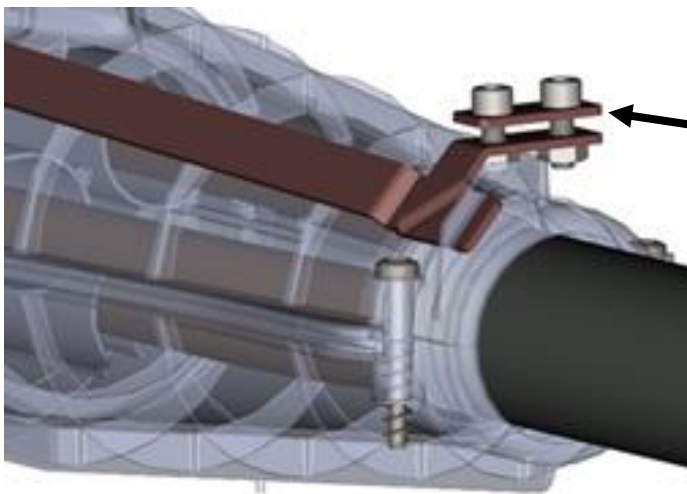
5.3 Take the copper braid applied in 5.1 and lay into a BCNE3 UTB connector.

5.4 Take each braid applied in 5.2 to the copper tapes and lay into the BCNE3 UTB connector.

5.5 Make off connector.

42.7 M Series Connector Arrangement

The M series joints are supplied with an integral earth bar with connectors at each end
Tighten clamp bolts to 12Nm



For CWS cables the earth wires terminate directly into the clamp.

For PICAS, PISAS, PILC and SWA cables the previously connected braids are terminated into the connector

Note :- For Electrical And Mechanical Stability
The Roll Spring Assembly Must Be Assembled In The Following Sequence.

Fig 1

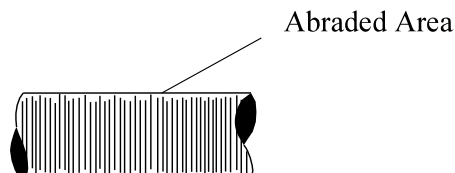


Fig 1a

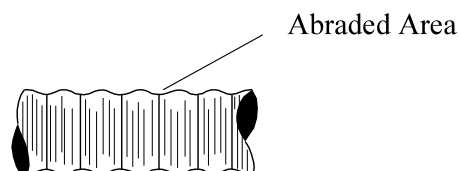


Fig 2

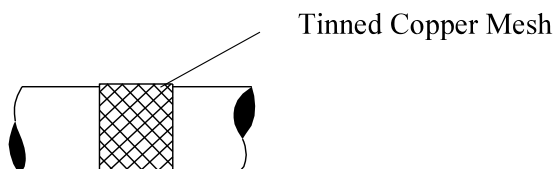
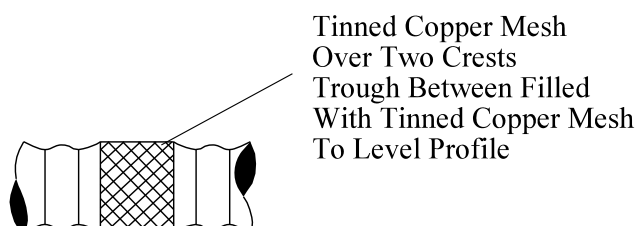



Fig 2a



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				APPLICATION OF EARTH BONDS	
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				GR2D 6.42.1	
				Rev No	

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Note :- The Application For All Cable Types Is Identical
From Fig 3 Onwards

Fig 3

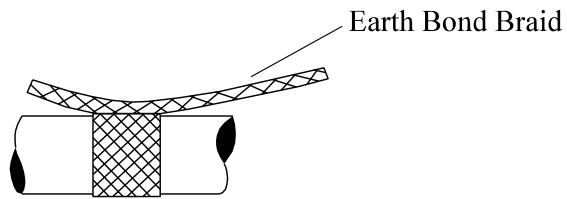


Fig 4

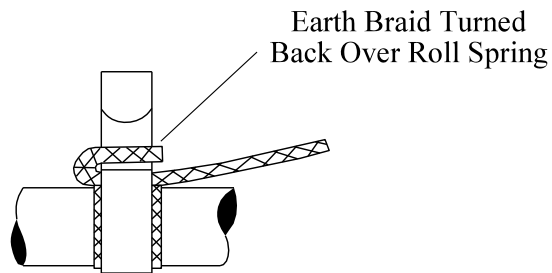


Fig 5

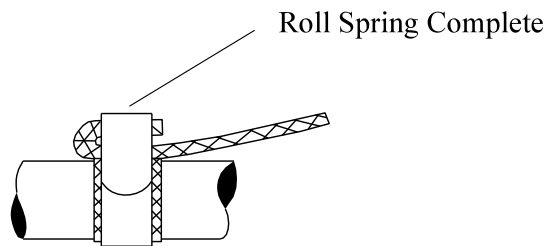
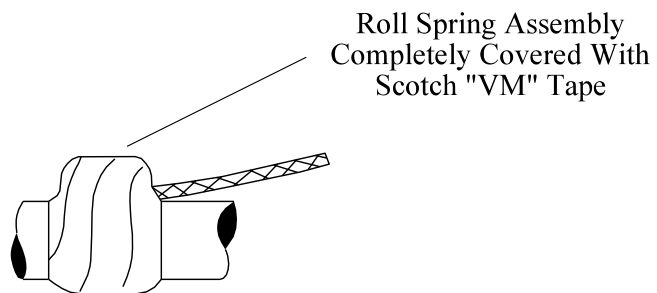



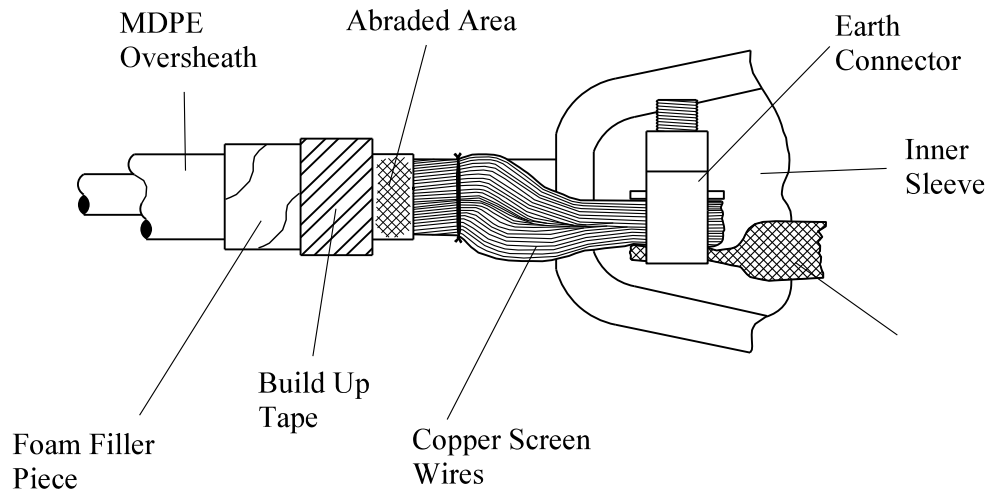
Fig 6



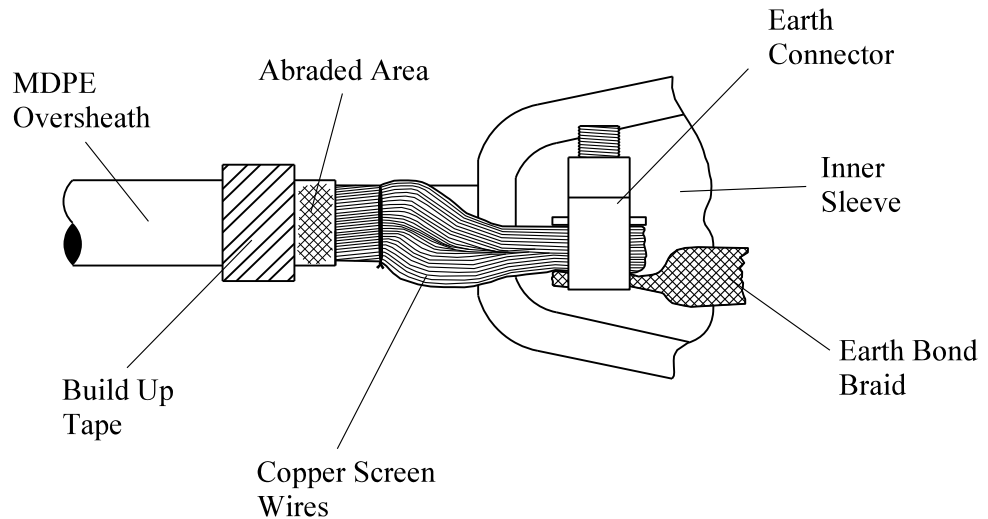
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EPR TRIPLEX



EPR SINGLE CORE

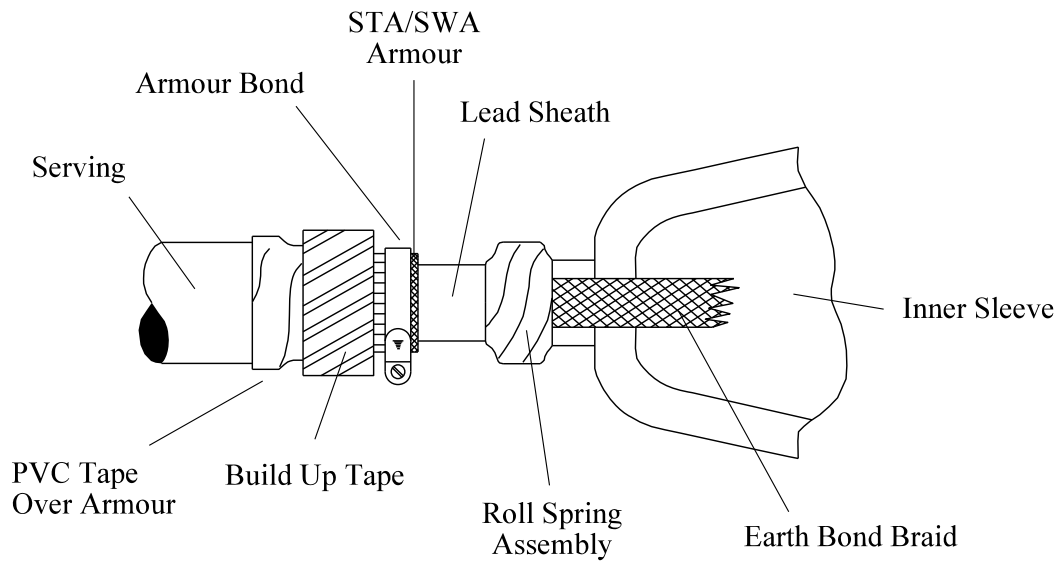


PLAN VIEW

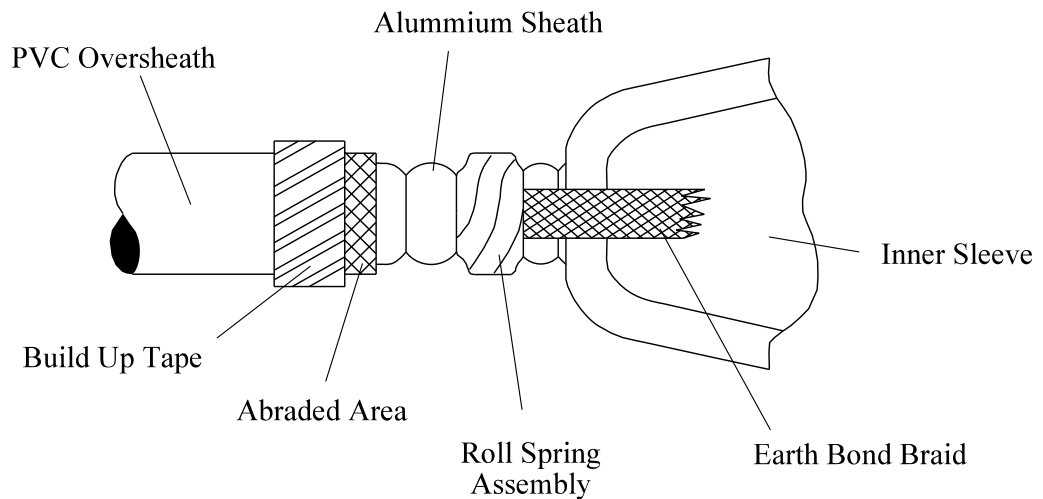
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PILC



PICAS

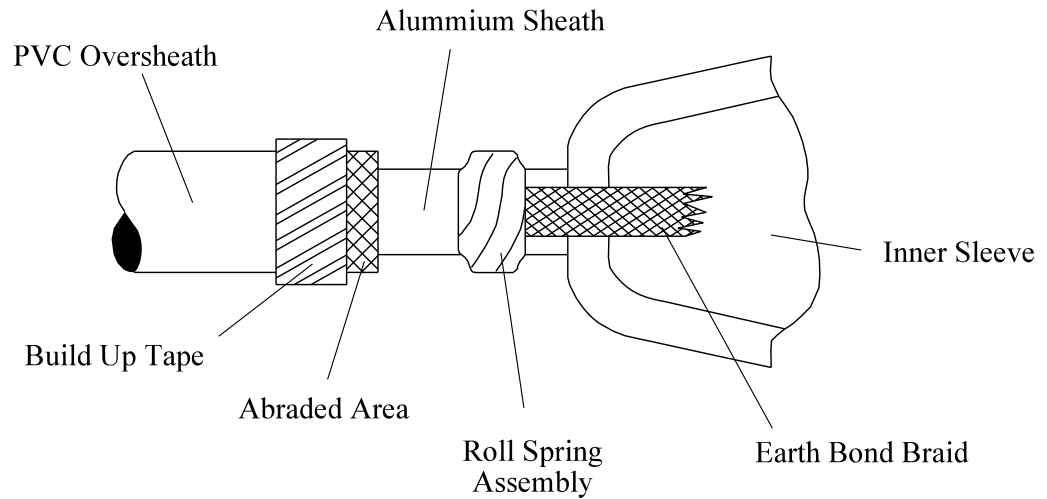


PLAN VIEW

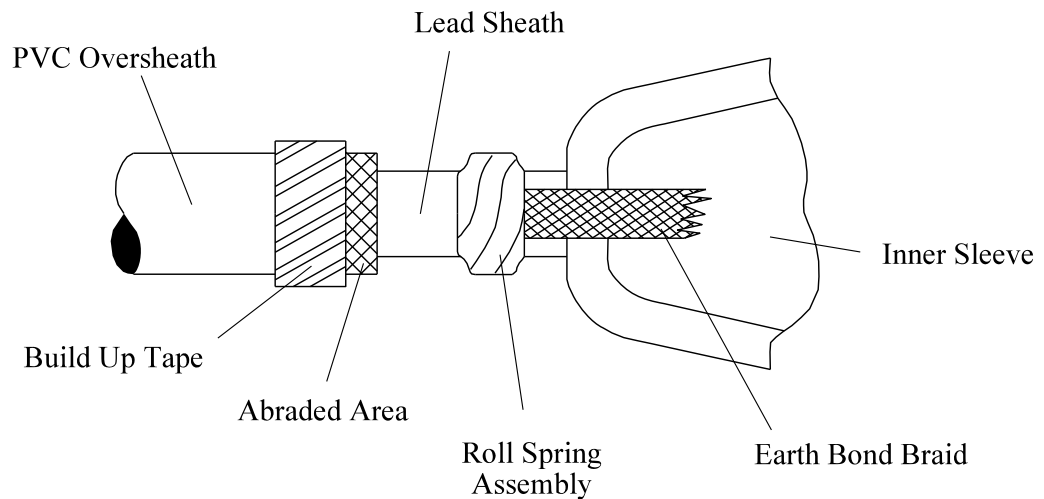
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PISAS



PILC SINGLE CORE



PLAN VIEW

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GENERAL REQUIREMENT 43

DEGREASING OF JOINTS AND TERMINATIONS

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents given in General Requirement 1.

General

Failure to degrease or clean contamination from joints or terminations will prevent the sealing of glues and resins to prevent the ingress of moisture, whereas traces of contamination on conductor insulation may lead to tracking and possible electrical failure.

Degreasers must be approved and only approved degreasers are to be used.

Safety

The degreasers should only be dispensed from the small containers provided, do not use large cans.

Ensure good ventilation, particularly if working in confined places.

Dispense only sufficient degreaser onto the wiper, it is unnecessary, wasteful and potentially harmful to pour out large quantities which merely splash onto the ground.

Contact of the degreaser with naked flames and red-hot surfaces should be avoided.

Do not smoke while using the degreasers.

Avoid unnecessary contact with the skin; the approved PVC gloves provided shall be worn, if considered necessary, eye protection may be worn.

Follow any safety precautions printed on the container.

Containers are to only be disposed of at Company depots, and a decontamination label is to be placed over the hazardous warning label.

43.1 Degreasing Terminations

The degreasing operation must be carried out prior to the fitting of the termination body and after all semi-conducting screen removal has been completed.

- 1.1 Apply the approved degreaser to a clean wipe, only use sufficient to effectively remove any contaminant present.
- 1.2 Firstly degrease the insulation taking care as to not touch the semi-conducting screen with the wipe, changing the wipe as it becomes contaminated.

- 1.3 To ensure the insulation is clean a full 360-degree contact is made with the insulation and in a single motion wipe down towards the semi-conducting screen. Throw away the wipe once this operation has been completed.
- 1.4 When degreasing has been completed, replace the top on the container to avoid spillage.

43.2 Degreasing Joints

The degreasing operation must be carried out prior to the fitting of the outer sleeves.

- 2.1 Apply the approved degreaser to a clean wipe, only use sufficient to effectively remove any contaminant present.
- 2.2 Firstly degrease the metallic sheaths and inner sleeve, changing the wipe as it becomes contaminated.
- 2.3 Degrease any abraded PVC or MDPE sheaths.
- 2.4 When degreasing has been completed, replace the top on the container to avoid spillage.

GENERAL REQUIREMENT 44

INSTALLATION OF COPPER STOCKING (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

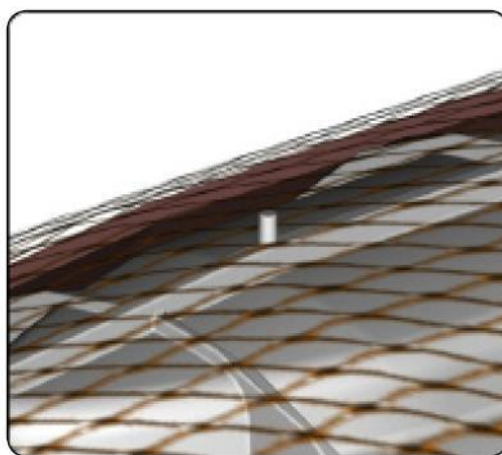
General

The copper stocking provides a conductive screen around the joint so eliminating any potential difference, which may arise.

The copper stocking is to be bonded onto the metallic cable sheaths/copper wires using cable ties at either end of the joint.

Note: For K series joints the copper stocking must be parked before the phase connections are made. For M series joints the copper stocking is split and can be wrapped over after the inner shell is fitted.

To aid fitting the split stocking on the M series joints the inner shell has an ABS spine that holds the stocking in place whilst it is wrapped around the shell



Method of Installation -

44.1 Straight/Branch Joints – EPR / XLPE Cables

- 1.1 Take the parked / split copper stocking and position equidistant over the inner sleeve.
- 1.2 Fold and tailor the copper stocking to the profile of the inner sleeve.
- 1.3 Using the supplied cable ties secure the copper stocking to the copper screen wires between the cable oversheath and 20 swg tinned copper binding wire, trimming of the excess copper stocking.

- 1.4 Ensure all excess copper stocking is clear of the mastic water block tape applied to the oversheath termination.

44.2 Straight/Branch Joints - PICAS/PISAS/PILC Cables

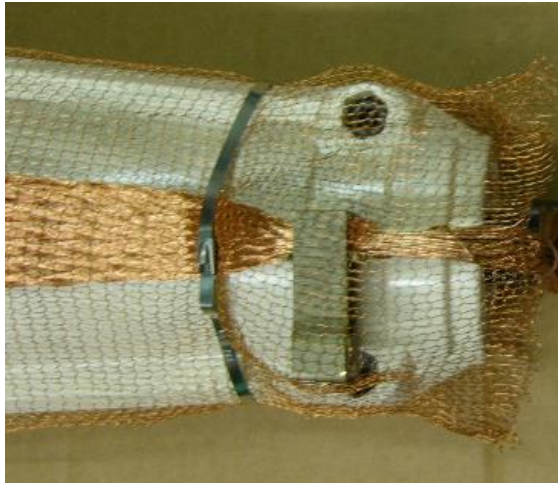
- 2.1 Take the parked / split copper stocking and position equidistant over the inner sleeve.
- 2.2 Fold and tailor the copper stocking to the profile of the inner sleeve.
- 2.3 Using the supplied cable tie secure the copper stocking to the metallic sheath, trimming of the excess copper stocking.
- 2.4 Ensure all excess copper stocking is clear of the mastic water block tape applied to the oversheath termination.

44.3 Stop End / Loop Joints – EPR/XLPE/PICAS/PISAS/PILC Cables

- 3.1 Take the parked / split copper stocking and position equidistant over the inner sleeve.
- 3.2 Fold and tailor the copper stocking to the profile of the inner sleeve.
- 3.3 Using the supplied cable tie secure the copper stocking to the stop end rod, trimming of the excess copper stocking.
- 3.4 Ensure all excess copper stocking is clear of the mastic water block tape applied to the oversheath termination.

44.4 Extended Straight/Branch Joints – EPR / XLPE Cables

- 4.1 Take the parked copper stocking, supplied with the base module, and position the stocking starting at the non-extended end of the joint and over the inner sleeve, ensuring the stocking is folded and tailored to the profile of the inner sleeve.
- 4.2 Using the supplied cable tie secure the copper stocking to the metallic sheath of the non-extended end of the joint, trimming of the excess copper stocking and making sure that all strands of the copper stocking are totally clear of the mastic water blocking tape and folded back over the cable tie and laid onto the stocking. Tailor the stocking to the inner sleeve then cable tie the stocking to the inner sleeve at the extended end of the joint.



- 4.3 Take the previously parked short stocking supplied with the extended shell (shown rolled at end) ready to be placed and overlapped onto first applied stocking, shown cable tied around inner shell. See below.



- 4.3 Take the short copper stocking and overlap the first copper stocking by approximately 30 mm beyond the stainless steel cable tie i.e. end of copper stocking 30mm beyond the cable tie. See below.



- 4.4 Apply a second stainless steel cable tie to the two stockings, as shown above. Turn back the short copper stocking over second applied stainless steel cable tie to prevent the stocking from being pulled away from overlap of the two applied stockings.



- 4.5 Using a stainless steel cable tie secure the copper stocking to the copper screen wires between the cable oversheath and 20 swg tinned copper binding wire, trimming of the excess copper stocking.
- 4.6 Ensure all excess copper stocking is clear of the mastic water block tape applied to the oversheath termination.

GENERAL REQUIREMENT 45

APPLICATION OF MASTIC TAPE WATER BLOCK

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

45.1 General

Due to the possible ingress of moisture between the single cores of EPR or XLPE cables, which form a triplex cable, being jointed with the Lovink jointing system, this ingress of moisture then in turn causes problems when the particular circuit is sheath tested. The following method shall be undertaken on all EPR/ XLPE single core and triplex cables which are jointed with the Lovink resin filled system.

In addition polyurethane resin will not form an effective moisture seal to the lead/aluminium sheath; therefore it is necessary to introduce a mastic tape seal.

45.2 Method of Application

Refer to Drawing GR2D 6.45.1 whilst undertaking this General Requirement.

45.2.1 Lead Sheaths within Lovink Joints

- 1.1 Thoroughly clean the exposed lead sheath between the two earth bonds with an approved degreaser.
- 1.2 Abrade circumferentially the whole area with a file card.
- 1.3 Clean the abraded lead sheath with an approved degreaser.
- 1.4 Apply with light tension two half lap layers of black mastic water blocking tape over the exposed lead sheath.

45.2.2 Aluminium Sheaths within Lovink Joints

- 2.1 Thoroughly clean the exposed aluminium sheath between the earth bond and PVC oversheath with an approved degreaser.
- 2.2 Abrade circumferentially the whole area with a stainless steel bristle wire brush.
- 2.3 Clean the abraded aluminium sheath with an approved degreaser.
- 2.4 Apply with light tension two half-lap layers of black mastic water blocking tape over the exposed aluminium sheath overlapping onto the PVC oversheath by 10mm.

45.3 EPR/XLPE Triplex Cables within Lovink Joints

45.3.1 Method of application

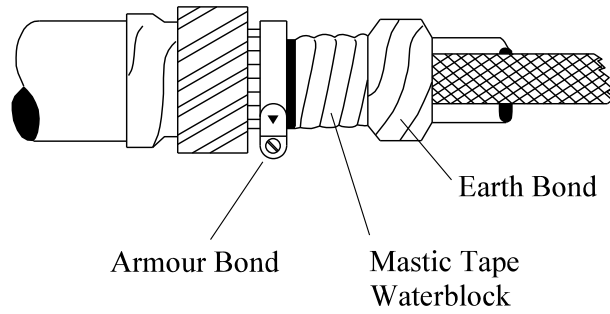
Refer to Drawing GR2D 6.45.2 (see attached) whilst undertaking this General Requirement.

- 3.1 Prep the cables as per the relevant jointing procedure.
- 3.2 The oversheaths are to be thoroughly abraded and cleaned with De-solvit 1000FD.
- 3.3 Apply two layers of 5313 water blocking tape starting 10mm from the over sheath termination with half lap layers, using light tension move towards and onto the copper screen wires for a distance of 10mm, return with half lap layers back to the start point on the oversheath.
- 3.4 On completion of step 3 cover the mastic tape with the yellow wax backing paper to keep the water block tape clean, undisturbed and to prevent cores from sticking together at this stage.
- 3.5 Fit the foam filler piece between the three single core cables, a cable tie is to be placed around the oversheath of each core before final positioning of the foam filler piece.
- 3.6 Proceed with the jointing procedure until the point is reached whereby the wax backing tape requires removal to allow completion of the joint.

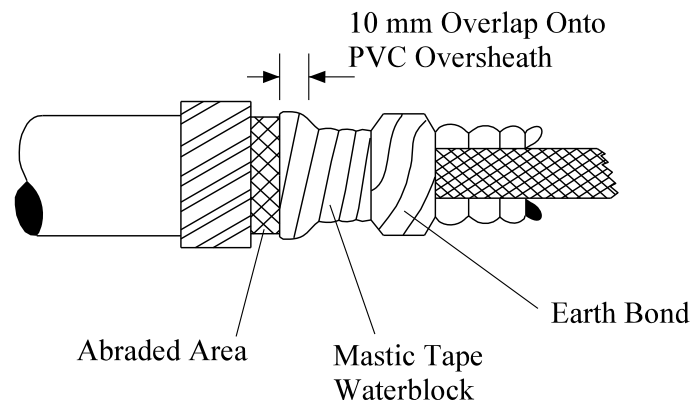
Note: - The mastic blocks will touch and seal as the cores are positioned into their final position, the cable ties around the outer sheaths will touch therefore allowing a gap between the cores for resin to flow between and allow sealing between the oversheaths.


All dimensions in mm

PILC



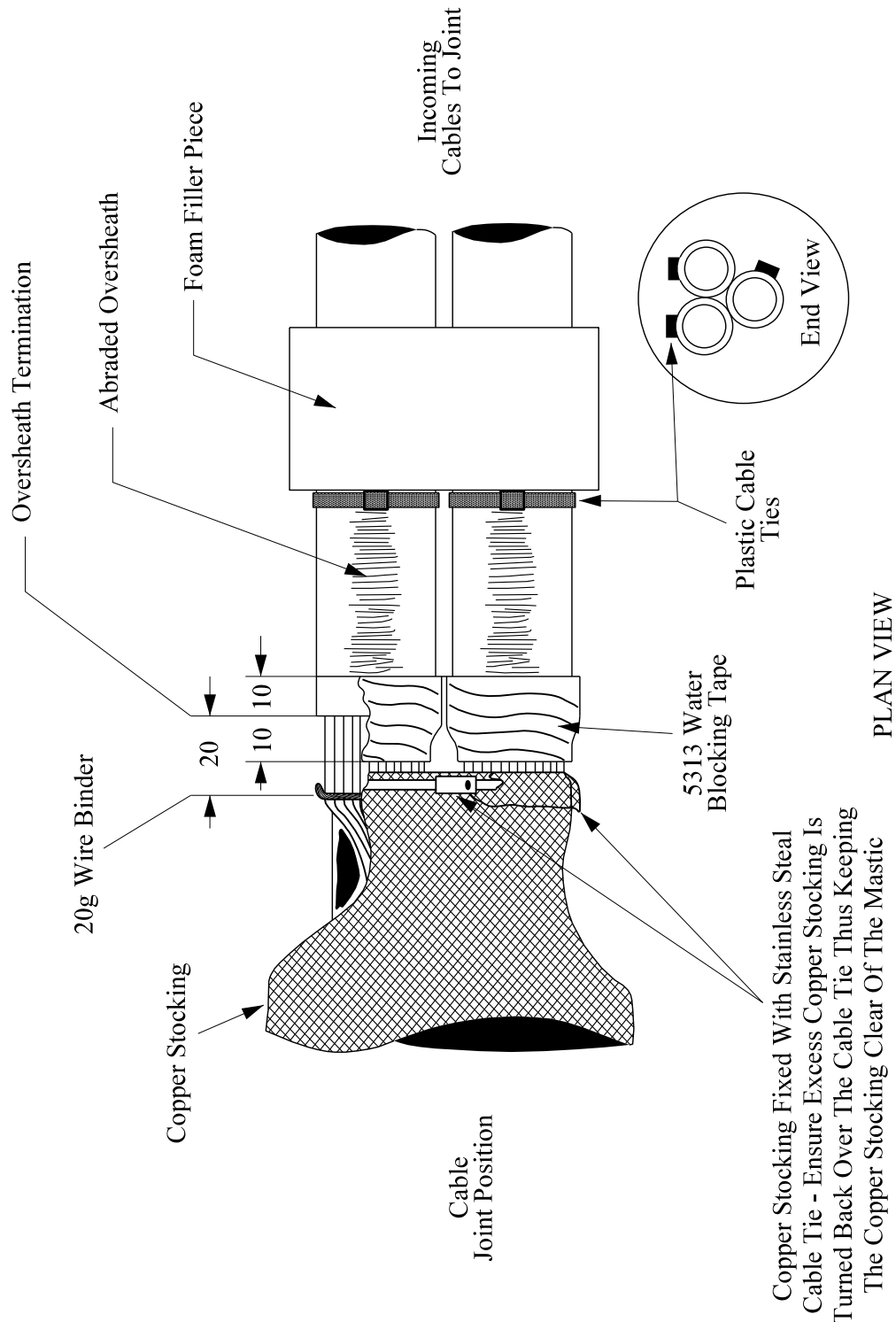
PICAS / PISAS




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Checked			Title MASTIC WATERBLOCK FOR METALIC SHEATH			Drg. No. GR2D 6.45.1	Rev No
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Title				Drg. No.		Rev No
PROCEDURE FOR WATER BLOCKING OF EPR / XLPE SINGLE CORE CABLE				GR2D 6.45.2		

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GENERAL REQUIREMENT 46

INSTALLATION OF OUTER SLEEVE (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

The outer sleeve forms part of the mechanical protection and moisture sealing requirements of the joint along with the two-part polyurethane resin fill.

A level of 7mm from the filling port top is to be achieved, this will allow for displacement when the metal filling port lids are inserted. These lids also act as a heat sink to assist heat dissipation during the resin-curing phase, so helping to control shrinkage.

Build-up of the cable entries is important to ensure centralisation of the sleeve and retention of the resin fill; small weeps, which appear during filling, may be blocked using sealing putty.

Support stand offs are positioned at the sleeve ends, these provide temporary support by binding the two halves with cable ties or PVC tape whilst the sleeve fixing screws are fitted and tighten.

The fitted sleeve base shall be supported before the commencement of pouring the resin fill.

46.1 Method of Installation

- 1.1 Degrease the inner surface of the sleeve halves.
- 1.2 Position the bottom half of the outer sleeve under the joint, and adjust so that the inner sleeve is equip-distant inside the outer sleeve, support in its required position.
- 1.3 Place the upper half of the sleeve to the lower half and fit the fixing screws.
- 1.4 Fit and tighten the fixing screws across the diagonal using a torque driver set at 5Nm.
- 1.5 Fill the outer sleeve with Protolin two-part polyurethane resin.
- 1.6 Fit the metallic filling lids into the filling ports.

GENERAL REQUIREMENT 47

MIXING AND POURING OF TWO-PART PROTOLIN RESIN (LOVINK)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

Protolin two part polyurethane provides mechanical and moisture sealing to the completed joint.

The liquid components of the Protolin two-part polyurethane resin used in the Lovink cable joints are contained in a foil pack, which forms an enclosed system. This ensures that mixing of the polyol and hardener components are completed without exposure to the mixer.

Although the enclosed system should be effective in preventing contact with harmful materials, the following basic precautions shall be taken when using Protolin two-part polyurethane resin.

Once the foil bag protecting the two part polyurethane mix has been opened the resin needs to be mixed, if for some reason the resin is not required then the two part polyurethane resin shall be mixed and once mixed disposed of correctly. Do not try to store the resin for some period of time as moisture will penetrate the bag and cause the resin to foam.

47.1 Safety/First Aid

Skin Contact

The hardener is irritating to the skin. The use of the disposable plastic gloves provided should eliminate any contact, but if it occurs, the affected area should be washed immediately with plenty of soap and water.

Splashes in the Eye

The hardener is irritating to the eyes. Suitable protection such as goggles or a face visor shall be worn when pouring or stirring. In case of contact with the eyes, rinse immediately with plenty of water and seek medical advice.

Breathing of Vapour

Ensure that adequate ventilation is provided to prevent high concentrations of vapour building up in the working area. Pay particular attention to this requirement when working in confined areas.

If adequate ventilation cannot be provided, suitable respiratory equipment shall be worn.

Fire Hazard

The resin and hardener have low flammability but, if a fire occurs in an area where the hardener is stored, a dangerous vapour will be produced. Anyone tackling the fire must wear suitable respiratory equipment.

Decontamination/Disposal of Containers

Isocyanate containers must be neutralised before disposal, this is unnecessary with the foil pack. The internal mixing bag can be disposed of as non-harmful after the contents have been thoroughly mixed.

A WPD label stating the contents are inert and safe to handle, must be applied to the hazardous black cross on the orange background before disposal.

47.2 Method of Mixing – K Series Joints

Safety and handling information is printed on the outside of the pack and must be observed.

- 2.1 Examine the foil pouch containing the hardener and polyol to ensure it is free of damage.
- 2.2 Support the foil pouch and using scissors make a small cut to the bag top, carefully tear the top edge along its length starting at the cut position.
- 2.3 Remove the contents from the foil pouch checking the two compartments for damage.
- 2.4 Support the two components with the green channel uppermost, take the free end of the bag and pull gently this will release the green channel and slide rail.
- 2.5 With the bag extended to its full length and with a tumbling action allow the two components to mix thoroughly until a uniform colour is achieved.

Mixing thoroughly for two minutes ensuring all components are removed from the seams of the bag.

- 2.6 Cut a corner of the bag and pour into the outer sleeve
- 2.7 Pour the mix slowly into one end of the outer sleeve, mixing and pouring should be continuous so that delays are kept to a minimum.
- 2.8 Apply decontamination labels to all hazardous warning signs and remove to WPD depots for correct disposal, drawing GR2D 6.47.1.

All dimensions in mm

Adhesive Backed Label


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THE CONTENTS OF THIS PACKAGE
HAVE BEEN RENDERED INERT AND
ARE NO LONGER HARMFUL

Note :- This Label Is To Be Placed Across The Black
Warning Cross On The Orange Background
Of The Suppliers Harmful Warning Label

This Is To Be Undertaken On All Harmful Substance
Containers / Packaging Used Within WPD
Once The Substance Has Been Rendered Inert

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SCALE	N.T.S.		Title DECONTAMINATION LABEL FOR HARMFUL SUBSTANCE CONTAINERS / PACKAGING			Drg. No. GR2D 6.47.1
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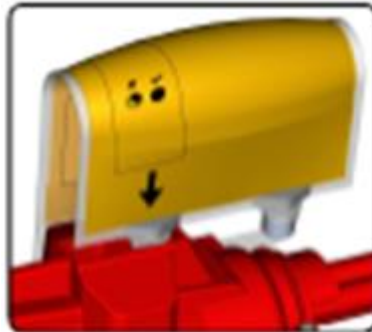
47.3 Method of Mixing – M Series Joints

Safety and handling information is printed on the outside of the pack and must be observed.

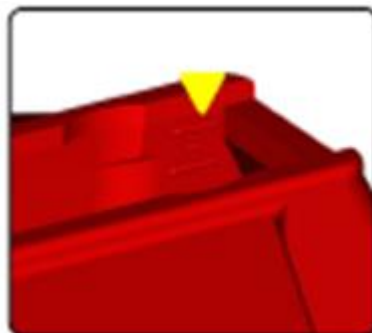
- 3.1 Examine the foil pouch containing the hardener and polyol to ensure it is free of damage.
- 3.2 Support the foil pouch and using scissors make a small cut to the bag top, carefully tear the top edge along its length starting at the cut position.
- 3.3 Remove the contents from the foil pouch checking the two compartments for damage.
- 3.4 Support the two component bag in the vertical, gently squeeze the two sections of the Protolin bag together so that the weak central seam bursts and allows the hardener and polyol to mix.
- 3.5 With the bag extended to its full length and with a tumbling action allow the two components to mix thoroughly until a uniform colour is achieved.

Mixing thoroughly for two minutes ensuring all components are removed from the seams of the bag.

- 3.6 Position the filling port of the bag into one of the filling ports of the outer shell and pour resin into the outer sleeve.



- 3.7 Pour the mix slowly into one end of the outer sleeve, mixing and pouring should be continuous so that delays are kept to a minimum.



- 3.8 Push both covers into the filling ports, see below.



- 3.9 Apply decontamination labels to all hazardous warning signs and remove to WPD depots for correct disposal, drawing GR2D 6.47.1.

GENERAL REQUIREMENT 48

INSTALLATION OF COLD SHRINK JOINT BODY (TYCO)

Before commencing the level of PPE required for this operation shall be as the matrix given in General requirement 3, also your attention is drawn to the Use of Solvents General Requirement1.

General

The cold shrink insulation joint body provides conductor insulation, stress control at the semi-con screens and connector position, also an earthed screen around and across insulation tube, thereby reinstating the values and requirements of the cable core. To ensure a good electrical contact at the critical points of the semi-con screen it is important that the stripping dimensions are adhered to and the tube centralised correctly on completion during and after fitting. It is very important that the joint is kept contamination free during all stages of construction; otherwise tracking to earth within the tube will occur thus resulting in the joint failing.

48.1 Method of Installation.

Refer to Drawings **GR2D 6.48.1, 6.48.2 and 6.48.3** whilst undertaking this General Requirement

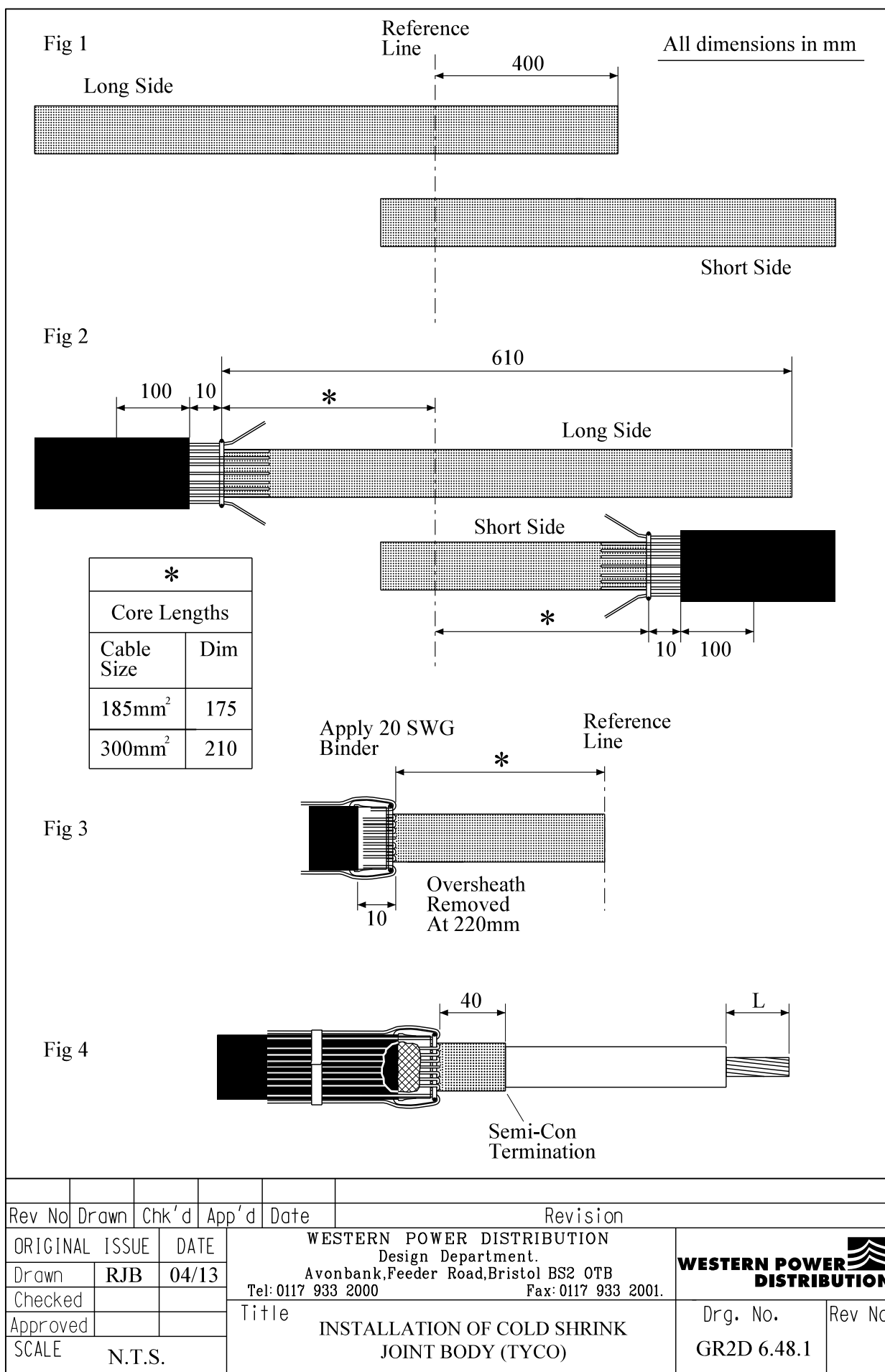
- 1.1 Ensure that one leg of the two single core cables being jointed overlaps the reference line of the joint by 400mm. Clean both the oversheaths for about 1.5m.
- 1.2 When jointing a large conductor size to a smaller conductor sized cable always park the joint body on the side of the smaller sized cable.
- 1.3 Ensure the release tail of the spiral holdout points away from the centre of the joint and slide the insulation tube over and park away from the jointing position. – Fig 1.
- 1.4 On the long side cable mark the oversheath at 620mm, apply a second mark at 720mm. Abrade the oversheath between these two marks. At the 620mm mark remove the oversheath. Apply a 20 swg binder at 610mm.
- 1.5 Apply a turn of Scotch 5313 mastic tape, under slight pressure around oversheath. Start 10mm on the oversheath apply two layers of Scotch 88 tape with a 50% overlap under moderate pressure over the Scotch 5313 tape.
- 1.6 Straighten the copper screen wires and bend back over the 20 swg binding wire applied in 1.4 ensuring the copper screen wires are spaced evenly over the tape applied in 1.5.
- 1.7 Temporarily secure the copper screen wires to the oversheath with Scotch 88 tape.
- 1.8 Mark the reference line of the joint on the semi-conducting screen. Set the cores into their final position and cut to length; taking into account the split connector.

- 1.9 From the reference line mark the semi-conducting screens at 170mm. Remove the semi-conducting screen to this point. Once the semi-con has been removed, polish the insulation with aluminium oxide.
- 1.10 Check the depth of barrel of the connector and remove the phase insulation of both the cores.
- 1.11 Park the joint body on the smallest cable, if present, if both cables are the same side park the joint body on the longer copper wire side. Ensure spiral points away from the centre of the joint.
- 1.12 The mechanical connector comes with an insert; this insert **shall be used on** 70mm² and 95mm² conductor sizes. Fit the connector and finger tighten the shear bolts. Check the dimension between the semi-conducting screen terminations, it shall be 340mm.
- 1.13 Starting at the connector ends, alternatively tighten the bolts until the heads shear off.
- 1.14 Check for proud edges on the bolts and remove, check for swarf on connector and cable insulation and clean away.
- 1.15 Degrease the entire joint area.
- 1.16 Apply a thin film of Tyco silicon grease from the sachet provided covering the entire joint area between the two folded back copper wire screens. Grease the connector area last.
- 1.17 Position the joint body in line with the folded back copper wire screen.
- 1.18 Release the spiral by pulling counter-clockwise. Check the position of the tube after having released five turns. The end of the tube should be butting up to the copper screen wires. In case of misplacement move the tube to the correct position – Fig 5.

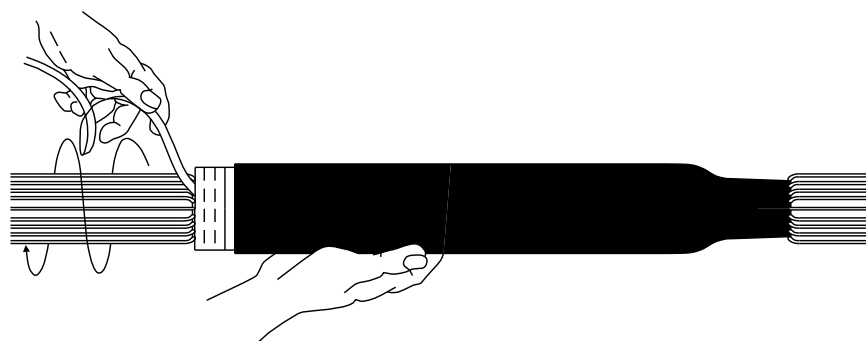
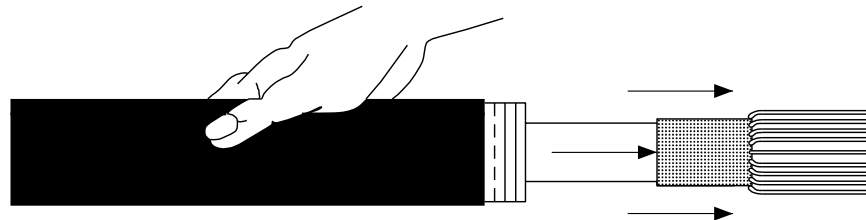
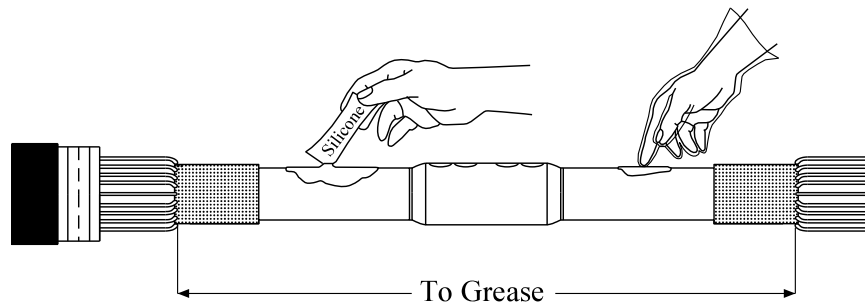
Support the tube in its correct position and remove the complete spiral from the tube – Fig 6.


Note: - Take care not to twist the cord of the spiral holdout during the release process. The cord of the spiral holdout should always be in line and never wrapped around the core.

- 1.19 Remove the redundant spiral from the cable.
- 1.20 Clean any silicon grease applied in 1.16 from the exposed semi-con screen or oil barrier tube.
- 1.21 The joint body is correctly installed if it touches the copper wire screens on both sides if necessary move the joint body into the correct position.



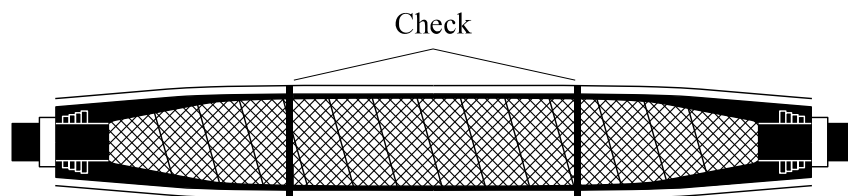
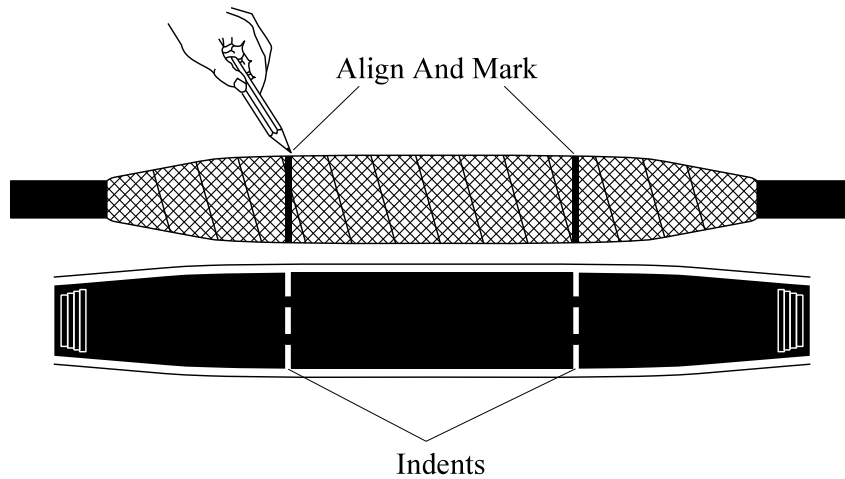
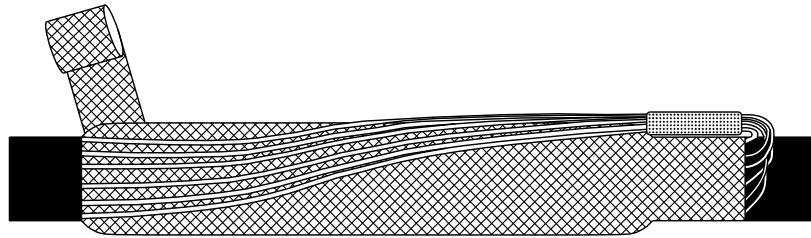
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GENERAL REQUIREMENT 49

INSTALLATION OF TINNED COPPER BRAIDED STOCKING (TYCO)

Before commencing the level of PPE required for this operation shall be as the matrix given in General requirement 3, also your attention is drawn to the Use of Solvents General Requirement1.

General

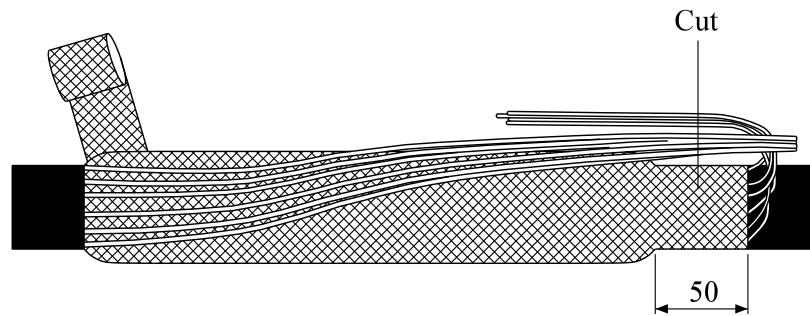
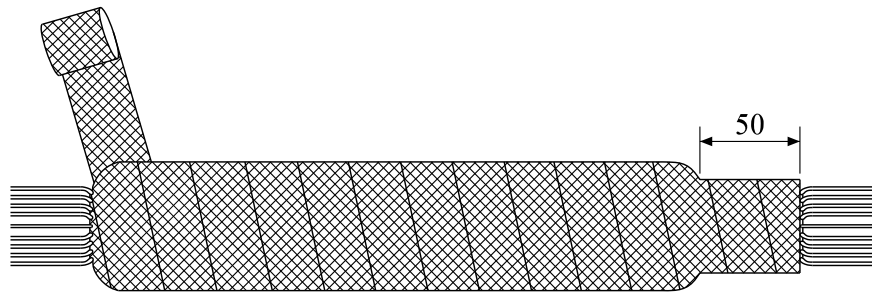
The tinned copper knit mesh provides an earthed electrical screen around the joint body, also giving earth continuity of the copper wire screen (EPR) throughout the system. It is therefore important that the stocking is stretched firmly down onto the joint body and the connections at either ends are secure to the copper screen wires of the cable.


49.1 Method of Installation

Refer to Drawings **GR2D 6.49.1 and 6.49.2** whilst undertaking this General Requirement.

- 1.1 Starting 50mm on to the oversheath of the short screen wire side, apply one layer of knit mesh tape with a 50% overlap covering the joint body and finishing level with the long folded back copper screen wires.
- 1.2 Bend the long copper screen wires back over the joint area.
- 1.3 Apply a 20 swg binder to the edge of the knit mesh applied in 1.22; bend the short copper wire screens back against the binder towards the centre of the joint. Gather the wires together and cut them centrally above the knit mesh – see fig xx.
- 1.4 Connect the two sets of copper screen wires together using a brass tunnel connector.
- 1.5 Use the remainder of the knit mesh as a second layer over the whole jointing area and ensure complete coverage of the copper screen wires.
- 1.6 Offer up the lower half of the joint shell locating it centrally beside the joint and mark on the joint where the two long indent mark on the joint shell are.
- 1.7 Wrap two layers of Scotch 88 tape for a width of 25mm around the joint at the marked positions.

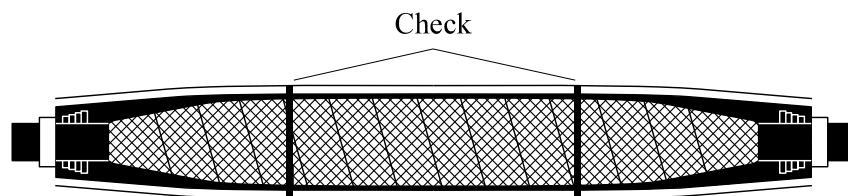
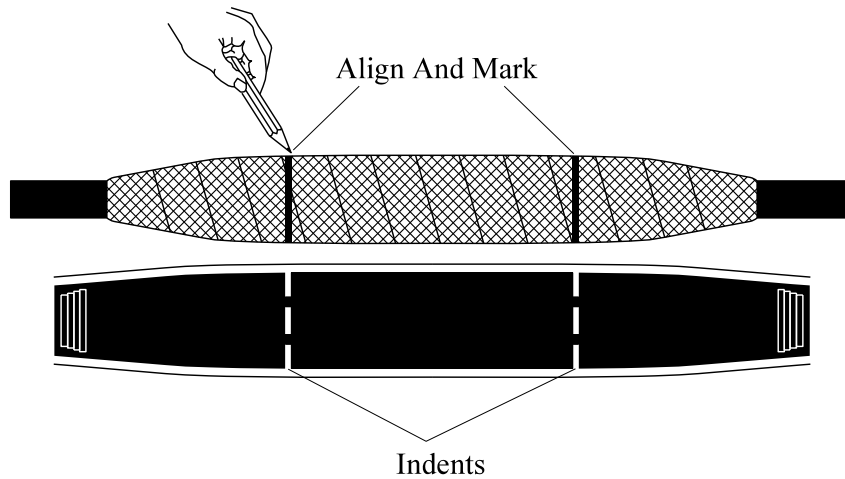
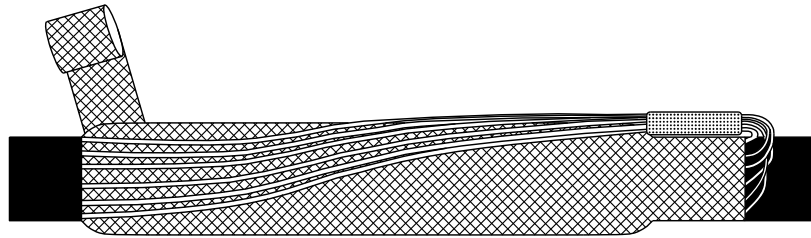
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GENERAL REQUIREMENT 50

MIXING AND POURING THREE PART POLYURETHANE RESIN

WT HENLEY or PRYSMIAN THREE PART RESIN

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

50.1 General

The liquid components of the three-part polyurethane resin currently used in cable joints, within the Company, is contained in a foil pack which forms an enclosed system. This means that mixing of the polyol and hardener components is completed before possible exposure.

Although the enclosed system should be effective in preventing contact with harmful materials, the following basic precautions shall be taken when using three-part polyurethane resin.

50.2 Safety Precautions

Skin Contact

The hardener is irritating to the skin. The use of the disposable plastic gloves provided should eliminate any contact, but if it occurs, the affected area should be washed immediately with plenty of soap and water.

Splashes in the eye

The hardener is irritating to the eyes. Suitable protection such as goggles or a face visor shall be worn when pouring or stirring. In case of contact with the eyes, rinse immediately with plenty of water and seek medical advice.

Breathing of vapour

Ensure that adequate ventilation is provided to prevent high concentrations of vapour building up in the working area. Pay particular attention to this requirement when working in confined areas.

Fire hazard

The resin and hardener have low flammability, but if a fire occurs in an area where the hardener is stored, a dangerous vapour will be produced. Anyone tackling the fire must wear suitable respiratory equipment.

Topping up of Joints

When using multiple buckets of resin for the various joints the maximum time between pouring one bucket of resin to the next bucket of resin is ten (10) minutes.

Decontamination of containers

Isocyanate containers must be neutralised before disposal. This can be done by filling the container with water and leaving with the top off for 24 hours. The top should not be replaced, so that the carbon dioxide gas produced by escape, otherwise the container may burst.

This is unnecessary with the foil pack. The packet can be disposed of as non-harmful after the contents have been mixed, provided the WPD label WPD/W400121 is stuck over the relevant DSD or CLP warning labels.

50.3 Mixing WT Henley or Prysmian Resin

General information and mixing instructions for the WT Henley or Prysmian three-part polyurethane resin are as follows:-

Suitable protective clothing, as per the matrix given General Requirement 3 shall be worn while mixing and pouring the resin.

Safety and handling information is printed on the outside of the pack.

- 3.1. Remove the pouch containing the resin and hardener from the sand. Remove the bag of sand from the bucket.
- 3.2. Ensure PPE as per the matrix in General Requirement 3 are worn.
- 3.3. Examine the foil pouch containing the hardener and polyol are not damaged in anyway. Once the inspection has been completed, support the pouch in the upright position on a convenient surface with the polyol (larger side) closer to you. Grip both sides of the pouch between the fingers and ball of the thumb. Gently tease the centre seal apart. Once the seal has broken, gently pull the sides of the pouch apart for the remainder of the seal.
- 3.4. Knead the sachet pack contents thoroughly for two minutes, taking care not to damage the sachet.
- 3.5. Cut a corner of the sachet, and pour into the empty bucket, rolling up the sachet and squeezing will aid removal of the resin mixture.
- 3.6. Gradually add the sand to the bucket while stirring the contents of bucket until it is thoroughly and evenly dispersed.
- 3.7. Pour the mix slowly into the joint shell. If more than one resin mix is required to fill the joint shell, subsequent mixing should be continuous so that delays are kept to a minimum.
- 3.8. Apply a WPD non-harmful warning label over all manufacturers harmful warning labels – GR2D 6.50.1.

- 3.9. The used sachet pack, mixing bucket etc. can be disposed of as non-toxic industrial site waste, after mixing.

50.4 TYCO THREE PART RESIN

Mixing Tyco Resin

Safety and handling information is printed on the outside of the pack and must be observed.

- 4.1 Examine the foil pouch containing the hardener and polyol to ensure it is free of damage.
- 4.2 Support the foil pouch and using scissors make a small cut to the bag top, carefully tear the top edge along its length starting at the cut position.
- 4.3 Remove the contents from the foil pouch checking the two compartments for damage.
- 4.4 Support the two components with the green channel uppermost, take the free end of the bag and pull gently this will release the green channel and slide rail.
- 4.5 With the bag extended to its full length and with a tumbling action allow the two components to mix thoroughly until a uniform colour is achieved.
- 4.6 Mixing thoroughly for two minutes ensuring all components are removed from the seams of the bag.
- 4.7 Cut a corner of the sachet, and pour into the empty bucket, rolling up the sachet and squeezing will aid removal of the resin mixture.
- 4.8 Gradually add the sand to the bucket while stirring the contents of bucket until it is thoroughly and evenly dispersed.
- 4.9 Pour the mix slowly into the joint shell. If more than one resin mix is required to fill the joint shell, subsequent mixing should be continuous so that delays are kept to a minimum.
- 4.10 Apply decontamination labels to all hazardous warning signs and remove to WPD depots for correct disposal, drawing GR2D 6.50.1.

All dimensions in mm

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GENERAL REQUIREMENT 51

USE OF HEAT SHRINK MATERIALS

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

The use of heat shrink materials with 11kV cables is reducing with the introduction of cold applied materials; the use will mainly be in the sealing of cable oversheaths, cable glands and end caps.

It is essential that heat shrinkable materials are used only in approved situations and that correct materials are used along with the correct gas torches.

Cleanliness is of the utmost importance particularly where heat-melt adhesives are involved; no dirt or grease must be allowed to contaminate the materials. The surface to which a seal is to be made must be thoroughly cleaned using an approved degreaser and abraded.

When tubing has to be cut to length before fitting, this should be undertaken in one clean cut with a pair of sharp scissors. Any unevenness where a cut has been made may lead to splitting of the tubing.

The shrinking operation should be carried out using a “quiet” blue flame, which must be kept moving during the operation.

The flame should be applied around the component and not along its length, to obtain even shrinkage and to prevent air bubbles being trapped.

Since there is usually some change of length during shrinkage, it is important to carry out the shrinkage operation in the correct sequence. The sequence to be used is given in the appropriate Jointing Procedure.

Where heat-melt adhesives and mastics are involved, additional heat (with a moving flame) must be applied to ensure good adhesion and flow of the mastic or adhesive.

GENERAL REQUIREMENT 52

DIMENSIONS OF CABLE BOXES FOR COLD APPLIED TERMINATIONS (TYCO)

General

For the cold applied indoor termination to fit into a cable box the cable box dimension from the bushing stud to the gland/base plate needs to be a minimum of 400mm but the ideal measurement is 450mm.

The minimum clearance between live metal work, phase to phase, with insulated bushing boots fitted is 75mm.

The minimum clearance between live metal and earthed metal work is 60mm.

GENERAL REQUIREMENT 53

PREPARATORY WORK ON INDOOR CABLE BOXES

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

53.1 General

Ensure that the EPR / XLPE cable is laid to a point directly below the cable box gland position. If the cable is not in line with the gland adjust the cable ground entry to the correct position.

Sufficient trench length and depth must be available to allow for core crossing, application of temporary earth continuity bonds, parking of sealing sleeves, breakout, gland and gland/base plate.

53.2 Method

- 2.1 Remove the gland / base plate and cable gland from the cable box, and park over the cable.
- 2.2 Position and line up the cable in the cable box and apply a PVC marker to each core at the through bushing centre and connector position, add a further 300mm and cut the cable at this position.

Note: - Do not remove the PVC tape markers at this stage.

- 2.3 Align the PVC tape markers applied in 2 with the through bushing bolt centre.
- 2.4 Check core phasing and make any adjustments of the cores below the cable gland position.
- 2.5 Complete the termination to the relevant Jointing Procedure.

GENERAL REQUIREMENT 54

TORQUE SETTINGS.

It is important that all nuts and bolts are correctly tightened to allow good load transfer between the cable and the various types of plant. Usually torque settings are given by the particular manufacturers, be they Plant manufacturers or Accessory manufacturers, if this torque setting is known then the values will be given in the relevant Jointing Procedures, if there are no torque settings given, then the torque settings given in this General Requirement are typical values shall be applied to the relevant nuts and bolts.

General

Offer up the connector to the equipment terminal and bolt up according to the manufacturer's instructions if no guidance is given on the bolting torque, then the settings given below in Table 1 should be used.

Recommended torque wrench settings for aluminium and copper terminations.		
Stud size (full nut) mm	Grade 8.8 stainless steel or equivalent studs Nm	Brass or high conductivity copper studs Nm
6	7	5
8	20	10
10	35	20
12	50	40
14	70	65
16*	90	90
20	150	-
* 16mm aluminium or copper stemmed bushings: - full nuts = 70Nm; half nuts = 55Nm.		

Table 1 – Recommended torque wrench settings.

GENERAL REQUIREMENT 55

ASSEMBLY OF OUTDOOR POLE TERMINATION CRUCIFIX

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

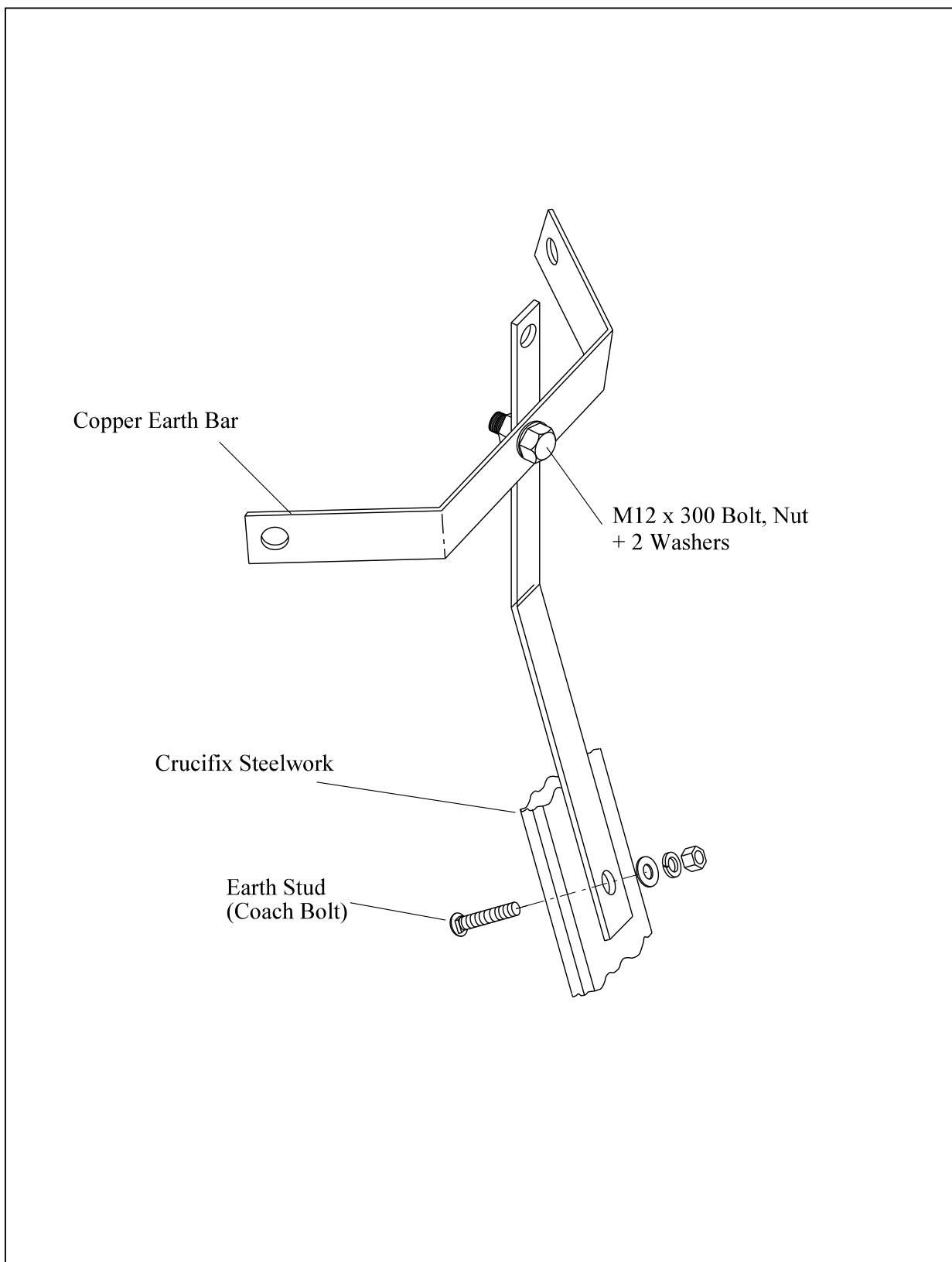
Prior to commencement of the termination the craftsmen will require to know the height to which the crucifix is to be erected on the pole (reference point being the crucifix pole bolt fixing hole) and the phasing of the overhead line.


The termination is to be made off to the crucifix at ground level and raised when required, this may not always be possible and alternatives such as working at erection height from scaffolding or a hydraulic platform, a tail and straight joint may be the only answer if the above information is not available beforehand.

55.1 Method of Assembly

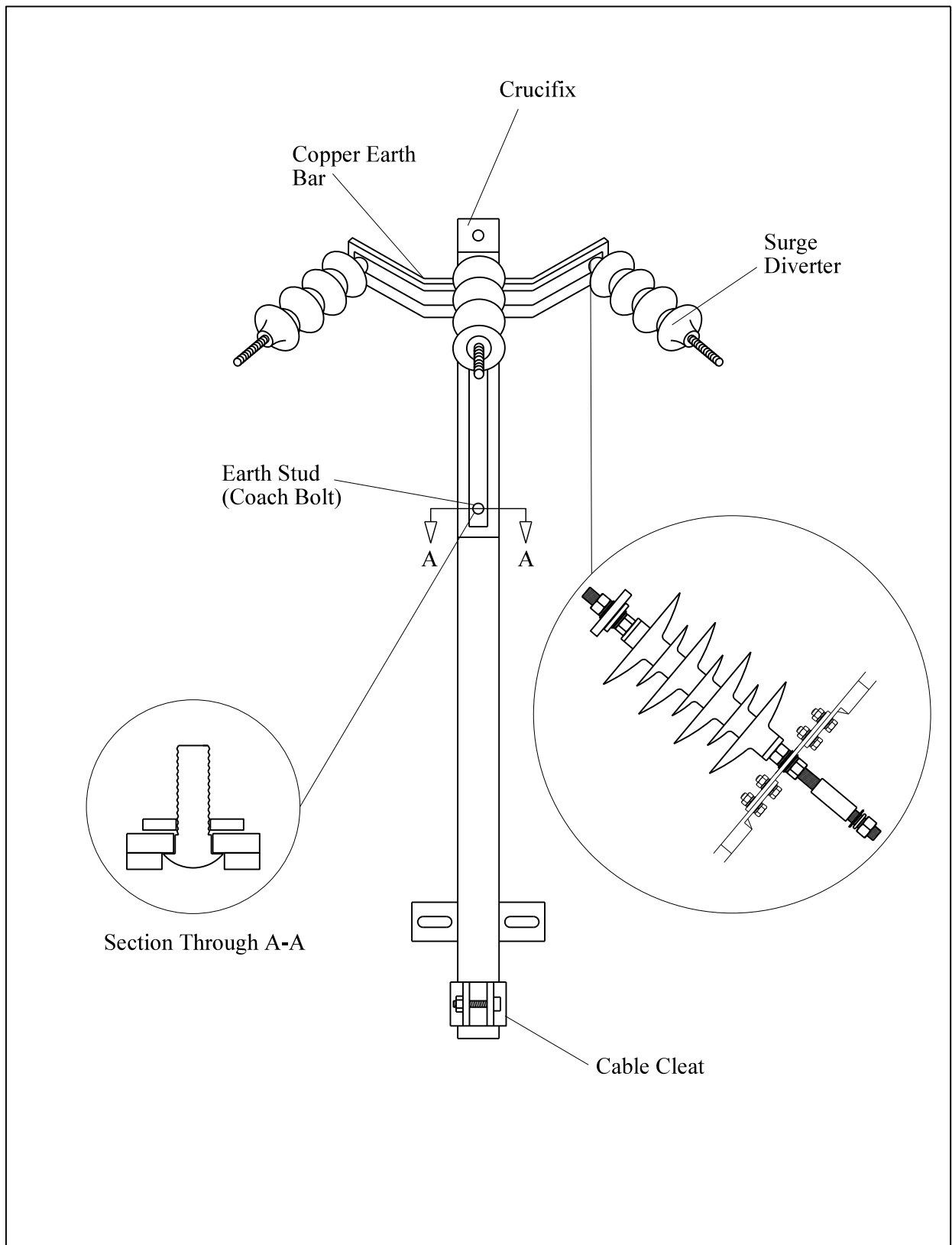
Refer to Drawings GR2D 6.55.1, 6.55.2, 6.55.3 and 6.55.4 whilst undertaking this General Requirement.


- 1.1 Bolt the copper earth bars together and fix the assembly to the crucifix with the coach bolt provided. Attach the cable cleat, surge diverters and the surge diverter adaptor plate to the crucifix.
- 1.2 From the top-fixing hole of the crucifix, position the crucifix on the pole approximately 1.7m above ground level. Ensure that the crucifix is in the correct plane in relation to the overhead line, fixing in position with a ratchet strap.
- 1.3 Ensure that the EPR / XLPE cable is laid to a point directly below the crucifix's final fixing position. If the cable is not in the correct position adjust the cable ground entry position.
- 1.4 Using the height given by the supervisor, measure the cable and apply a PVC tape marker to each core, add a further 400mm and cut the cable at this position.
Do not remove the PVC tape markers at this stage.
- 1.5 Forming the cable into a loop, take the end of the cable up to the crucifix and position in the cable cleat aligning the first PVC tape marker applied in 4 with the pole bolt fixing hole.
- 1.6 Check core phasing and make any adjustments of the cores below the cable cleat, clamp the cable into position within the cable cleat.
- 1.7 Complete the termination to the relevant Jointing Procedure.



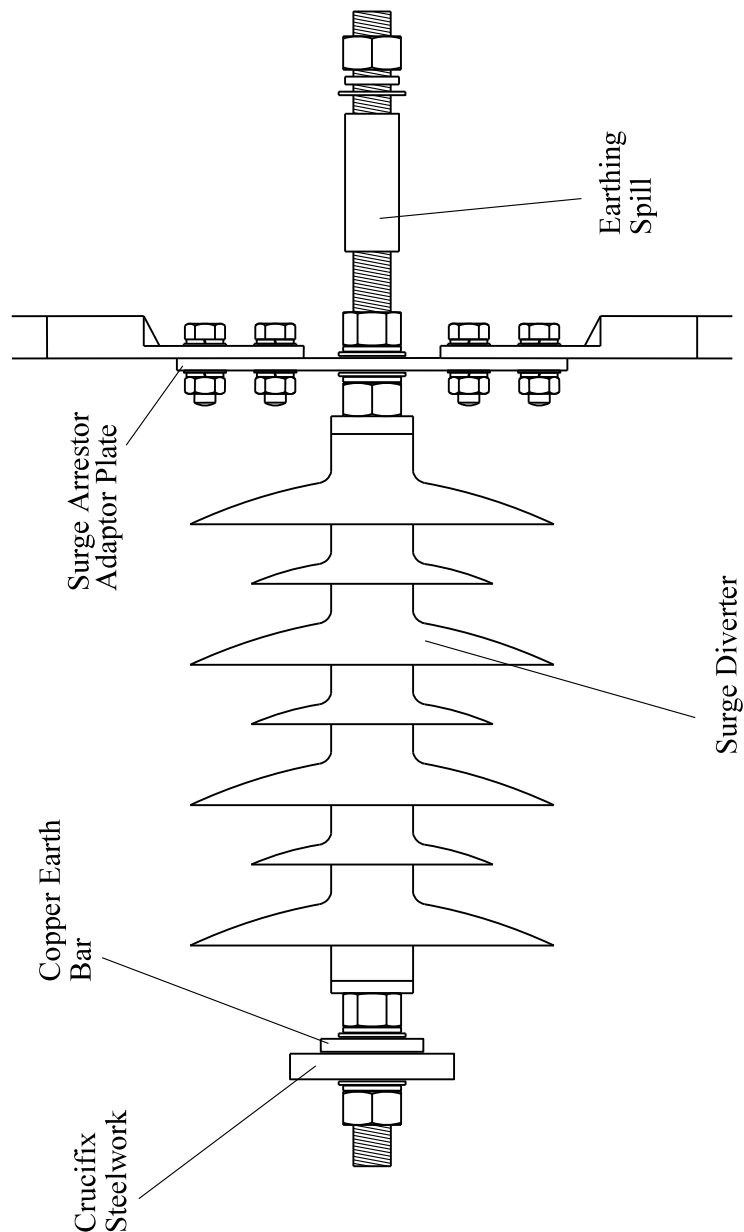
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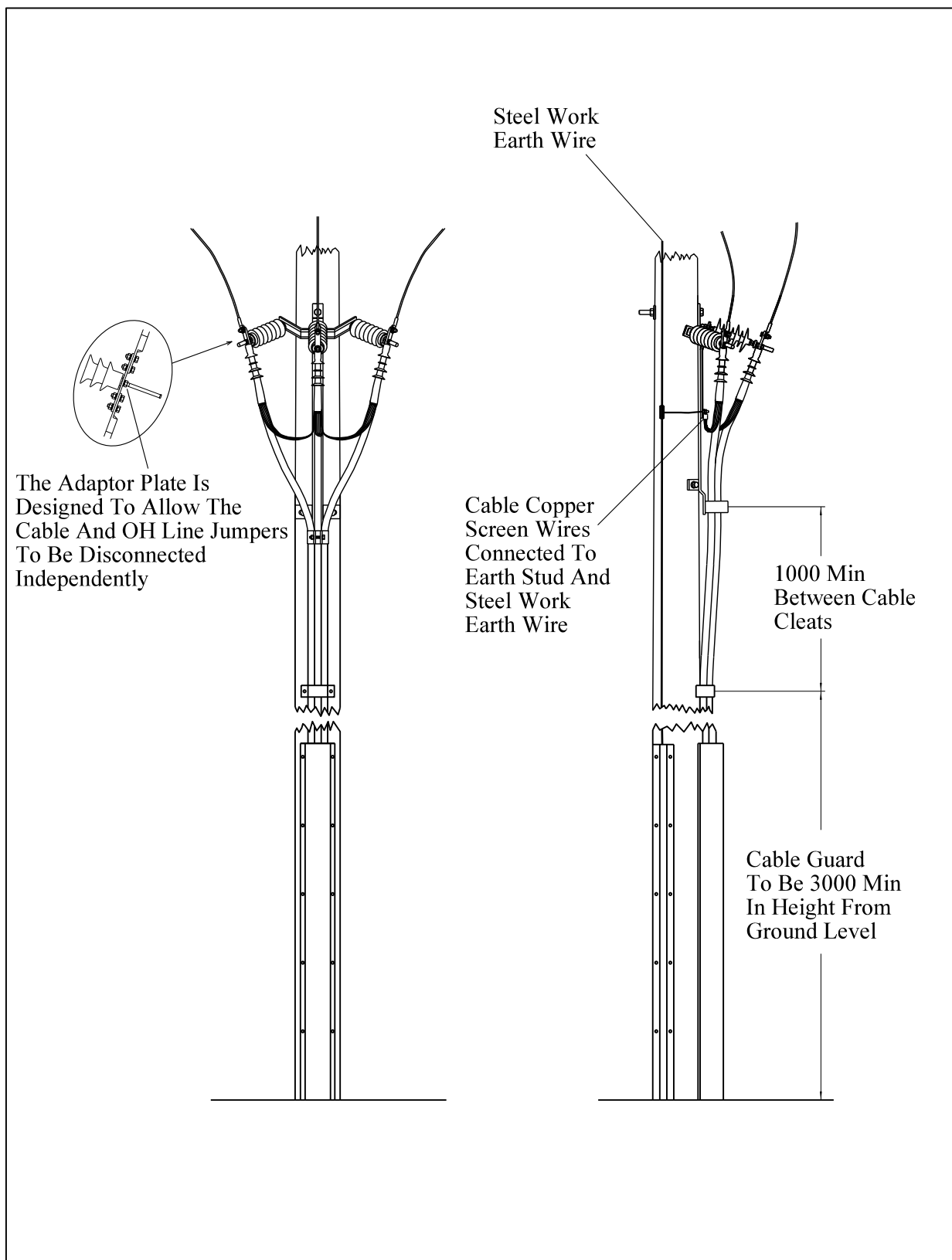
1	RJB			05/14	ADAPTOR PLATE ADDED		
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				ASSEMBLY OF SURGE DIVERTER COMPONENTS TO CRUCIFIX		GR2D 6.55.2	1

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GENERAL REQUIREMENT 56

INSTALLATION OF INDOOR / OUTDOOR TERMINATION BODY (TYCO)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

56.1 General

The Tyco cold applied termination covers all sizes of EPR / XLPE cable both indoor and outdoor.

The body is manufactured from silicon rubber, the body being expanded on a spiral carrier and incorporates the geometric stress control, and connector sealing mastic as one unit and is applied as one.

Length of body, stripping dimensions and installation for both the indoor and outdoor are of the same, the outdoor termination having the larger rain sheds as opposed to the indoor termination which has the smaller creepage extenders.

Termination bodies when used on 70mm² EPR may feel loose or spongy to the conductor insulation; if this occurs the body overtime will collapse further and should not cause electrical problems.

56.2 Method of Installation

- 2.1 Inspect the termination body for defects.
- 2.2 Slide the body over the cable core and support and position just above the 20 swg wire binder placed around the copper screen wires.
- 2.3 Carefully and slowly remove the white collapsible spiral coil former by unwinding in a anti-clockwise direction, once a small amount of the body has come off the coil former, slide the termination body up to the 20 swg binding wire. A slight twisting of the body in the clockwise direction helps this.
- 2.4 Support the body and remove the remainder of the former.

Note: - 630mm² terminations will require a slight pulling of the body towards the open end.
- 2.5 Should the body extend beyond the connector shoulder depending on length it may be eased back by hand.

Similarly if the body is just short of the lug shoulder this may be gained by pushing to the level of the shoulder.

GENERAL REQUIREMENT 57

INSTALLATION OF COLD APPLIED BUSHING BOOTS

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

The Tyco cold applied bushing boots can be used on both vertical and horizontal elliptical or round shaped bushings. The bushing kit can be used on bushing diameters which range from 31mm to 71mm, the kit comprises of 3 boots and 3 collars, these collars are cold shrink collar which are used to build-up the bushing diameter to accommodate the boot.

The boots are manufactured from silicon rubber and applied by pushing over the core and bushing this is aided by silicon grease also supplied within the kit.

The boot covers 95/185/300mm² EPR/XLPE cable only, cables outside of this range or where the bushing configuration is not as standard through type with the connection point directly on its end, or more than one cable is to be connected then the use of ABB Rulle tape will be required General Requirement 58.

Ensure that the minimum clearances within the cable box are as follows see Figure 1: -

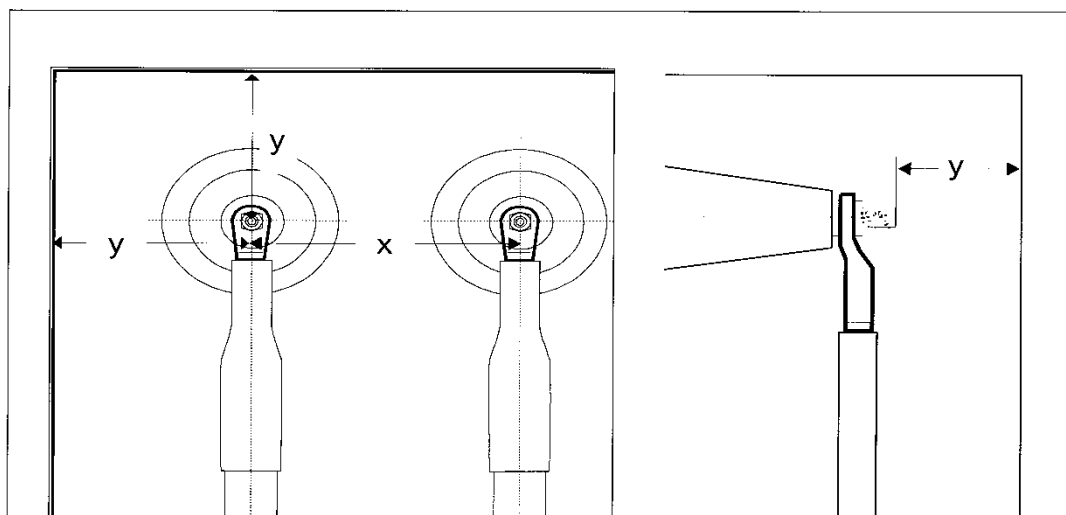


Figure 1

Description	U_m (kV)	7.2	12	17.5
Min. clearance between live metal X (mm)		100	100	100
Min. clearance between live metal and ground Y (mm)		60	60	75
Min. clearance between boots (mm)		12	12	12

57.1 Installation for bushings with a diameter of 31mm to 42mm only: -

- 1.1 Establish the diameter of the bushings, on which the boots are to be installed.
- 1.2 If the bushings are between 31mm to 42mm in diameter, the collars supplied with the (SMOE 62803) kit are required.
- 1.3 Clean the bushings with the approved degreaser.
- 1.4 Once dry, apply a thin layer of silicon grease onto the bushing.
- 1.5 Push the collar onto the bushing and position as shown in Figure 2.
- 1.6 Apply a thin layer of silicon grease 50mm onto the termination; see Figure 3.
- 1.7 Slide the boot down over the termination.
- 1.8 Apply a thin layer of silicon grease onto the collar.
- 1.9 Tighten the cable lug to the bushing.
- 1.10 Push the boot upwards over the collar as per Figure 4.
- 1.11 Installation of the RCAB is complete.

57.2 Installation for bushings with a diameter of 42mm to 71mm only: -

- 2.1 Establish the diameter of the bushings, on which the boots are to be installed.
- 2.2 If the bushings are between 42mm to 71mm in diameter, no collars are required.
- 2.3 Clean the bushings with the approved solvent.
- 2.4 Once dry, apply a thin layer of silicon grease onto the bushing.
- 2.5 Apply a thin layer of silicon grease 50mm onto the termination; see Figure 3.
- 2.6 Slide the boot down over the termination.

- 2.7 Tighten the cable lug to the bushing.
- 2.8 Push the boot upwards over the bushing, as per Figure 4.
- 2.9 Installation of the RCAB is complete.
- 2.10 Discard surplus collars and waste in the approved manner.

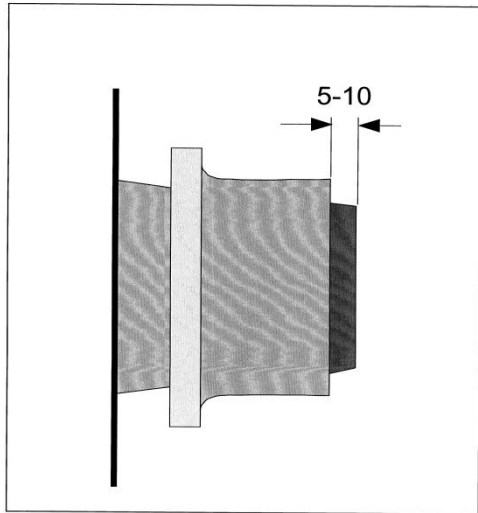


Figure 2

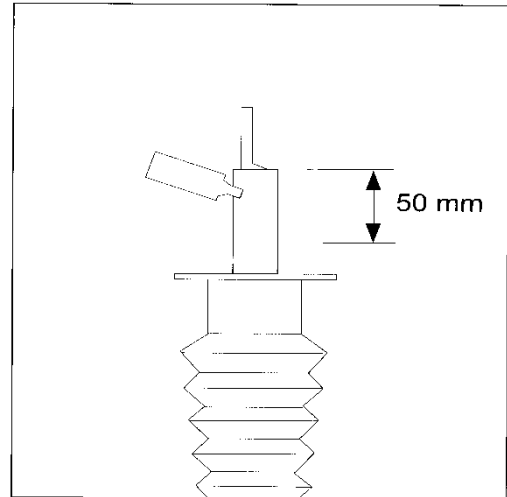


Figure 3

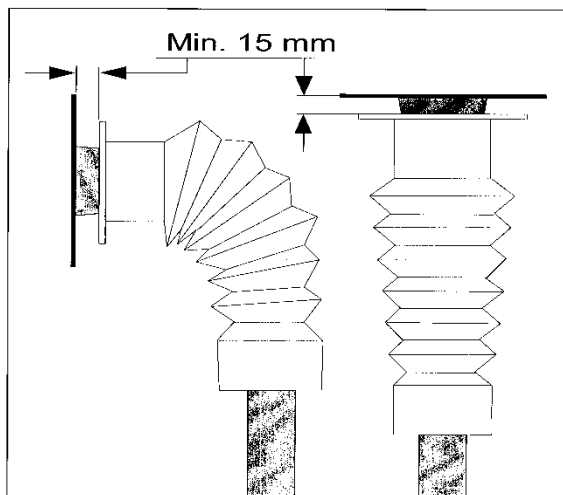


Figure 4

GENERAL REQUIREMENT 58

APPLICATION OF ABB RULLE TAPE TO BUSHINGS

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

Straight or right angle through bushings which are of a irregular shape or where more than one cable is to be connected the cold applied Tyco bushing boot is not compatible this also applies to 630mm² EPR where the ABB Rulle tape is to be used.

The Rulle tape is a two-layer tape the outer layer is a strong EPDM rubber, which provides the insulation and the inner layer is soft butyl mastic that provides good adhesion properties.

The outer EPDM rubber has white ellipses printed on the surface. Stretch the Rulle tape until the ellipses become circular, this ensures that the tape is being applied under the correct tension. Once the correct tension has been obtained the Rulle tape is applied using a 50% overlap to the complete installation.

58.1 Method of Installation

- 1.1 Thoroughly clean and degrease the bushing connection and termination body with an approved degreaser.
- 1.2 Remove the white backing paper tape, using half lap layers, apply to the exposed metal work of the termination lug and bushing connection, ensuring the ellipses become circular.
- 1.3 Overlap the tape onto the bushing and termination body by 30mm finishing on the connection point.

Note: - Ensure a minimum of two half-lap layers and correct applied tension at all times.

GENERAL REQUIREMENT 59

INSULATED EARTH STUD ASSEMBLY

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

All cable boxes dry or compound filled are to be fitted with an insulated earth stud, the stud being insulated to provide cable to switchgear earth segregation where required for new or existing distribution feeders. New or refurbished boxes will have the stud fitted by either the switchgear manufacturer or WPD plant centre.

When the need arises to break and remake and a compound filled box in situ the box will require drilling (14mm diameter hole) and the stud assembly fitted on-site, rubber seals are fitted to prevent compound leakage.

The stud assembly is to be installed as shown in drawing GR2D 6.59.1 whether the box is dry or compound filled.

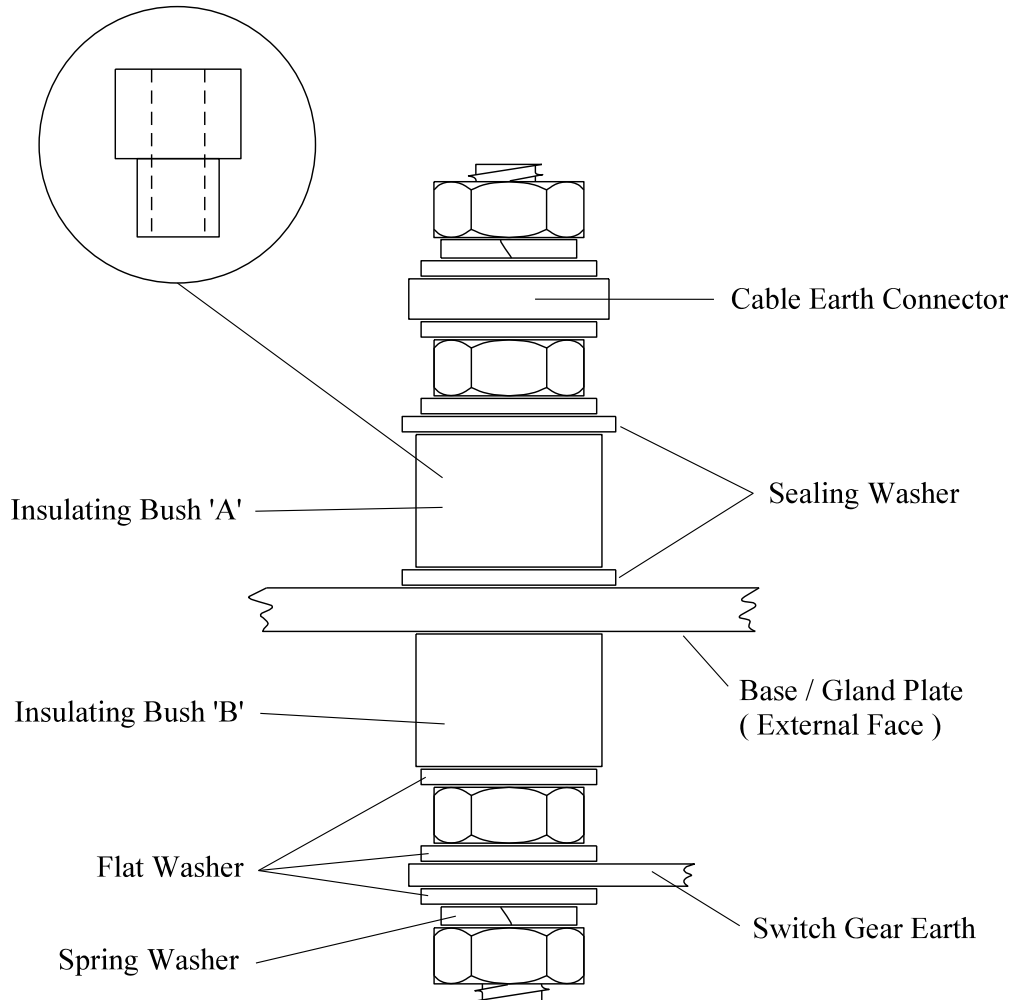
59.1 Installation


Refer to Drawing GR2D 6.59.1 whilst undertaking this General Requirement.

- 1.1 Remove the nuts, washers and white nylon insulating bush from the stud.
- 1.2 Ensure the rubber seals are in place and pass the red nylon bush from the outer face of the box through the entry hole in the gland/base plate or box side.
- 1.3 Pass the white nylon bush over the stud and locate over the red nylon bush.
- 1.4 Pass a flat washer, locking washer and nut over the stud and tighten into place.

Note: - The white nylon washer is to be within the cable box.

All dimensions in mm



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GENERAL REQUIREMENT 60

CABLE GLANDS

General

Cable glands were traditionally used for retaining hot compounds, resisting moisture and providing an earth continuity path between switchgear / transformer and cable.

Modern cable glands used with EPR cable provide sealing only, whether dry or cold pour compound filled boxes, they do not provide an earth continuity path within the system.

They may be of the compression (gripper) type or the more traditional type of gland used as a “stuffing” method.

The gland/base plate must be constructed of a material, which will prevent the setting up of circulating currents therefore causing possible derating of the cables.

60.1 Gland/Base Plates

For single core entry as opposed to trefoil (triplex) the gland/base plate must be of a non-ferrous metal such as brass, aluminium or stainless steel, alternatively the gland/base plate may be split through the cable entry centres and insulation material placed between to maintain the split.

60.2 Compression Glands (Gripper)

Compression on gripper glands may be used for dry or cold pour compound filled cable boxes, they are constructed from Polyamide PA6 material for cable sizes of 95/185/300mm² EPR the maximum torque that can be applied to both the locking nut and gland fixing thread is 7.5Nm. The gland is capable of operating between –20°C and +90°C continuously.

For 630mm² EPR the glands are constructed of brass and are for dry boxes only.

60.3 Stuffing Glands

A stuffing gland for single core entry as opposed to trefoil (triplex) must be manufactured from brass or aluminium, ferrous metals i.e. steel must not be used due to the setting up of circulating currents therefore derating the cable.

For trefoil (triplex) configurations the gland may be made of steel.

All stuffing glands will require a heat shrink breakout or heat shrink sealing sleeve to provide a complete seal on dry boxes, for cold pour compound filled boxes these will also require filling with “Lovifit” glue.

GENERAL REQUIREMENT 61

SEALING OF CABLE GLANDS – DRY BOXES

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

To provide a complete cable entry seal with dry cable box terminations the cable gland may be sealed using either a heat shrink breakout or a mastic lined sealing sleeve.

Alternatively if the gland/base plate provides single cable entry as opposed to trefoil (triplex) formation then a compression “gripper” gland may be used; one must ensure that the gland/base plate conforms to General Requirement 60.

Method of Installation

Refer to Drawing GR2D 6.61.1 whilst undertaking this General Requirement.

61.1 Stuffing Gland – Heat Shrink Breakout

- 1.1 Clean and degrease cable gland and cable oversheath with an approved degreaser.
- 1.2 Slide the gland assembly up to its final position and mark the cores at the gland base, lower the gland away from the build-up area.
- 1.3 Apply build up tape to centralise the cores within the gland.
- 1.4 Position and fix the gland assembly into its final position.
- 1.5 Position the breakout over the gland ensure the base of the breakout skirt is abutting the gland flange or gland/base plate.
- 1.6 Start shrinking from the breakout skirt towards the cable.

Note: - Due to the possibility of the breakout sliding down the gland, allow the breakout skirt to cool before proceeding onto the cable.

- 1.7 Carefully brush flame the complete breakout to ensure a release of the internal adhesive coating and a complete seal.

61.2 Stuffing Gland – Mastic Lined Heat Shrink Sleeve

- 2.1 Clean and degrease cable gland and cable oversheath with an approved degreaser.
- 2.2 Slide the gland assembly up into its final position mark the cores at the gland base, lower the gland away from the build-up area.
- 2.3 Cut three lengths of Scotchfil putty tape and press the midpoints together to form a Y piece of double thickness – Fig 1.
- 2.4 Separate the three cores and place the Y piece between the cores. The lower edge of the Y piece is to be in line with the mark made at the gland end.
- 2.5 Mould each end of the Y piece between the cores to form a uniform shape of the three cores and Scotchfil putty – Fig 2.
- 2.6 Apply Scotchfil putty under very light tension around the cores to build up to the internal diameter of the gland, directly over the previously applied Y piece – Fig 3.
- 2.7 Apply two turns of Scotch 88 tape under light tension over the Scotchfil putty applied in 6.
- 2.8 Position and fix the gland assembly into its final position.
- 2.9 Position the mastic lined tube over the gland ensuring equal overlap onto the cores and gland – Fig 4.
- 2.10 Start shrinking from the gland towards the cable.

Note: -Due to the possibility of the mastic lined sleeve sliding down the gland, allow the gland end of the mastic lined sleeve to cool before proceeding onto the cable.

- 2.10 Carefully brush flame the complete mastic lined sleeve to ensure a release of the internal mastic coating and a complete seal.

61.3 Compression Gland (Gripper)

- 3.1 Remove the gland/base plate locking nut from the gland assembly, release the lower nut of the gland assembly so releasing the pressure on the rubber-sealing ring.

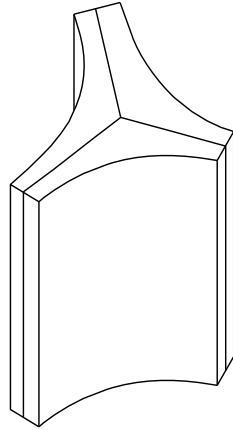
Check and ensure the rubber ‘O’ sealing ring is in place over the threads of the gland assembly.

- 3.2 Before the cable oversheath is removed slide a gland assembly over each cable followed by the gland/base plate and gland/base plate-clamping nut.
- 3.3 Complete the termination as per the jointing procedure to a point where the gland/base plate has been fixed to the cable box.

- 3.4 Slide the gland assembly up and into the cable entry hole, locate the gland/base plate locking nut and seals.
- 3.5 Tighten the gland assembly-locking nut ensuring compression of the rubber-sealing ring.
- 3.6 Ensure all gland assembly and gland/base plate-locking nuts are tight before closure of the cable box.

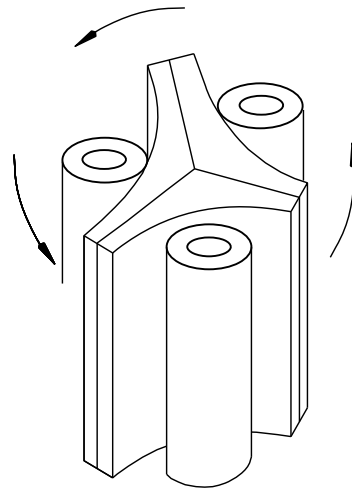
Note: -For 630mm² EPR compound filled cable boxes a non-ferrous “stuffing gland” is to be used as per General Requirement 60.

All dimensions in mm



Scotchfil 'Y' Piece

Fig 1



'Y' Piece Applied To Cores

Fig 2

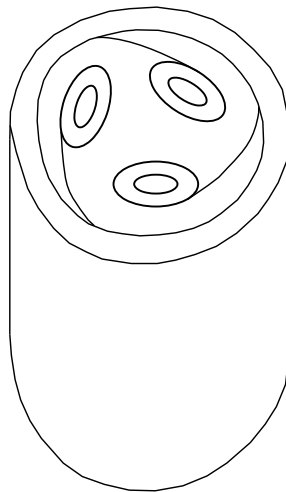


Fig 3

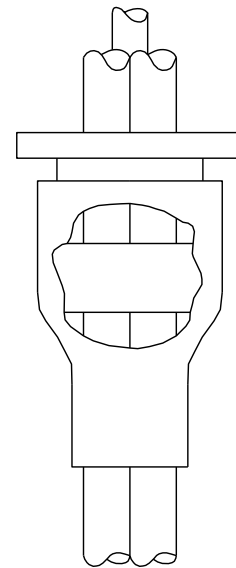



Fig 4

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GENERAL REQUIREMENT 62

SEALING OF CABLE GLANDS – COMPOUND BOXES

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

To provide a complete cable entry seal with cold pour compound filled cable box terminations the cable gland may be sealed using either a traditional cable gland (stuffing) or a compression “gripper” gland.

Either method being acceptable for 95/185/300mm² EPR/XLPE cable, 630mm² EPR will require a stuffing gland and will be dependent on the cable box being used whether existing or replaced with new.

It must be noted that where single entry of each cable is provided the base plate must conform to General Requirement 60.

Method of Installation

Refer to Drawing GR2D 6.62.1 whilst undertaking this General Requirement.

62.1 Cable Gland (Single or Trefoil Triplex Configuration)

- 1.1 Clean and degrease cable gland and cable oversheaths with an approved degreaser.
- 1.2 Slide the gland/base plate assembly up into its final position and mark the cable(s) at the gland top and base, lower the gland assembly away from the marked area.
- 1.3 Clean and abrade the cable oversheath(s) between the marks placed in 1.2, use an approved degreaser.
- 1.4 Apply build up tape to centralise the cable(s) within the gland.
- 1.5 Position and fix the gland assembly into its final position.
- 1.6 Position the breakout or mastic lined sealing sleeve over the gland ensure the base of the breakout skirt or edge of the mastic lined sealing sleeve is abutting the gland flange.
- 1.7 Start shrinking from the breakout skirt or mastic lined sealing sleeve towards the cable.

Note: - Due to the possibility of the breakout or mastic lined sealing sleeve sliding down the gland whilst shrinking, allow the breakout skirt or gland of the mastic lined sealing sleeve to cool before proceeding onto the cable(s).

- 1.8 Ensure a gap is formed between the cable(s) and gland, and fill with “Lovifit” glue.

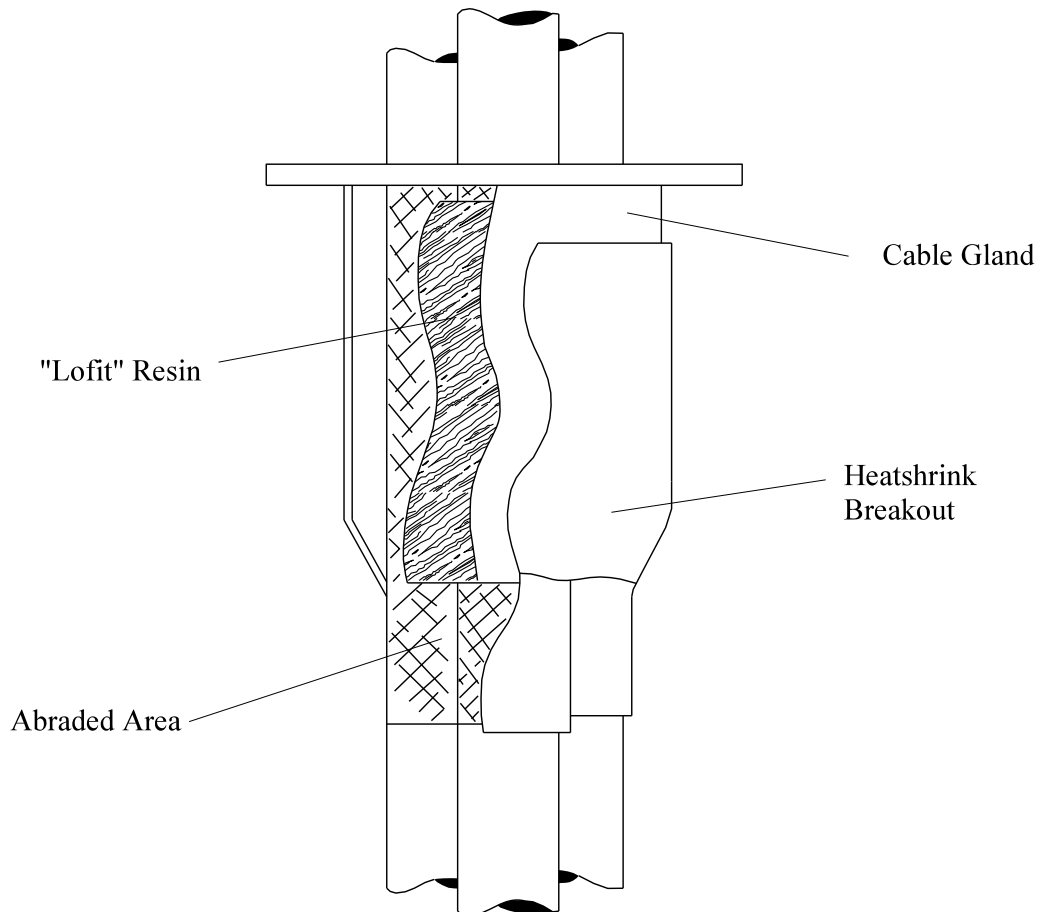
62.2 Compression Glands (Gripper)

- 2.1 Remove the base plate-locking nut from the gland assembly; release the lower nut of the gland assembly so releasing the pressure on the rubber-sealing ring.

Check and ensure the rubber ‘O’ sealing ring is in place over the threads of the gland assembly.

- 2.2 Before the cable oversheath is removed slide a gland assembly over each cable followed by the gland/base plate and gland/base plate-clamping nut.
- 2.3 Complete the termination as per the jointing procedure to a point where the gland/base plate has been fixed to the cable box.
- 2.4 Slide the gland assembly up and into the cable entry hole locate the gland/base plate locking nut and seals.
- 2.5 Tighten the gland assembly-locking nut ensuring compression of the rubber-sealing ring.
- 2.6 Check and ensure the rubber ‘O’ sealing ring is in place over the threads of the gland assembly.
- 2.7 Ensure all gland assembly and gland/base plate-locking nuts are tight before closure of the cable box.

All dimensions in mm



Note:- For A Single Core Cable The Breakout Will Be Replaced With A Mastic Lined Sealing Sleeve

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GENERAL REQUIREMENT 63

COMPLETED OUTDOOR POLE TERMINATION PRIOR TO ERECTION

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3.

General

Once the Jointer has completed the pole termination, final erection of the crucifix remains to be undertaken, by the Linesmen.

Using heavy-duty cable ties positioned below the centre phase and catching the angle of the steelwork, cable tie the crucifix to the terminal pole and remove the ratchet strap.

If required put additional cable ties below the earthing stud and around the pole.

The Linesmen can then raise the completed crucifix when he is ready by removing the cable ties.

See Drawing GR2D 6.63.1 for the completed 11kV pole termination.

All dimensions in mm

11kV Cable Termination Bracket
(Crucifix)

Steelwork Earth Lead

Overhead Line Conductors
To Main Line Connections

Surge Arresters

11kV Cables

Earth Braid On Cable
Sheath To Be Connected To
The Main Steelwork Earth
By Means Of A Lead With
A Lug And Crimp

Cable Cleat


Lid

Troughing

Cable Capping

3000 Min

1000

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GENERAL REQUIREMENT 64

INSTALLATION OF THE LOAD BREAK BUSHING WELL INSERT (Euromold)

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

The Bushing Well Insert threads into a universal bushing well situated on a piece of plant e.g. a “Padmount” transformer and the Live Break Elbow then plugs into the Bushing Well Insert. Both the Bushing Well Insert and the Live Break Elbow require earthing down to the plant earth as both items have a semi-conducting outer cover, which requires an earth reference.

The use of a torque tool Coopers BIT/TK 120X-Q should be used to provide the correct torque, this tool is known as the Torkey and is available to purchase from Langley Engineering.

64.1 Method of Installation

- 1.1 Remove the red shipping cap and thoroughly clean the bushing well with an approved degreaser.
- 1.2 Apply a thin uniform coating of the Euromold silicon grease, which is supplied, in the bushing well insert kit.
- 1.3 Clean the mating interface of the bushing well insert with a clean wipe and an approved degreaser, and apply a thin uniform coating of the Euromold silicon grease.
- 1.4 Loosen the clamp lever and insert the torque tool into the bushing well insert, turning the tool slightly to engage, tighten clamp lever to secure tool to insert.
- 1.5 Place the threaded end of the bushing well insert into the bushing well. Turn clockwise until the torque tool makes an audible click. The torque tool tightens the bushing well insert to approximately 20Nm.
- 1.6 Using 2.5mm² green/yellow PVC sheathed copper wire, remove 30mm of insulation, form the strands into a tight conductor by twisting. Remove a single terminal from the terminal block, release both screws, feed the 2.5mm² wire through the hole in the terminal block, and through the earthing tab of the bushing well insert and back into the terminal block tighten the two screws.
- 1.7 Form the 2.5mm² earth wire into a tight spiral by wrapping around a former.
- 1.8 Remove the insulation and incorporate the other end into the earth connector used to connect the copper screen wires of the live break elbow to earth.

64.2 Method of Removal

- 2.1 Loosen the clamp lever and insert the torque tool into the bushing well insert, turning the tool slightly to engage, tighten clamp lever to secure tool to bushing insert.
- 2.2 Place an open-end spanner or adjustable wrench on the hexagonal nut at the base of the Torkey.
- 2.3 Rotate the tool counter clockwise until the bushing well insert is fully disengaged from the bushing well.

Note: - For bushing well insert retightening follow steps 1.2 to 1.5 of bushing well insert installation.

64.3 Tool Calibration

The Torkey of the Bushing Insert Tool is pre-set at 13Nm and is designed to provide years of trouble free service.

The Bushing Well Insert typically requires 11-13 Nm of torque to make an adequate connection with the bushing well stud.

It is recommended that the tool is checked for calibration every 12 months, this may be undertaken by the Boddingtons Electrical Ltd.

GENERAL REQUIREMENT 65

INSTALLATION OF LOAD BREAK PROBE AND ELBOW (Euromold)

Before commencing the level of PPE required for this operation shall be as the matrix given General Requirement 3, also your attention is drawn to the Use of Solvents.

General

The Load Break Elbow connector is a fully shielded and insulated plug-in termination for connecting underground cable to transformers such as the “Padmount” transformers used mainly in rural areas by WPD.

Although they are designed to make and break load they will only be connected and disconnected dead within WPD.

Load break probes are fitted into the insulation and earth screened body of Load Break Elbows.

The use of a Coopers torque tool LPW 1525/TK 120X should be used to provide the correct torque, this tool is known as the Torkey, this is available to purchase from Langley Engineering.

Method of Installation

65.1 Load Break Elbow

- 1.1 Clean the conductor insulation, wiping towards the semi-conducting screen using an approved degreaser.
- 1.2 Apply a thin coating of Euromold silicon grease to the insulation.
- 1.3 Clean the elbow cable entrance and lubricate with Euromold silicon grease.
- 1.4 Place the elbow on the cable with a twisting motion, pushing elbow onto the cable until threaded eye of the connector is aligned with the elbow.

65.2 Load Break Probe (Torkey Wrench)

- 2.1 Depress spring-loaded lever to prepare load break probe wrench to receive the load break probe.
- 2.2 Handle probe from threaded end, inserting probe arc follower (tip) first into centre bore of the wrench.
- 2.3 Release lever allowing curved end of lever to drop into the probe cross-hole.

- 2.4 Elbow connector eye should be lined up as straight as possible inside the elbow to prevent cross threading of the probe.
- 2.5 Place probe stud into connector eye and rotate one turn counter clockwise until probe clicks. Then rotate probe clockwise several turns by hand to ensure it is threading into connector eye without cross threading.
- 2.6 Continue tightening with the tool until the Torkey makes a snapping noise.

This is an indication that the pre-set torque level has been reached and no further tightening is required.
- 2.7 Depress spring-loaded lever completely and remove from the installed probe.

65.3 Removal or Re-Tightening of Load Break Probe

- 3.1 Depress the spring-loaded lever and position wrench tube over probe until wrench end is located at the probe cross-hole. Release lever until curved end of lever drops into probe cross-hole.
- 3.2 To remove probe firmly grip knurled area of probe wrench and rotate tool counter-clockwise.

Note: - For probe retightening, follow steps 2.3 to 2.6 of probe installation.

65.4 Tool Calibration

The Torkey on this Combination Tool is pre-set at 13Nm and is designed to provide years of trouble free service. Elbow manufacturers generally recommend a torque value of between 11 – 13Nm on the elbow connector system.

It is recommended that the tool be checked for calibration every 12 months; the customer or supplier may undertake this.

If the value drops below 100 in lbs. Torkey replacement is recommended.

65.5 Installation of Elbow to Bushing Well Insert

- 5.1 Using 2.5mm² green/yellow PVC sheathed copper wire, remove 30mm of insulation, form the strands into a tight conductor by twisting. Remove a single terminal, from the terminal block release both screws, feed the 2.5mm² wire through the hole in the terminal block, and through the earthing tab of the elbow body and back into the terminal block, tighten the two screws.
- 5.2 Wrap the 2.5mm² earth wire around the elbow body and copper screen wire conductor in a spiral.
- 5.3 Remove the insulation and incorporate the other end into the earth connector used to connect the copper screen wires from the live break elbow to earth.
- 5.4 Slide the appropriate live break elbow over the bushing well insert.

- 5.5 The bushing is equipped with a latch indicator ring that serves as a visual indicator to verify that the mating of components have been properly carried out. This yellow ring should **not** be visible; if any yellow is visible the elbow or protective cap must be completely reinstalled or latched before energizing to assure a quality connection.

GENERAL REQUIREMENT 66

INSTALLATION OF THE INTERFACE C (K) 430-TB/G SEPARABLE CONNECTORS

Before commencing the level of PPE required for this operation shall be as the matrix given General Requirement 3, also your attention is drawn to the Use of Solvents.

General

The Nexans separable connector is a fully shielded and insulated separable tee connector termination for connecting underground cable to transformers or switchgear used mainly in primary substations by WPD. The connectors are made of a terpolymer of ethylene, propylene and a nonconjugated diene. This hydrocarbon-based elastomer has all the advantages of general purpose rubbers but its performance excels in electrical strength and resistance to environmental conditions.

These devices are NOT designed to make and break load and are designed as a screen break separable connector. The terminal connector uses shear bolt technology and it is essential that the right separable connector is used on the requisite cable as these terminations are known as interference fit that is they have been designed for a specific cable size only. All 95, 185 and 300mm² 11kV Euromold separable connectors have a designation (K) 430TB/G- then the cable size – then the mechanical connector size.

Notes: - Do not allow hydrocarbon oils or solvents to contaminate the EPDM rubber, in the event of contamination, immediately wipe the surface clean with a dry cloth.

Only use the Euromold silicon grease used with the Euromold separable connectors.

Silicone SG high viscosity grease has been chosen for both its lubrication and dielectric properties. It is used as a lubricant when installing all pre-moulded rubber accessories and epoxy bushings as well on the insulation of dry cables. Silicone SG grease displays a high level of long-term lubricating stability avoiding any ageing effects (e.g. the risk of sticking). It also offers excellent dielectric properties assuring good performance at high voltage interfaces. In addition the grease contributes to making interfaces watertight. It is completely compatible with all pre-moulded rubber accessories as well as with polymeric insulated cables. Use of this grease has proved to be of value in the installation of accessories in series and for operations such as greasing interfaces after disconnection.

Method of Installation

66.1 Interface C Separable Connectors

- 1.1 Prepare the EPR cable to the appropriate dimension. Clean the conductor insulation, wiping towards the semi-conducting screen using an approved degreaser.
- 1.2 Apply a thin coating of Euromold silicon grease to the insulation.

- 1.3 Clean the separable connector cable entrance and lubricate with Euromold silicon grease.
- 1.4 Place the separable connector on the cable with a twisting motion, pushing separable connector onto the cable until palm of the end termination connector is aligned in the separable connector.
- 1.5 Push the first connector on to the bushing.
- 1.6 Insert the first 400TCS clamping screw into the threaded hole of the bushing.
- 1.7 Use a torque wrench with a 22 mm socket tighten exerting 50 Nm.
- 1.8 Clean and lubricate the female interface of the separable connector, and the male interface of the 400BIPA basic insulating plug.
- 1.9 Insert the BIPA into the separable connector, engage the threads and hand tighten.
- 1.10 Using a 24mm socket tighten the BIPA to 30Nm.
- 1.11 Clean the inner surface of the voltage diction cap and place on the surge diverter. Push down hard until the cap “snaps” into place.
- 1.12 Ensure the separable connector is earthed.
- 1.13 After completion the connector installation, cables should be appropriately clamped to protect against dynamic short circuit forces.

Warning: - A connector/bushing or connector/connector mated combination should not be allowed to carry the full weight of the cable. Therefore it is necessary to correctly clamp; using Ellis Patents two bolt Atlas cable clamps; the cables as close as possible to the connectors to remove the weight of the cable/s from the equipment bushing.

Otherwise the weight of the cable and separable connector will apply a bending moment to the equipment bushing interface which will lead to the bolt cross threading!

GENERAL REQUIREMENT 67

INSTALLATION OF THE INTERFACE C (K) 440-TB/G SEPARABLE CONNECTORS

Before commencing the level of PPE required for this operation shall be as the matrix given General Requirement 3, also your attention is drawn to the Use of Solvents.

General

The Nexans separable connector is a fully shielded and insulated separable tee connector termination for connecting underground cable to transformers or switchgear used mainly in primary substations by WPD. The connectors are made of a terpolymer of ethylene, propylene and a nonconjugated diene. This hydrocarbon-based elastomer has all the advantages of general purpose rubbers but its performance excels in electrical strength and resistance to environmental conditions.

These devices are NOT designed to make and break load and are designed as a screen break separable connector. The terminal connector uses shear bolt technology and it is essential that the right separable connector is used on the requisite cable as these terminations are known as interference fit that is they have been designed for a specific cable size only. All 400 and 630mm² 11kV Euromold separable connectors have a designation (K) 440TB/G- then the cable size – then the mechanical connector size.

Notes: - Do not allow hydrocarbon oils or solvents to contaminate the EPDM rubber, in the event of contamination, immediately wipe the surface clean with a dry cloth.

Only use the Euromold silicon grease used with the Euromold T connectors.

Silicone SG high viscosity grease has been chosen for both its lubrication and dielectric properties. It is used as a lubricant when installing all pre-moulded rubber accessories and epoxy bushings as well on the insulation of dry cables. Silicone SG grease displays a high level of long-term lubricating stability avoiding any ageing effects (e.g. the risk of sticking). It also offers excellent dielectric properties assuring good performance at high voltage interfaces. In addition the grease contributes to making interfaces watertight. It is completely compatible with all pre-moulded rubber accessories as well as with polymeric insulated cables. Use of this grease has proved to be of value in the installation of accessories in series and for operations such as greasing interfaces after disconnection.

Method of Installation

67.1 Interface C Separable Connectors

- 1.1 Prepare the EPR cable to the appropriate dimension. Clean the conductor insulation, wiping towards the semi-conducting screen using an approved degreaser.
- 1.2 Apply a thin coating of Euromold silicon grease to the insulation.

- 1.3 Clean the separable connector cable entrance and lubricate with Euromold silicon grease.
- 1.4 Place the separable connector on the cable with a twisting motion, pushing separable connector onto the cable until palm of the end termination connector is aligned in the separable connector.
- 1.5 Push the first connector on to the bushing.
- 1.6 Insert the first 400TCS clamping screw into the threaded hole of the bushing.
- 1.7 Use a torque wrench with a 22 mm socket tighten exerting 50 Nm.
- 1.8 Clean and lubricate the female interface of the separable connector, and the male interface of the 400BIPA basic insulating plug.
- 1.9 Insert the BIPA into the separable connector, engage the threads and hand tighten.
- 1.10 Using a 24mm socket tighten the BIPA to 50Nm.
- 1.11 Clean the inner surface of the voltage diction cap and place on the surge diverter. Push down hard until the cap “snaps” into place.
- 1.12 Ensure the separable connector is earthed.
- 1.13 After completion the connector installation, cables should be appropriately clamped to protect against dynamic short circuit forces.

Warning: - A connector/bushing or connector/connector mated combination should not be allowed to carry the full weight of the cable. Therefore it is necessary to correctly clamp the cables as close as possible to the connectors to remove the weight of the cable/s from the equipment bushing.

GENERAL REQUIREMENT 68

INSTALLATION OF THE INTERFACE C (K) 440-TB/G MULTIPLE CABLE ARRANGEMENT

Before commencing the level of PPE required for this operation shall be as the matrix given General Requirement 3, also your attention is drawn to the Use of Solvents.

General

The Nexans separable connector is a fully shielded and insulated separable tee connector termination for connecting underground cable to transformers or switchgear used mainly in primary substations by WPD. The connectors are made of a terpolymer of ethylene, propylene and a nonconjugated diene. This hydrocarbon-based elastomer has all the advantages of general purpose rubbers but its performance excels in electrical strength and resistance to environmental conditions.

Notes: - Do not allow hydrocarbon oils or solvents to contaminate the EPDM rubber, in the event of contamination, immediately wipe the surface clean with a dry cloth.

Only use the Euromold silicon grease used with the Euromold separable connectors.

Silicone SG high viscosity grease has been chosen for both its lubrication and dielectric properties. It is used as a lubricant when installing all pre-moulded rubber accessories and epoxy bushings as well on the insulation of dry cables. Silicone SG grease displays a high level of long-term lubricating stability avoiding any ageing effects (e.g. the risk of sticking). It also offers excellent dielectric properties assuring good performance at high voltage interfaces. In addition the grease contributes to making interfaces watertight. It is completely compatible with all pre-moulded rubber accessories as well as with polymeric insulated cables. Use of this grease has proved to be of value in the installation of accessories in series and for operations such as greasing interfaces after disconnection.

68.1 Methodology

- 1.1 Clean the conductor insulation, wiping towards the semi-conducting screen using an approved degreaser.
- 1.2 Apply a thin coating of Euromold silicon grease to the insulation.
- 1.3 Clean the T connector cable entrance and lubricate with Euromold silicon grease.
- 1.4 Push the first connector on to the bushing.
- 1.5 Insert the first 400TCS clamping screw into the threaded hole of the bushing.
- 1.6 Use a torque wrench with a 22 mm socket tighten exerting 50 Nm.
- 1.7 Clean and lightly lubricate both, connector interface and connecting plug interface.

- 1.8 Push the connecting plug into the connector, engage the threads and hand tighten.
- 1.9 Use a torque wrench with a 10mm Allen key and tighten to 50 Nm
- 1.10 Clean and lightly lubricate both, the second connector and the connecting plug interface. Push the 2nd connector on to the connecting plug.
- 1.11 Insert the second 400TCS clamping screw in to the threaded hole of the connecting plug.
- 1.12 Using a 22 mm socket torque to 50 Nm.
- 1.13 Clean and lubricate the female interface of the T connector, and the male interface of the 400BIPA basic insulating plug.
- 1.14 Insert the BIPA into the separable connector, engage the threads and hand tighten.
- 1.15 Using a 24mm socket tighten the BIPA to 50Nm.
- 1.16 Clean the inner surface of the voltage diction cap and place on the surge diverter. Push down hard until the cap “snaps” into place.
- 1.17 Ensure the separable connectors are earthed.
- 1.18 After completion the connector installation, cables should be appropriately clamped to protect against dynamic short circuit forces.

Warning: - A connector/bushing or connector/connector mated combination should not be allowed to carry the full weight of the cable. Therefore it is necessary to correctly clamp the cables as close as possible to the connectors to remove the weight of the cable/s from the equipment bushing.

GENERAL REQUIREMENT 69

INSTALLATION OF THE INTERFACE C SURGE DIVERTER CONNECTORS

Before commencing the level of PPE required for this operation shall be as the matrix given General Requirement 3, also your attention is drawn to the Use of Solvents.

General

The Nexans separable connector is a fully shielded and insulated separable tee connector termination for connecting underground cable to transformers or switchgear used mainly in primary substations by WPD. The connectors are made of a terpolymer of ethylene, propylene and a nonconjugated diene. This hydrocarbon-based elastomer has all the advantages of general purpose rubbers but its performance excels in electrical strength and resistance to environmental conditions.

Notes: - Provided the Interface C surge diverter is always fitted to the equipment bushing interface, the surge diverter can accept both the (K)430-TB and the (K)440-TB/G separable connectors.

Do not allow hydrocarbon oils or solvents to contaminate the EPDM rubber, in the event of contamination, immediately wipe the surface clean with a dry cloth.

Ensure that the Maximum Continuous Operating Voltage (MCOV) of the 11kV system does not exceed the MCOV rating of the surge diverter, i.e. Cornwall use a different MCOV rating due to the use of Peterson coils on the 11kV network, so make sure you have the right surge diverter!

Handle the surge diverter with care; avoid dropping or knocking the surge diverter as this could damage the internal components of the surge diverter.

Only use the Euromold silicon grease used with the Euromold surge diverters.

Silicone SG high viscosity grease has been chosen for both its lubrication and dielectric properties. It is used as a lubricant when installing all pre-moulded rubber accessories and epoxy bushings as well on the insulation of dry cables. Silicone SG grease displays a high level of long-term lubricating stability avoiding any ageing effects (e.g. the risk of sticking). It also offers excellent dielectric properties assuring good performance at high voltage interfaces. In addition the grease contributes to making interfaces watertight. It is completely compatible with all pre-moulded rubber accessories as well as with polymeric insulated cables. Use of this grease has proved to be of value in the installation of accessories in series and for operations such as greasing interfaces after disconnection.

69.1 Methodology

Always ensure that the surge diverter is fitted adjacent the switchgear or plant to which the C type equipment interface is fitted to, as this will provide a degree of protection against accidental damage to the surge diverter.

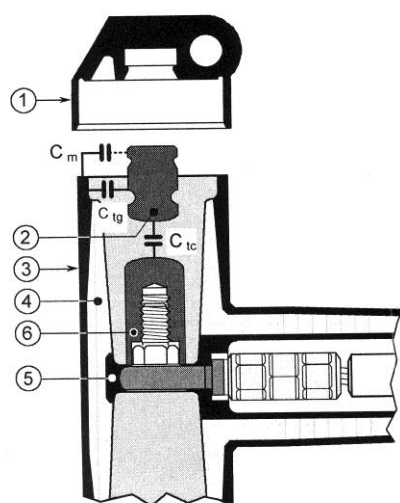
- 1.1 Clean and lubricate the female interface of the surge diverter, and the male interface of the equipment bushing.
- 1.2 Push the surge diverter home on to the equipment bushing.
- 1.3 Remove the protective cap from the surge diverter interface.
- 1.4 Insert the contact rod into the metal rod insert hole of the surge diverter.
- 1.5 Ensure the body of the surge diverter is positioned vertically and that the earth terminal side is pointing downwards. Using the 10mm hex Allen key torque the contact rod to 50Nm.
- 1.6 Clean and lubricate the male interface of the surge diverter and the female interface of the T connector.
- 1.7 Push the T connector home onto the surge diverter.
- 1.8 Insert the 40TCS clamping screw into the threaded hole of the contact rod.
- 1.9 Using a 22mm socket tighten the clamping screw to 50Nm.
- 1.10 Clean and lubricate the female interface of the T connector, and the male interface of the 400BIPA basic insulating plug.
- 1.11 Insert the BIPA into the T connector, engage the threads and hand tighten.
- 1.12 Using a 24mm socket tighten the BIPA to 50Nm.
- 1.13 Clean the inner surface of the voltage detection cap and place on the surge diverter. Push down hard until the cap “snaps” into place.
- 1.14 Ensure the T connector is earthed and connect the earth braid of the surge diverter to the system earth.

Warning: - A bushing/surge diverter/connector or bushing/surge diverter/connector/connector mated combination should not be allowed to carry the full weight of the cable. Therefore it is necessary to correctly clamp the cables as close as possible to the connectors to remove the weight of the cable/s from the equipment bushing, thus preventing cross threading of the copper clamping screw.

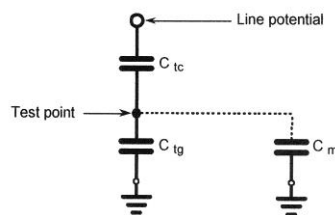
GENERAL REQUIREMENT 70

CAPACITIVE TESTING OF THE INTERFACE C (K) 430-TB/G or (K) 440-TB/G SEPARABLE CONNECTORS

The connectors manufactured by EUROMOLD are provided with a capacitive test point. This enables a local check to be made to confirm that the product is de-energised prior to disconnection.



SEPARABLE CONNECTORS
 - (K)(M)400TE
 - (K)(M)400TB
 - (K)(M)440TB



KEY

- ① Conductive rubber cap
- ② Metallic insert (capacitive test point)
- ③ Conductive EPDM screen (earth potential)
- ④ EPDM insulation
- ⑤ Internal EPDM screen (line potential)
- ⑥ Metallic insert (line potential)

The capacitive test point consists of a metallic insert moulded into the insulation and electrically connected to a convenient external terminal. Under normal operating circumstances this terminal is earthed by its conductive rubber cap. The cap must be removed prior to testing. When applying the test device you are effectively establishing a capacitive potential divider, the components of which are: -

C_{tc} = 1.5 to 3 Pico farads between test point and line connections.

C_{tg} = 5 to 8 Pico farads between test point and earthed conductive screen.

C_m = 15 Pico farads representing the approximate capacity of the detection apparatus.

The voltage available at the test point is directly proportional to the line voltage depending on the capacitance ratio.

The following ratio is typical: -

$$\frac{V_{measure}}{V_{phase / earth}} = \frac{C_{tc}}{(C_{tc} + C_{tg} + C_m)} = \frac{1}{14}$$

Although relatively high voltages can be present on the test point after removing the conductive cap, the overall available energy is minimal and any potential would disappear instantaneously if touched by an operator or other personnel. The current transfer would be a fraction of a micro ampere and imperceptible to human touch.

Before commencing the level of PPE required for this operation shall be as the matrix given in [General Requirement 3](#).

Using the Approved Edgcumbe high voltage indicator, the following tests shall be carried out using an approved HV indicator:-

The HV indicator will indicate when connected between phases and earth. **The HV indicator shall be proved before and after use.**

When carrying out any voltage checking on separable connectors the conductive rubber cap, marked as (1) on the figure shown on page 172. Once the rubber cap has been removed the following test should be carried out: -

(a) The separable connector shall be confirmed live or dead by testing with the HV indicator from earth to phase L1, L2 and L3 and then between phases.

(b) If required when energising a dead cable the HV indicator can be connected between earth to phase L1, L2 and L3 and then between phases.

GENERAL REQUIREMENT 71

USE OF EPR CABLE IN EXISTING COMPOUND FILLED CABLE BOXES

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

When there is a need to replace PILC, PICAS or PISAS cables installed in existing compound filled cable boxes with new EPR / XLPE cable the following will need to be addressed.

A minimum of 300mm for 95/185/300mm² and 350mm for 630mm² between the gland/base plate to connection point must be achieved; if this is not obtainable an extension of the cable box should be considered. The minimum clearance phase to phase clearance in a Lovisil filled cable box is 75mm, and the minimum phase to earth clearance in a Lovisil filled cable box is 60mm.

Consideration should be given to new replacement box, which can be obtained from Webster Wilkinson who will manufacture to the existing box; insulators can be fitted if required.

71.1 Method of Installation

- 1.1 Remove the compound from the cable box gently melting out with infrared lamps, release and remove the existing cable.
- 1.2 Remove the gland/base plate from the gland removing any traces of compound, once clean roughen the gland internally with emery cloth.
- 1.3 Clean the compound from the internals of the box; gland/base plate and cover ensuring all are as clean as possible.
- 1.4 Replace all existing gaskets with new.
- 1.5 Drill and fit an earth stud to the box side.
- 1.6 Check insulators are free from chips, cracks, and complete termination to the relevant Jointing Procedure.

GENERAL REQUIREMENT 72

PRIOR TO ENERGIZATION OF ALL CABLE CIRCUITS

General

In compliance with the ESQC Regulations 2-03 no cable circuit shall be energized unless the following minimum conditions have been met: -

On building sites where cable has been laid and an additional cable will be required to be laid in the near future, then the minimum which will be acceptable prior to the cable being energized, is the cables are covered with 75mm of crushed limestone or granite dust, (3mm to dust) with marker tape laid on top of the crushed limestone or granite dust, as per ST: NC2H – Relating to Inspection and Recording.

Where joint holes have been dug and the cables exposed the minimum requirement shall be that the joint hole shall be signed and guarded as per that laid out in ST: HS14D.

Where the cable has been laid up to a pole, the minimum requirement shall be that the cable and pole shall signed and guarded as per that laid out in ST: HS14D.

GENERAL REQUIREMENT 73

SEALING OF CABLE ENDS

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, also your attention is drawn to the Use of Solvents General Requirement 1.

General

The capping of cable ends is very important especially with paper-insulated cables, to prevent the ingress of moisture. With more modern polymeric insulating materials the need to prevent moisture is to allow the resin to seal effectively, prevent the corrosion of aluminium conductors as well as to prevent the overall deterioration of the cable over time.

There are three methods of capping cables: -

Cold Shrink Cap

Heat Shrink Cap

Denso Tape – temporary sealing only i.e. 24 hrs.

73.1 Cold Shrink Cap

The cold shrink cap being the most commonly used and can be applied to all cable types. Before preparing and applying, a cap of the correct size must be selected; caps are range taking to suit variable cable diameters and to ensure a good moisture seal the selection is most important.

Methods of Application

PVC or MDPE Oversheathed Cables – Drawing GR2D 6.73.1

1. Select correct cap to suit cable diameter, ensure the cap is coated internally with sealant and not pin-holed.
2. Clean and degrease PVC/MDPE oversheath – Fig 1.
3. Slide the cap onto the cable pushing well onto the cable end.
4. Pull the spiral out of the cold shrink cap in an anti-clockwise direction until the cold shrink cap is fully shrunk onto the cable.

73.2 Heat Shrink Cap

Methods of Installation

Refer to Drawing GR2D 6.73.1 and 6.73.2 whilst undertaking this General Requirement.

PVC/MDPE Oversheathed Cables

Refer to Drawing GRD2 6.73.1.

- 2.1 Select correct cap to suit cable diameter, ensure the cap is coated internally with sealant and not pin holed.
- 2.2 Clean and degrease PVC/MDPE oversheath with an approved degreaser – Fig 1.
- 2.3 Abrade the PVC oversheath to the length of the cap, abrading is to be undertaken circumferentially ensuring all glossing of the sheath is removed. General Requirement 15.
- 2.4 Clean the abraded area thoroughly with an approved degreaser – Fig 1.
- 2.5 Slide the cap onto the cable pushing well onto the cable end – Fig 2.
- 2.6 Using a soft blue flame start shrinking from the closed end of the cap and work towards the open end. Ensure the flame is worked evenly round the cap, ensuring enough heat is given to melt the sealant coating – Fig 3.
- 2.7 Once the cap has fully shrunk into position a ring of sealant will be seen around the cable sheath at the cap end – Fig 4.

PILCSTA/PILCSWA Cables

Refer to Drawing GR2D 6.73.2. The cable must be prepared down to the lead sheath; the cap must not be placed over the outer serving etc.

- 2.8 Select correct cap to suit cable diameter, ensure the cap is coated internally with sealant and not pin holed.
- 2.9 Mark outer serving the length of the cap plus 50mm from the cable end, apply a wire binder to the cable at this point – Fig 1.
- 2.10 Remove outer serving, armour and bedding General Requirement 11.
- 2.11 Thoroughly clean the lead sheath from all traces of bitumen with an approved degreaser.
- 2.12 Ensure any sharp edges at the end of the lead sheath are removed with a file.
- 2.13 Clean the lead sheath with an approved degreaser and abrade the lead sheath circumferentially up to the termination of the outer serving etc, using file card – Fig 1.
- 2.14 Clean the abraded area with an approved degreaser.
- 2.15 Slide the cap onto the cable pushing well onto the cable end.

- 2.16 Using a soft blue flame starting shrinking from the closed end of the cap and work towards the open end. Ensure the flame is worked evenly around the cap, ensuring enough heat is given to melt the sealant coating – Fig 2.
- 2.17 Once the cap has fully shrunk into position a ring of sealant will be seen around the cable sheath at the cap end – Fig 3.
- 2.18 Apply two half lap layers of “88” black PVC tape covering the end of the outer serving, armour termination, lead sheath and finishing on the heat shrink cap – Fig 4.

73.3 Denso Tape

Denso tape is to be used for temporary sealing i.e. 24 hours, it can be applied to all cable types as follows: -

PVC/MDPE Oversheathed Cables – applied direct without any special preparation.

PILCSTA/PILCSWA Cables – cables are to be prepared as for heat shrink cap method and the Denso tape must be applied direct to the cleaned lead sheath.

Method of Application

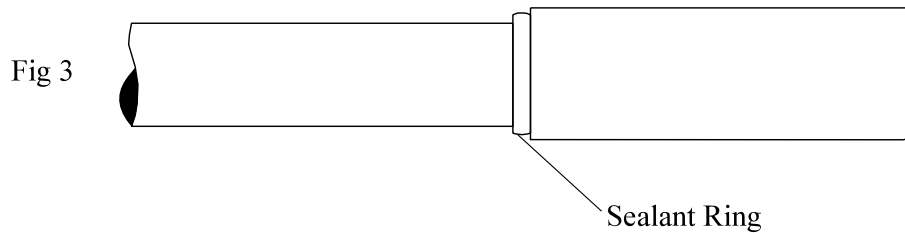
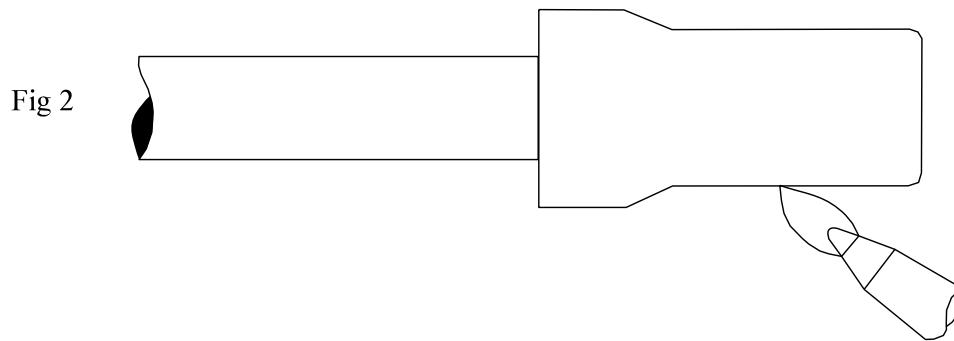
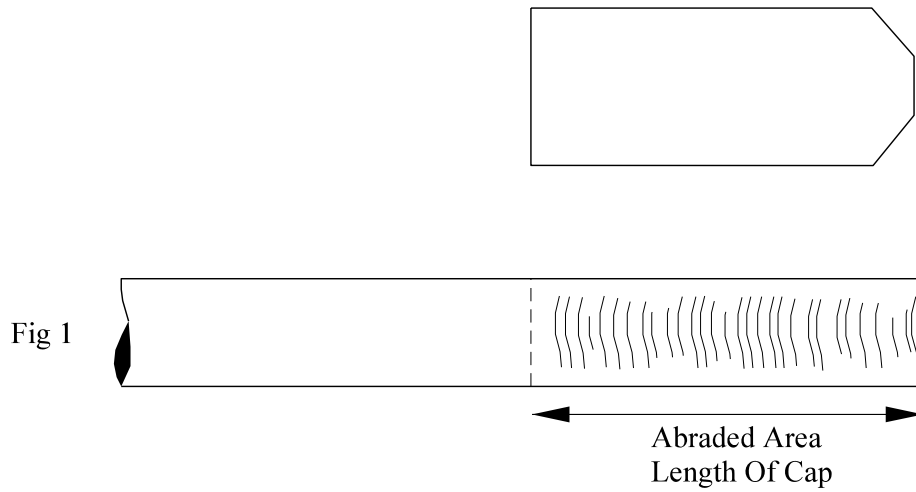
Disposable gloves are to be worn when applying.

The tape is to be applied with a minimum of two half lapped layers, as each layer is applied the paste within the tape must be worked well through the tape.

Starting on the cable sheath a minimum of a width and one half of the tape from the cable end, wrap towards the cable end, with a criss-cross action apply the required layers across the cable end returning to the start point.

Cut the tape and ensure the paste is worked well into the taped end.

All dimensions in mm



Rev No	Drawn	Chk'd	App'd	Date	Revision
ORIGINAL ISSUE		DATE		<div>WESTERN POWER DISTRIBUTION Design Department. Avonbank,Feeder Road,Bristol BS2 0TB Tel: 0117 933 2000 Fax: 0117 933 2001.</div> <div>WESTERN POWER DISTRIBUTION</div>	
Drawn	RJB	04/13			
Checked					
Approved					
SCALE		N.T.S.			
Title				SEALING OF CABLE ENDS - PVC/MDPE SHEATHED CABLES	
				Drg. No. GR2D 6.73.1	
				Rev No	

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All dimensions in mm

Fig 1

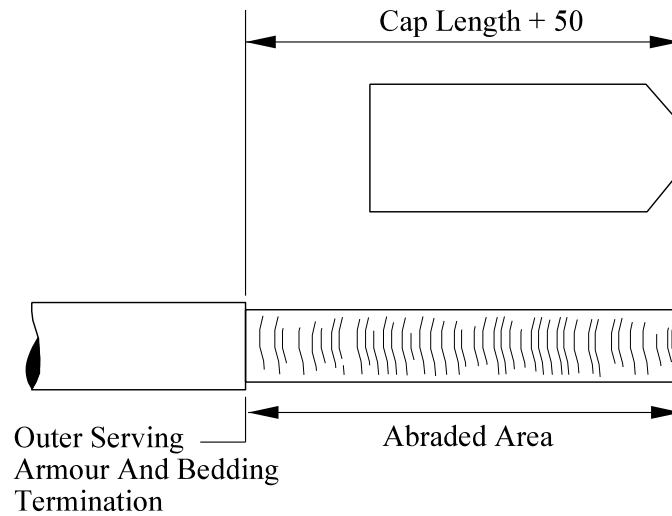


Fig 2

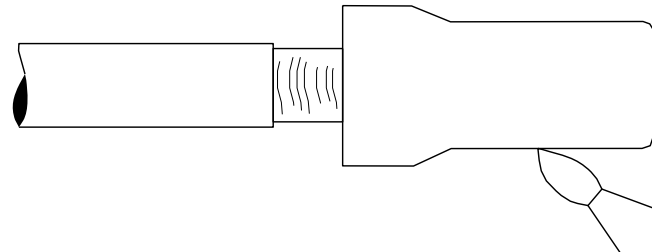


Fig 3

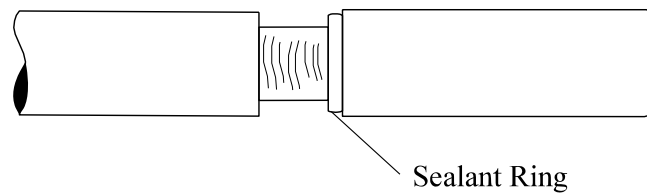
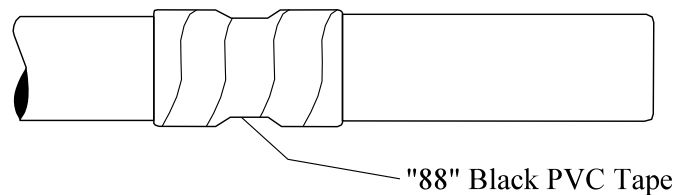


Fig 4



Rev No	Drawn	Chk'd	App'd	Date	Revision
ORIGINAL	ISSUE	DATE	WESTERN POWER DISTRIBUTION		
Drawn	RJB	04/13	Design Department.		
Checked			Avonbank, Feeder Road, Bristol BS2 0TB		
Approved			Tel: 0117 933 2000 Fax: 0117 933 2001.		
SCALE	N.T.S.	Title			SEALING OF CABLE ENDS -
			PILCSTA / PILCSWA CABLES		
			Drg. No.		Rev No
			GR2D 6.73.2		

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GENERAL REQUIREMENT NO. 74

IZUMI SB-3UK SHEARBOLT TOOL.

This tool is the **ONLY APPROVED shearbolt tool** designed for use by WPD Jointing staff that is undertaking jointing activities, which use mechanical connectors containing shearbolts. The following jointing activities are included: -
Live and dead LV Mains jointing, dead 11kV jointing and dead 33kV jointing.

Note: - The Izumi Shearbolt tool is not to be used on the B&H MSIP connector.

74.1 Components

The tool comes with the following items: -
Izumi SB-3UK shearbolt tool.
Nickel Cadmium (Ni-Cd) 14.4V battery.
Izumi CH-70DC charger.
Rubber battery shroud.
Plastic toolbox.

74.2 Batteries

It will take approximately 6 to 8 charging and discharging cycles to build up to the maximum power in new batteries. A battery should give anything between 400 and 600 cycles, typically 12 to 18 months if cycled on a daily basis. The sign of a battery coming to the end of its life would be the battery going flat after very little use, because it does not hold its charge.

Ni Cad cells are prone to building up a memory if not fully discharged on a regular basis. In effect, this means that if your battery is only 50% flat and you charge it repeatedly, the battery registers the 50% charge state as being its flat state and will thus only give you 50% of its capacity. **All batteries must be completely discharged by normal use before re-charge to get the most out of them.**

Charger Model	Charging Time	Remarks
CH-25EMC 220/240V		Refresh function: - By pressing discharge switch to avoid battery memory effect, the Charger will discharge battery and recharge automatically. For fully charged batteries, time required: - BP-70E & EI = 10 Hrs.
	BP-70R 1.2Ah - 15 Minutes	
	BP-70I 1.2Ah with LED - 15 Minutes	
	# BP- 70E 2Ah - 20 Minutes	
	BP-70EI 2Ah with LED - 20 Minutes	
	BP-250RI 4Ah - 45 Minutes	
* CH-70DC 12 V	Inverters are now available to enable use in vehicle.	Power source: - 12 / 24V DC car / vehicle battery Connected to cigarette lighter.
	BP-70R 1.2Ah - 60 Minutes	
	BP-70I 1.2Ah with LED - 60 Minutes	
	* BP- 70E 2Ah - 90 Minutes	
	BP-70EI 2Ah with LED - 90 Minutes	
	BP-250RI 4Ah - 180 Minutes	

*** Standard issue with W.P.D. tools.**

74.3 Operation

Battery Charging: -

1. Connect the battery charger plug to the supply.
2. Insert battery pack into the charger.
3. Charging takes approx. 20 to 90mins depending on the charger used.

Battery Insertion

1. To insert the battery into the tool body, insure battery is facing in the correct direction, and then push the charged battery firmly into place until a click is heard.
2. After inserting a battery, check that it is securely in place by gently pulling on the battery. Do not press the locking latch while pulling the battery.

Speed Control

1. The trigger has a built-in variable speed control. As the trigger is pressed the speed increases gradually to a maximum when fully depressed.
2. The drive rotates when the trigger is pressed and stops when the trigger is released.
3. To reverse the drive, move the reverse switch (on side of tool) to position “R” and press the trigger as before.

Shearing the Bolts

1. Place the mechanical connector onto the conductor in accordance with the manufacturer’s recommendations and “finger-tighten” all bolts.
2. Fit the right size socket for the shear bolts on the mechanical connector to the ½” drive shaft of the tool.
3. Check that the forward/reverse switch on the side of the tool is in the forward position “F”.
4. Place the socket over the first shear bolt and press the trigger until the shearbolt shears, release the trigger.
5. Repeat on all bolts in the sequence of the manufacturer’s recommendations until all shearbolts have sheared.

74.4 Precautions

Never use the tool to place the shearbolts in the mechanical connector, **always** use fingers and make sure the shearbolt is not cross threaded. Prior to shearing make sure that the tool is in forward rotation before placing the socket over the shearbolt.

Do not drop the tool. Dropping the tool may damage the internal gears and result in the tool not functioning correctly. Always store in the case provided when not in use.

Before commencing the level of PPE required for this operation shall be as the matrix given in General Requirement 3, your attention is drawn to the use of **Ear Defenders**.

APPENDIX A

SUPERSEDED DOCUMENTATION

This Standard Technique is a revision of document ST: CA2C/8 dated May 2016 and replaces that document.

APPENDIX B

ASSOCIATED DOCUMENTATION

ST:CA2A, ST:CA2M, ST:CA2N, ST:CA2O, ST:CA2S, ST:CA2T, ST:CA2U, ST:CA2V.

APPENDIX C

KEY WORDS

Installation details on 11kV accessories.