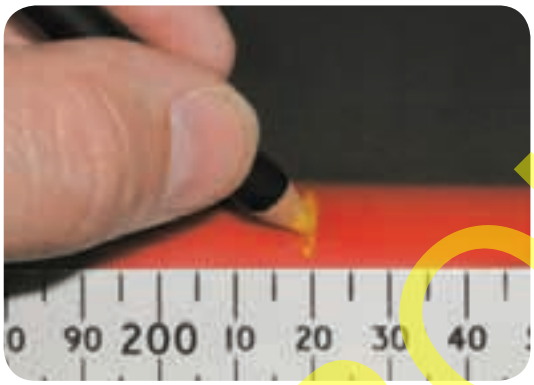
3 STANDARD PROCEDURES FOR PREPARING 11KV AND 6.6KV MAINS CABLES

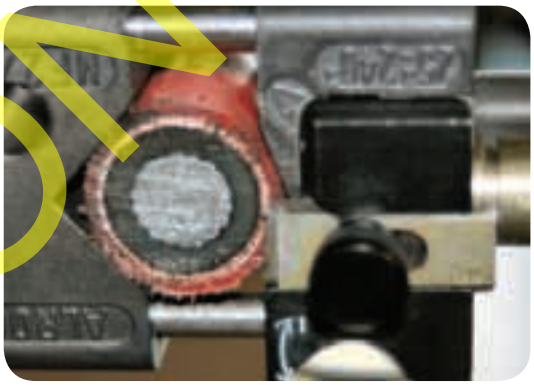
3.1 Single Core Copper Wire Screened Polymeric Cables

3.1.1 Removing the Outer Sheath

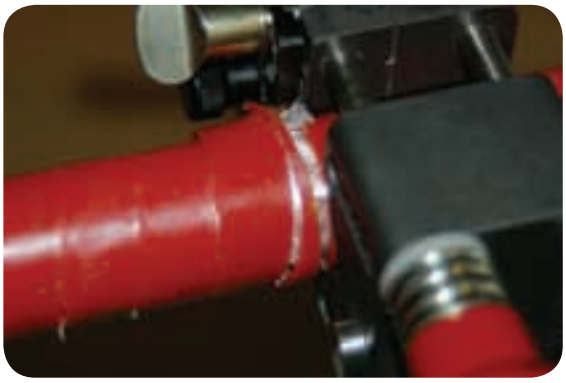
- Mark the removal point of the outer sheath as indicated on the relevant jointing instruction, using a Chinagraph pencil.



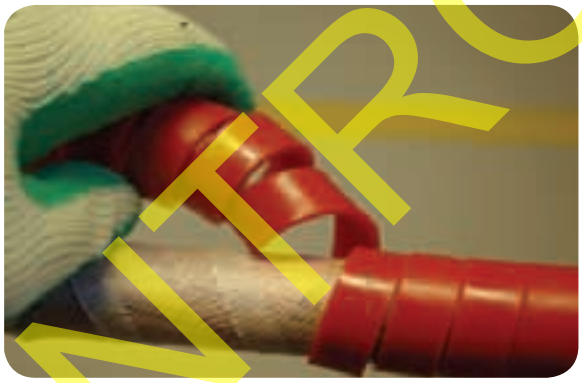
- Remove the sheath to this point using the approved Alroc tool. Starting at the open end of the cable, set the tool to the correct cutting depth, to avoid damaging the copper wire screens below. Make a spiral cut up to the position of the sheath removal point.



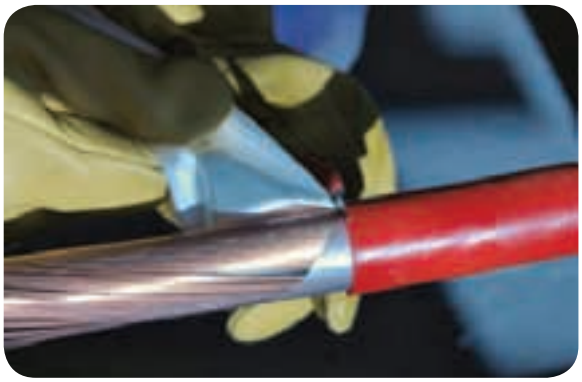
- Just before reaching the sheath removal point, reset the cutting blade angle so that a square cut is achieved. If necessary, try this process out on the overlapping section of the cable.



- Remove the outer sheath by unwinding the spiral made by the stripping tool.

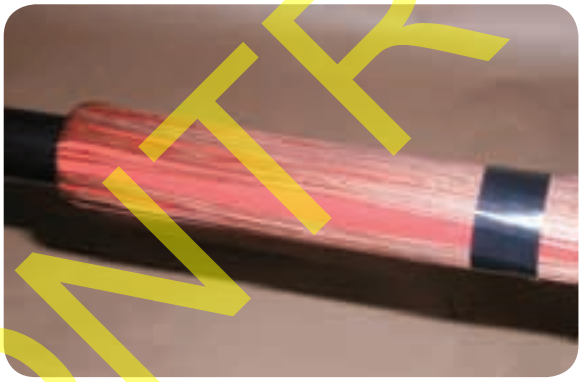


- Remove the fabric or plastic tape from the screen wire using an approved knife, taking care not to damage the copper wires below.



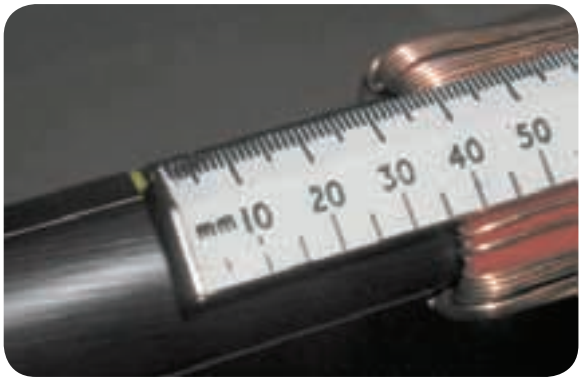
- Flame brush the outer sheath for a distance of 150mm along the sheath, away from the sheath removal point and allow to cool.

- Unwind the copper wires and lay them back along the over-sheath in the position required by the joint being made, then secure with PVC tape. See Sections 4.1.4 to 4.1.6 for details of the different types of screen-wire preparation.

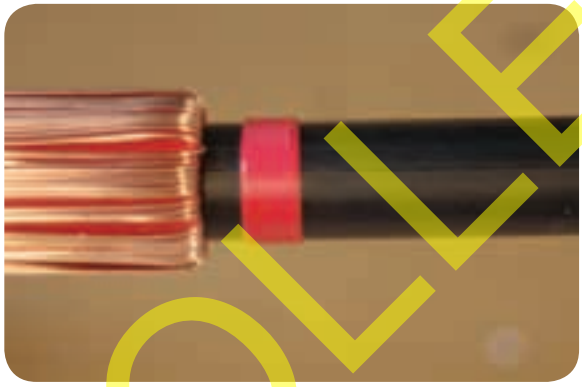


3.1.2 Removing the Bonded Polymeric Screen

- The Alroc bonded screen stripping tool is designed to leave 40mm of black insulation screen from the copper wire screens.



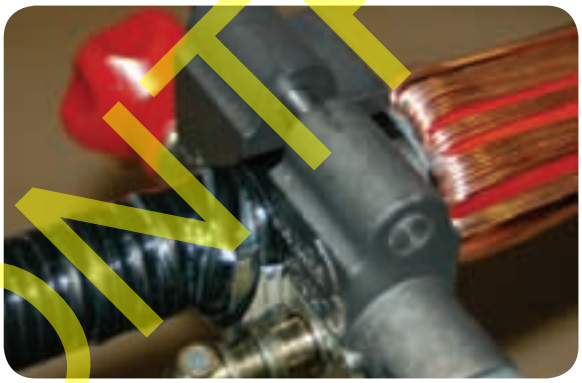
- The only joints that require more than 40mm is the single core polymeric branch, which requires 60mm and the transition branch where the screen is removed 180mm from the reference line.
- Remove the extra 20mm of insulation screen by:
  - Making a Chinagraph pencil mark 20mm from the outer sheath cut.
  - Applying several layers of PVC tape on the sheath side of the mark.
  - Using the stripping tool as described in this section.



- Smear the end of the insulation with a thin film of silicone grease.

- Starting at the open end of the cable, set the tool to the correct cutting depth so that the entire screen is removed with only the minimum amount of insulation. It is essential that the core is as straight as possible for this operation, otherwise traces of the screen may be left behind.

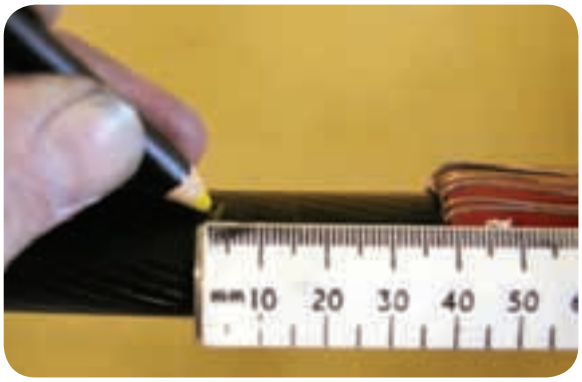
- Continue turning the tool until it butts up against the copper screen wires and then turn the tool until a smooth right angled taper is produced. Test the tool on the overlap section of the core if necessary.



- Clean and degrease the insulation with an approved solvent wipe to remove all traces of conducting material. Always wipe from cut end towards screen wire to avoid contaminating the insulation with carbon from the uncut screen.

3.1.3 Removing the ‘Easy-Strip’ Insulation Screen

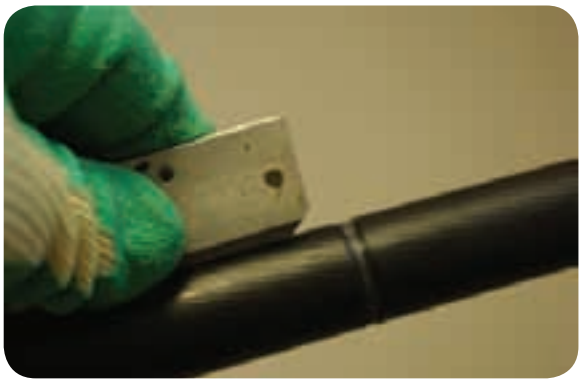
- Mark the removal point of the polymeric screen with a Chinagraph pencil 40mm from the sheath cut.



- Apply six layers of PVC Tape, with the sticky side out, around the insulation screen at the screen cut position, nearest to the sheath cut.

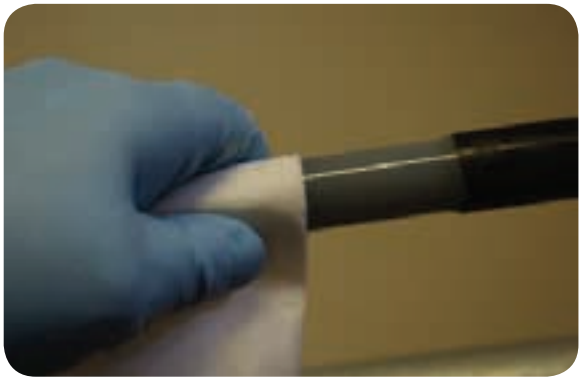
- Use an abrafile to make a circular abrasion around the screen, using the PVC tape as a guide, just deep enough so that the insulation below is visible.

- Remove the PVC tape. Starting at the circular abrasion and using the correct 0.5mm depth-guarded tool, make two separate score lines along the core towards the cut end. The lines shall be equally spaced and approximately 30° apart.



- At the position where the scores meet the cut end, further deepen the score marks and pull the conducting screen away from the insulation up to the circular abrasion. Repeat this operation for the other screen section.

- Clean and degrease the insulation with a solvent wipe to remove all traces of conducting material. Always wipe from the cut end towards the screen wire to avoid contaminating the insulation with carbon from the uncut screen.

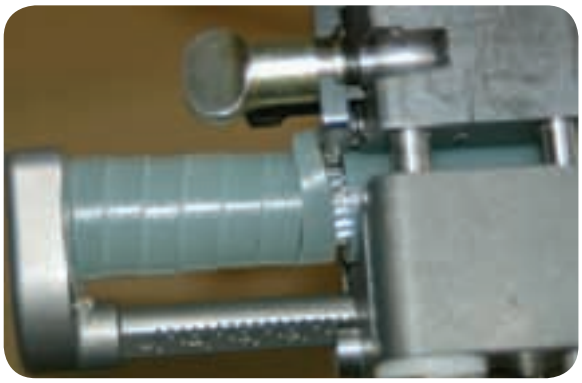


3.1.4 Removing the Polymeric Insulation

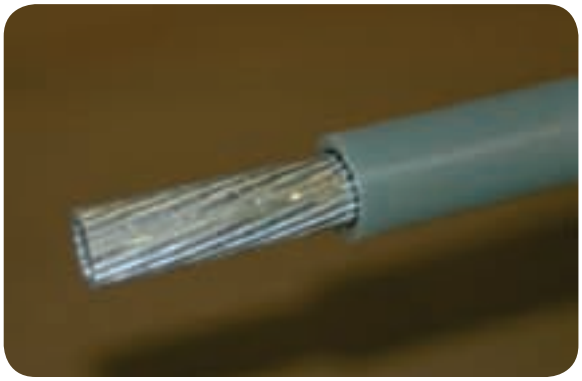
- Using the Alroc tool, set the ‘stop gauge’ to the connector insertion depth.

- Position the tool at the open core end. Adjust the blade to the required depth, which is just deep enough so the blade does not damage the conductor.

- Rotate the tool along the core, using the spiral cut setting, until the stop gauge prevents it moving any further.



- Remove the tool and the removed insulation spiral.



3.2 Single Core Polylam Cables

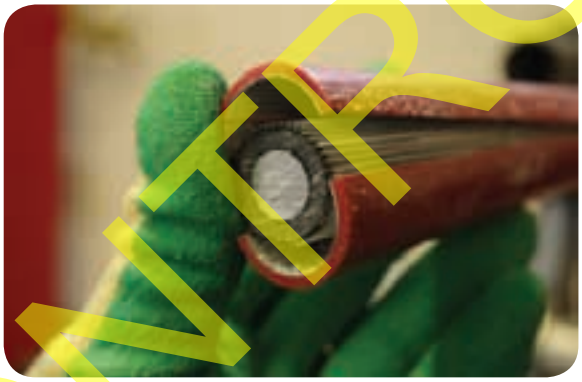
3.2.1 Removing the Outer Sheath and Aluminium Foil Layer

- Mark the removal point of the outer sheath with a Chinagraph pencil, as indicated on the relevant jointing instruction. Make an additional line on the sheath 35mm past the original mark to show the position where the long straight cuts start.

- Using a pair of PG3 sheath stripping pliers, make a circular cut around the sheath at the removal point.

- Make two longitudinal cuts (180° apart) using the PG3 sheath stripping pliers, starting 35mm beyond the circular cut and extending towards the open end of the cable.

- Lift the two sections of the sheath away from the open end and break them off at the circular cut position. The aluminium foil layer shall be removed simultaneously with the outer sheath.

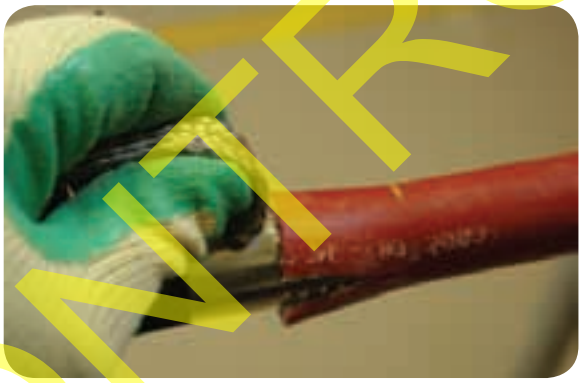


3.2.2 Installing 'Cheese-Grater' Earth Connection

- Use the approved laminate belling tool to carefully lift the laminate sheath away from the insulation screen where the two slits remain.

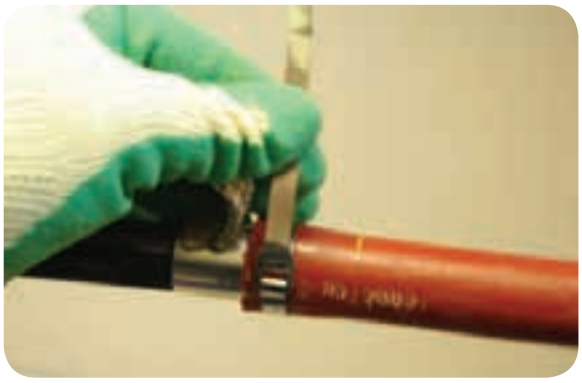
- Ease the sheath outwards, carefully progressing around the sheath in a circular pattern until it is approximately between 5mm and 7mm above its original position. Do it gently to avoid cracking the aluminium layer which reduces its fault carrying capability.

- Position the ‘cheese-grater’s serrated section under the raised laminate sheath so that the entire section is underneath the remaining sheath. The gap in the ‘cheese-grater’ shall be positioned so that it does not correspond with the slits in the outer sheath and laminate.

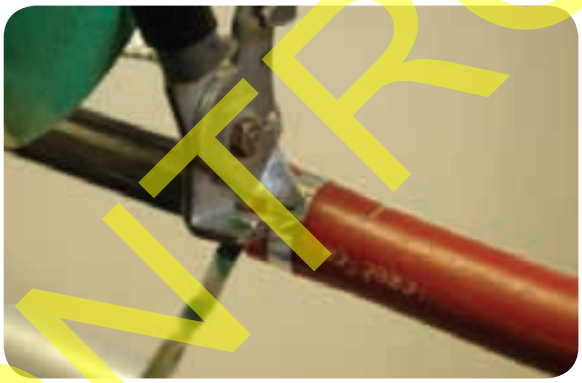


- Use the sheath roller tool to compress the sheath on to the serrations of the ‘cheese-grater’, until the sheath is back to its original position.

- Install the first ligerex strap around the cable sheath, 5mm back from the sheath cut, and secure with the ligerex tightening tool.



- Install the second ligerex strap around the cable sheath 20mm from the sheath cut and tighten with the approved ligerex tightening tool.

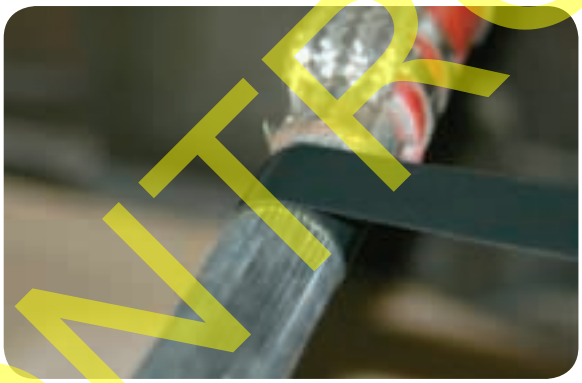


- Fix the tinned copper braid fixed to the ‘cheese-grater’ to the outer sheath of the cable 60mm from the sheath cut.

3.2.3 Removing the ‘Easy-Strip’ Insulation Screen

- Mark the removal point of the polymeric screen with a Chinagraph pencil, as indicated on the relevant jointing instruction. Remove the Easy-strip screen to this point.

- Apply six turns of PVC tape to the insulation screen, sticky side out, to provide a guide for the abrafile.

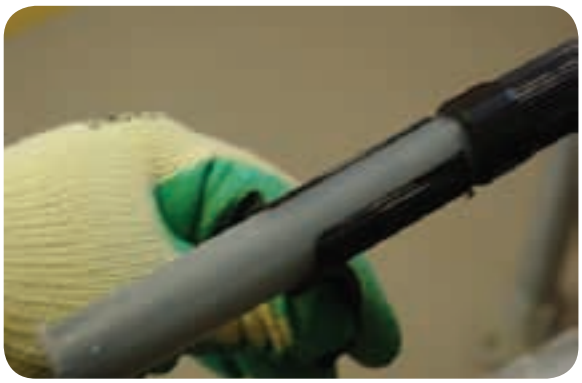


- Using an abrafile, make a circular abrasion around the screen at the removal point just deep enough to expose the insulation below.

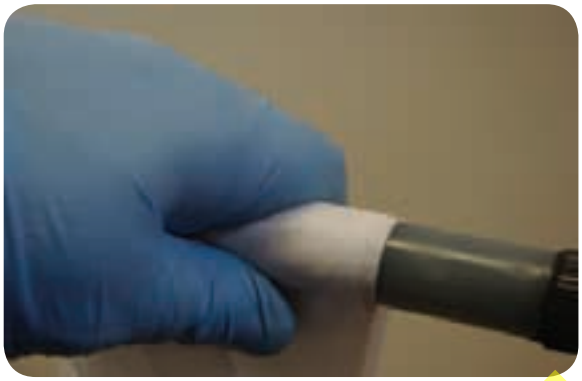
- Starting at this position, and using the correct 0.6mm depth guarded tool, make two separate score lines along the core towards the cut end. The lines shall be equally spaced and approximately 90° apart.

- Where the score meets the cut end, further deepen the score marks and pull the conducting screen away from the insulation up to the circular abrasion.

- Repeat this operation for the remaining section of insulation screen.

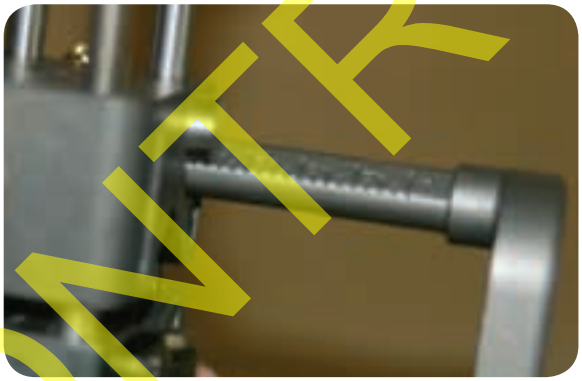


- Carefully remove the PVC tape. Clean and degrease the insulation with an approved solvent wipe to remove all traces of conducting material. Always wipe from the cut end towards the screen wires to avoid contaminating the insulation with carbon from the uncut screen.



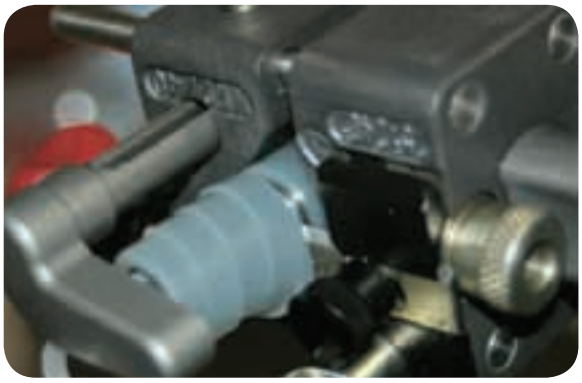
3.2.4 Removing the Polymeric Insulation

- Using the Alroc tool, set the ‘stop gauge’ to the depth of the mechanical connector or lug.



- Position the tool at the open core end. Adjust the blade to the required depth, which is just deep enough so the blade does not damage the conductor.

- Rotate the tool along the core using the spiral cut setting until the stop gauge prevents it moving any further. Remove the tool and the removed insulation spiral.



3.3 3-Core Polymeric Cables

3.3.1 Removing the Outer Sheath

- Make a mark on the sheath at the removal point, as indicated on the relevant jointing instruction.

- Using an approved knife, depth-guarded saw or PG3 stripping pliers, make a circular cut around the sheath.

- From the open end of the cable make a longitudinal cut down the sheath to the circular cut mark. Remove the sheath at this mark by unwrapping from the armours or screen wires below.

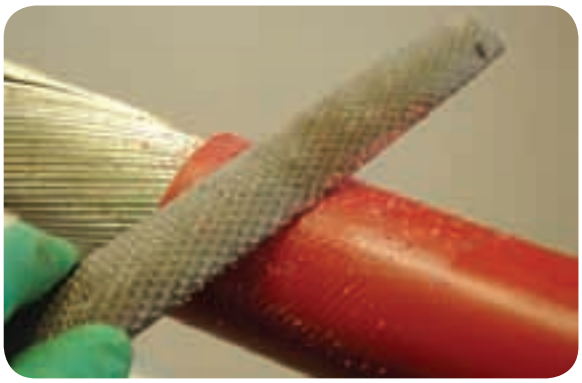
3.3.2 Preparation of Plastic Cable Sheath

3.3.2.1 Polyethylene (PE) Sheaths

- Flame-brush the outer sheath for a distance of 150mm from the sheath removal point.

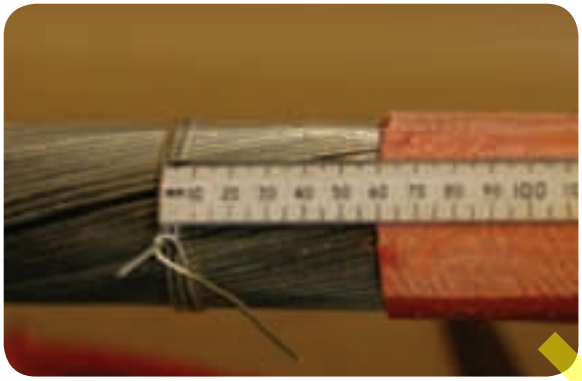
3.3.2.2 PVC Sheaths

- Abrade the PVC sheath with a rasp for a distance of 60mm.



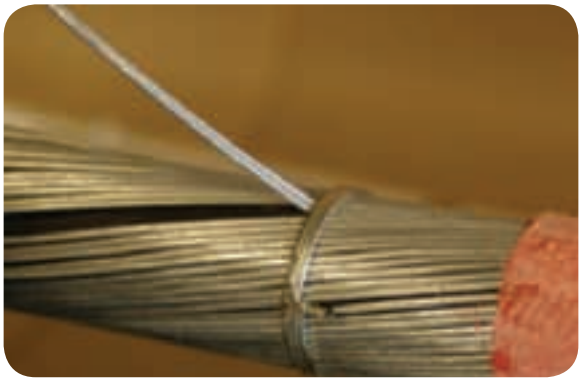
3.3.3 Preparation of Steel Wire Armour (Steel Wire Armour Cables)

- A transition straight kit and an additional 3-core polymeric preparation kit is required for this process.
- Mark the armour removal point as indicated on the relevant jointing instruction. Place a wire binder onto the armour wire, adjacent to the armour removal position, on the sheath cut side.

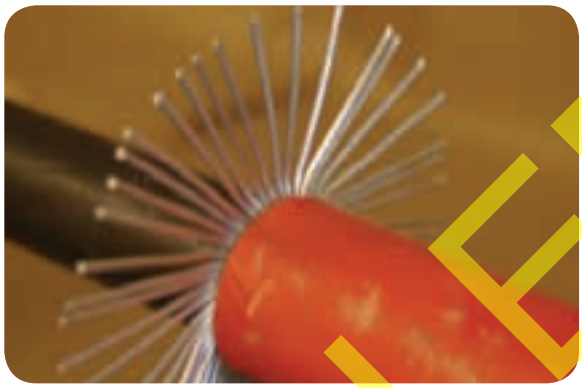


- Using a depth-guarded or junior hacksaw, cut around the armours approximately halfway through.

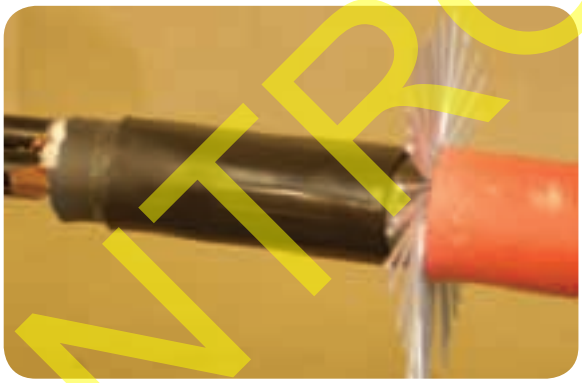
- Wear suitable gloves while removing the armour. Lift and unwrap the armour wires a few at a time and break them off against the binder by bending them backwards and forwards.



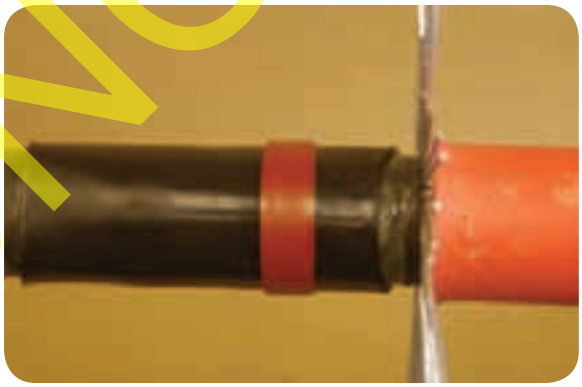
- Remove the wire binder and lift all the armour wires so that they are at right-angles to the cable sheath.

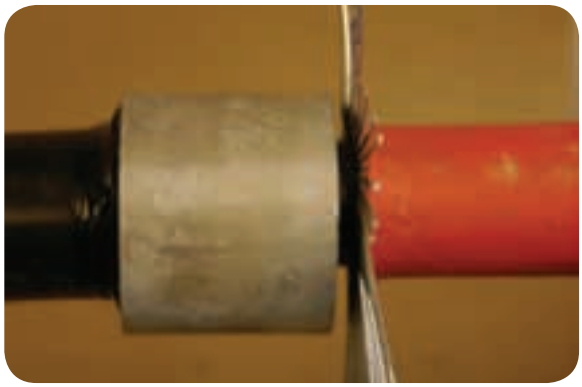


- Place the piece of black heatshrink tube, supplied in the 3-core polymeric preparation kit, over the inner bedding layer of the cable and shrink into place.

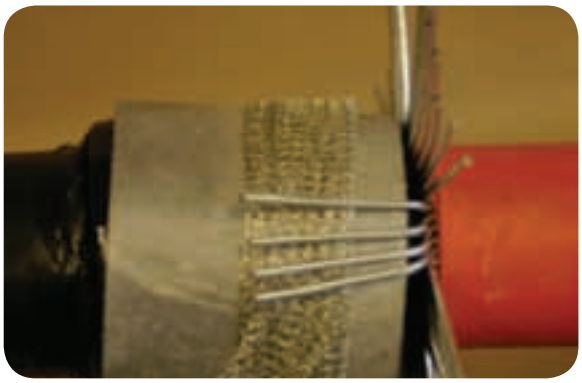


- Place a number of single-width turns of red sealant tape around the red tube over the outer sheath cut. Build this up in layers until the support ring from the 3-core polymeric preparation kit just fits over it.

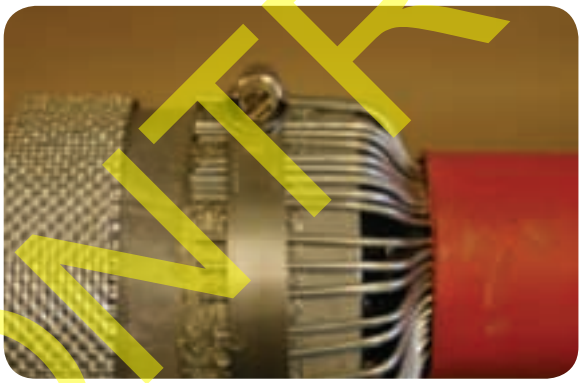




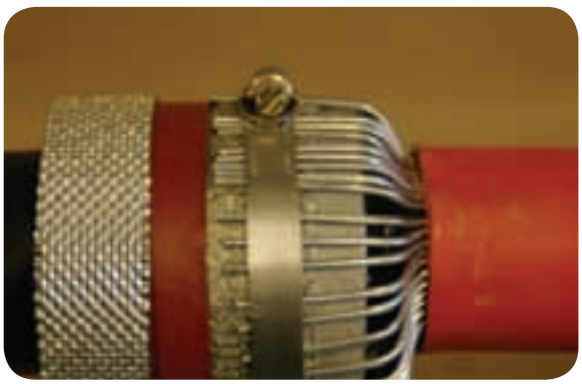
- Fold a length of copper mesh in half over its full length to reduce its width to approximately 30mm. Wrap two layers of the mesh around the support ring in line with the end of the armour wires when they are folded back on to the ring.



- Bend all the armours down on to the copper mesh on the support ring and secure in place with the supplied large worm-drive clip. Bend the long length of 'cheese-grater' strip to form a circle and position it on the support ring, at the opposite end from where the armour wires have been positioned.



- Apply two half-lap layers of red sealant tape to the space between the end of the armour wires and the 'cheese-grater' on the support ring.



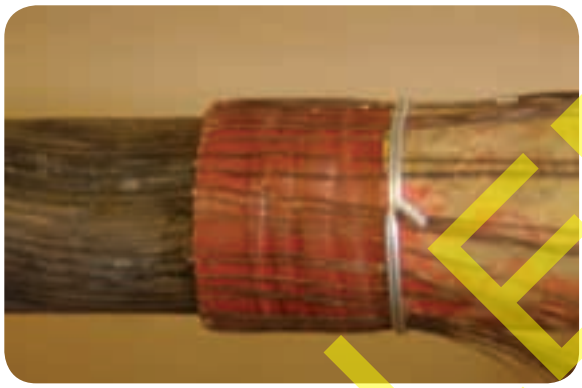
3.3.4 Preparation of Copper Wire Screen (Copper Wire Screened Cables)

- Unwind the copper screen wires and lay them back along the outer sheath.

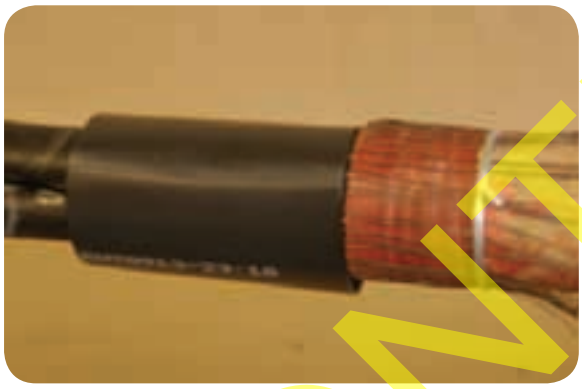
- A transition straight kit and an additional 3-core polymeric preparation kit is required for this process.
- Make a Chinagraph pencil mark on the abraded cable sheath 50mm from the sheath cut.

- Wrap a one-third-lap layer of red sealant tape around the sheath up to the Chinagraph pencil mark.

- Fold the copper wires back onto the red sealant tape and secure them with a double wire binder, level with the end of the mastic.

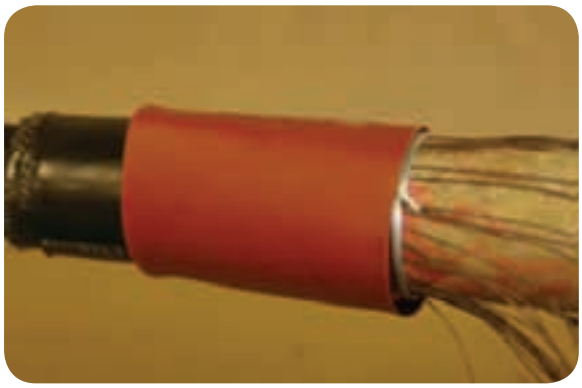


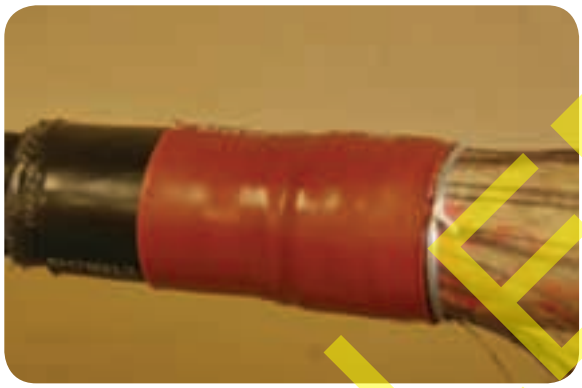
- Place the piece of black heatshrink tube supplied in the 3 core polymeric preparation kit over the inner bedding layer of the cable and shrink into place.



- Make a Chinagraph pencil mark on the black heatshrink tube 15mm from the outer sheath cut and wrap a one-third-lap layer of red sealant tape from the mark over the copper wires up to the wire binder.

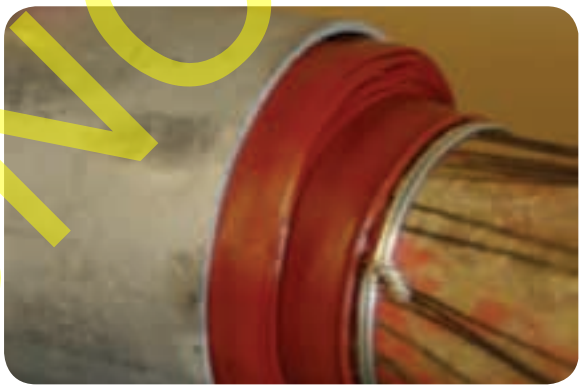
- Push the large red crutch sealing sleeve from the transition joint kit over the cable end and line it up with the wire binder. Shrink into place starting from the wire binder end.

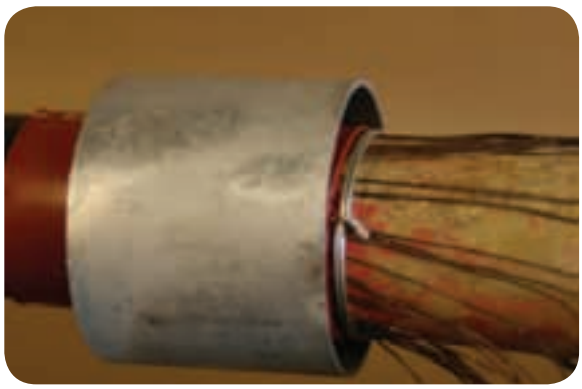




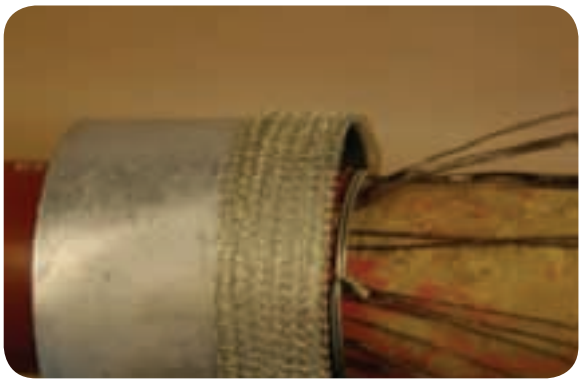
- Place a number of single-width turns of red sealant tape around the red tube over the outer sheath cut. Build this up in layers until the support ring from the 3-core polymeric preparation kit just fits over it.

- Place the support ring over the mastic and line the end of it up with the double wire binder.

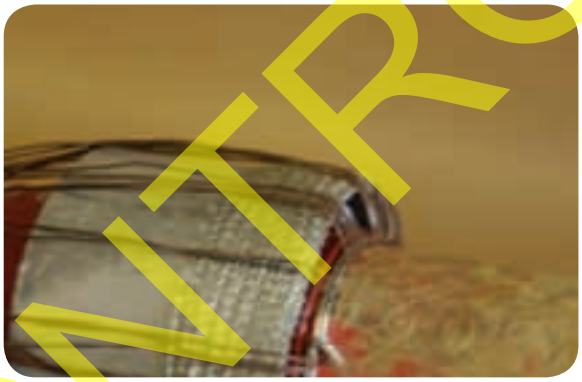




- Fold a length of copper mesh in half over its full length to reduce its width to approximately 30mm. Wrap two layers of the mesh around the edge of the support ring (furthest away from the joint) and temporarily secure.

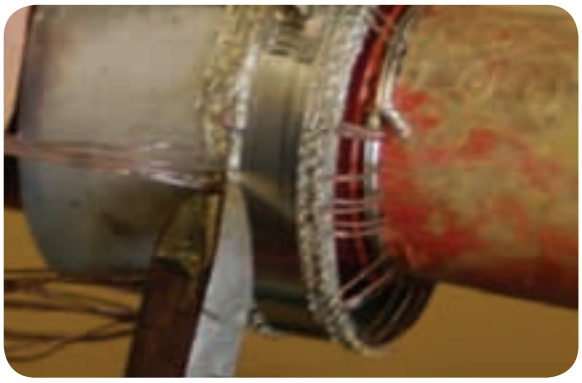


- Turn back the copper wires and lay them over the copper mesh so they are tidy and do not cross each other.

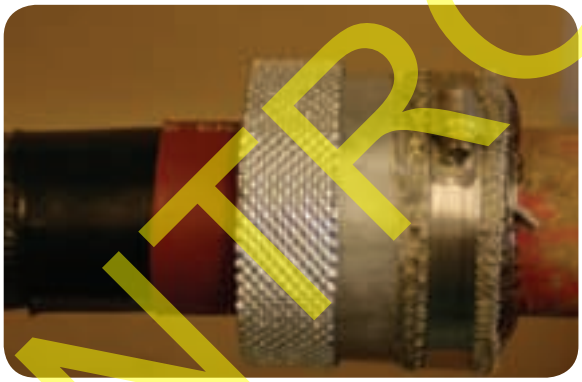


- Wrap the remaining copper mesh over the wires and secure with a half hitch. Clamp the copper wires and mesh down on to the support ring with the worm drive clip provided.

- Trim the copper wires with side cutters, so that they are level with the inner end of the copper wire mesh.



- Bend the long length of ‘cheese-grater’ strip to form a circle and position it on the support ring, at the opposite end from where the copper wires have been fixed to the support ring.



- Apply two half-lap layers of red sealant tape to the space between the end of the copper wires and the ‘cheese-grater’ on the support ring.

3.3.5 Removing the Inner Bedding Layer

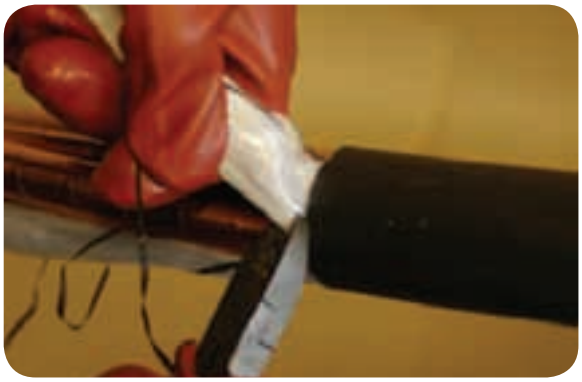
- Mark the position of the inner bedding removal point with a Chinagraph pencil, as indicated on the relevant jointing instruction.

- If there is a rubber bedding layer, remove it with a plastic hack knife by making a circular cut at the bedding removal point and then making a cut lengthways down the bedding.

- Unwrap the bedding and remove it using an approved knife. Take care not to damage the cores below.

3.3.6 Removing the Fillers

- Un-lay the fillers and carefully remove them at the inner bedding removal position, using a pair of side cutters. Do not forget to remove the central filler.



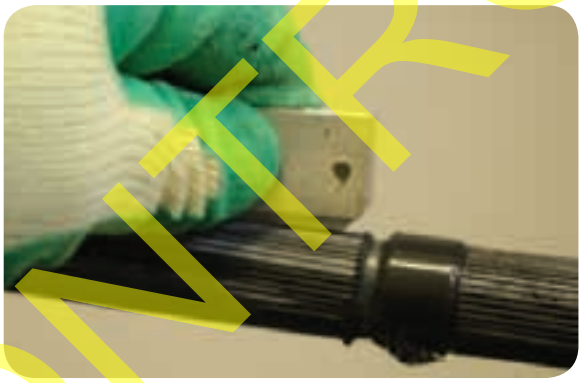
3.3.7 Removing the Insulation Screen

- Mark the removal point of the polymeric screen with a Chinagraph pencil 180mm from the centre line of the joint.
- Test the cut end of each core to determine the type of screen before applying any heat to aid removal.

- Apply six turns of PVC tape, sticky side out, to the insulation screen to provide a guide for the abrafile.

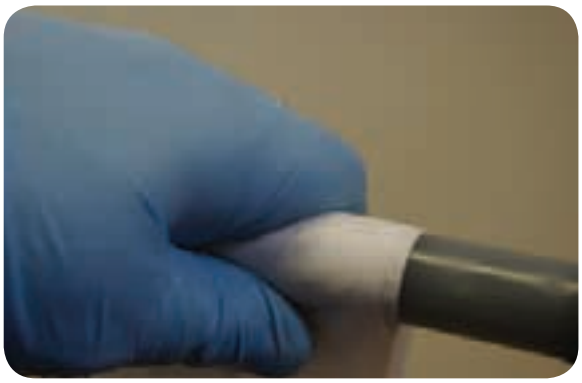
- Use an abrafile to make a circular abrasion around the screen at the removal point, just deep enough to expose the insulation below. Take extra care on cables with sector-shaped cores to ensure that only the minimum amount of insulation is removed.

- Remove the PVC tape. Use a 0.4mm depth-guarded tool to make two separate score lines along the core from the screen cut to the cut end. The lines shall be equally spaced and approximately 30° apart.



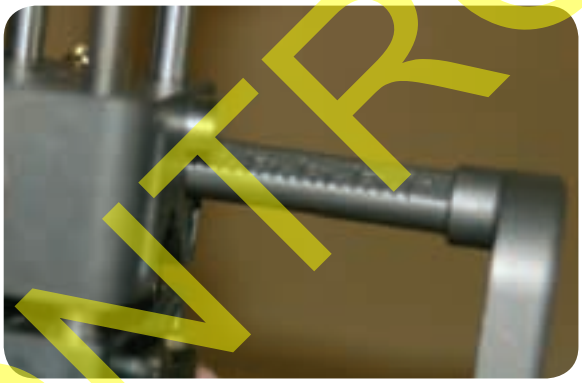
- Further deepen the score marks at the position where they meet the cut end and pull the conducting screen away from the insulation up to the circular abrasion. Repeat this operation for the other screen section.

- Clean and degrease the insulation with an approved solvent wipe to remove all traces of conducting material. Always wipe from cut end towards screen wires to avoid contaminating the insulation with carbon from the uncut screen.



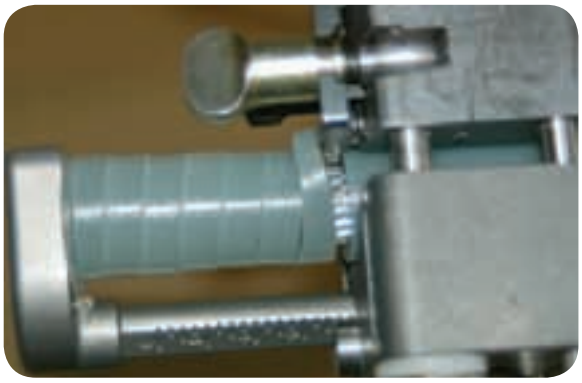
3.3.8 Removing the Polymeric Insulation

- Using the Alroc tool, set the stop gauge to the connector insertion depth.

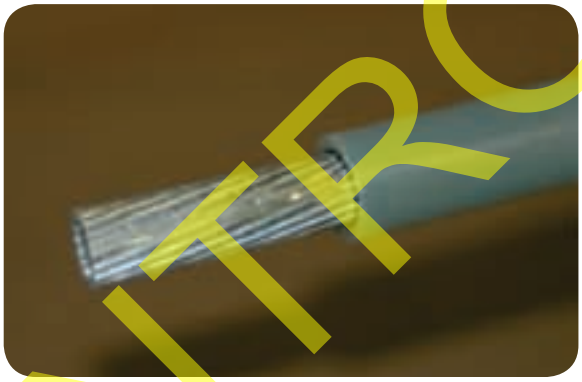


- Position the tool at the open core end. Adjust the blade to the required depth, which is just deep enough so the blade does not damage the conductor.

- Rotate the tool along the core using the spiral cut setting until the stop gauge prevents it moving any further.



- Remove the tool and the removed insulation spiral.



3.4 PICAS – Paper Insulated Corrugated Aluminium Sheathed Cables

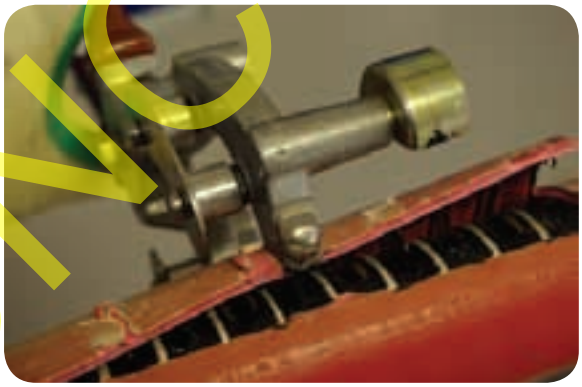
3.4.1 Removing the Outer PVC Sheath

- Make two Chinagraph pencil marks on the PVC sheath, one at the sheath removal point and the second one 200mm towards the cut end of the cable.

- Cut round the sheath at both of these marks using a pair of PG4 sheath stripping pliers.

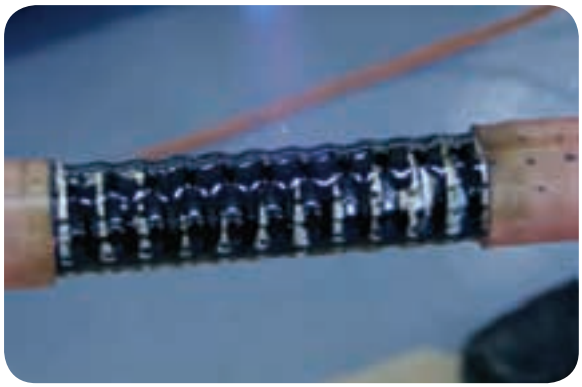
- Now make a lengthwise cut along the PVC sheath between the two circular cuts.

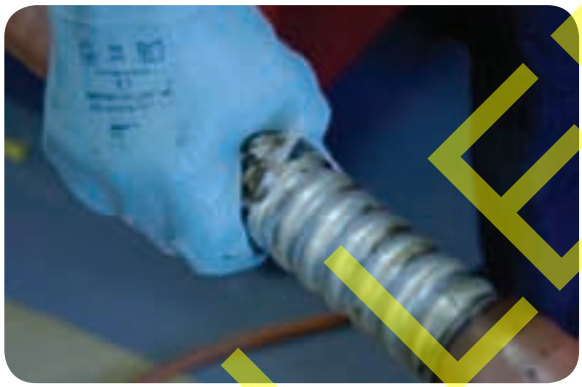
- Lift the edge of the sheath with the jaws of the PG4 Pliers and unwrap it, tearing against the circular cut points. Gentle heat from a gas torch may assist this operation in cold weather.



3.4.2 Removing the Bitumen Layer

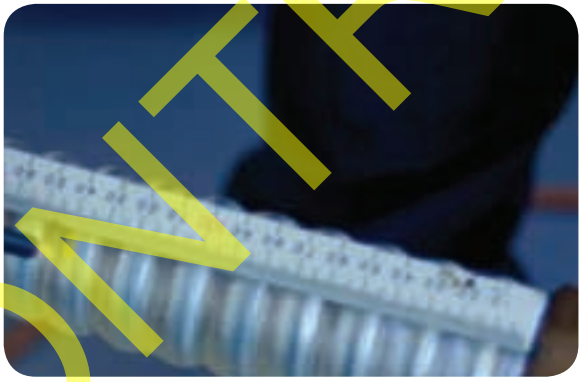
- Wear appropriate gloves during this operation. Warm the bitumen layer using a gas torch and use the approved solvent wipes to clean the aluminium sheath.
- When this process is complete, the aluminium sheath should be bitumen-free and clean.





3.4.3 Removing the Corrugated Aluminium Sheath

- Mark the aluminium sheath at the removal point using a Chinagraph pencil, as indicated on the relevant jointing instruction. If this mark falls within one of the valleys, move the mark to the next crest towards the cut end of the cable.



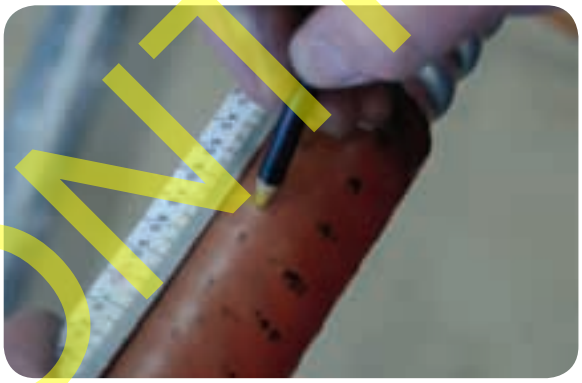
- Using the approved tool, make a circular cut around the marked ridge of the aluminium sheath. The cut should be right through the aluminium. Take care not to damage the papers below.

- Once the circular cut has been made, the aluminium sheath can be removed by pulling the sheath towards the open cable end. Twisting the sheath from side to side whilst pulling shall make this task easier.

- On some occasions, when there is a lot of sheath to remove, it may be necessary to carry out this process more than once. If this is the case, always make the first cut closest to the cut cable end.

3.4.4 Preparation of PVC Sheath

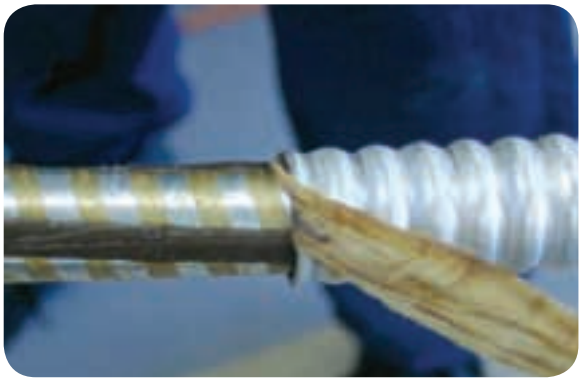
- Mark the PVC sheath with a Chinagraph pencil, 60mm from the PVC sheath cut.



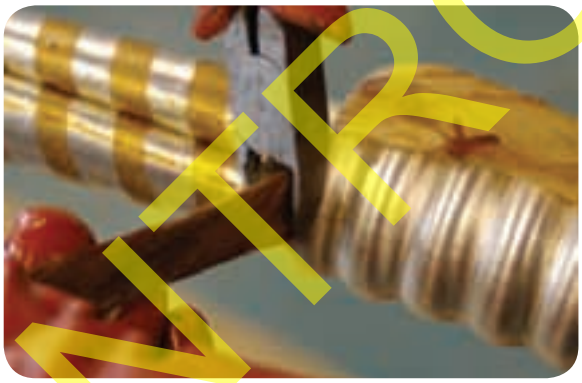
- Abrade the PVC sheath with a rasp between the sheath cut and the Chinagraph pencil mark.

3.4.5 Removing the Copper Woven Tapes (CWT) and Core Fillers

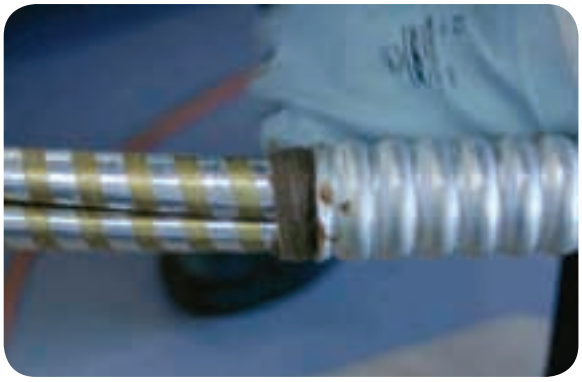
- Unwind the CWT and remove any surplus length with side cutters.



- Un-lay the fillers and carefully remove them at the belt paper position using a pair of side cutters. Do not forget to remove the central filler.

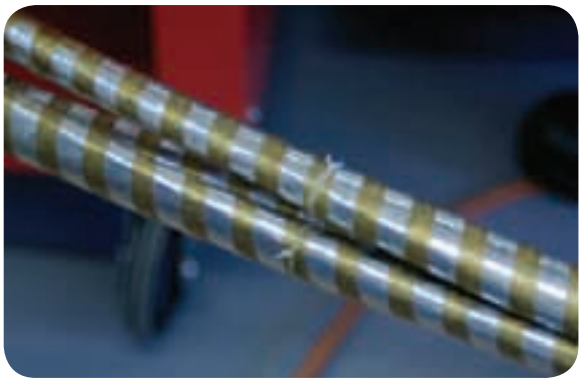


- Rewind the CWT tightly around the cable cores at the crutch position for a distance of 20mm from the aluminium sheath cut and tie off. Remove any surplus tape with insulated side cutters.

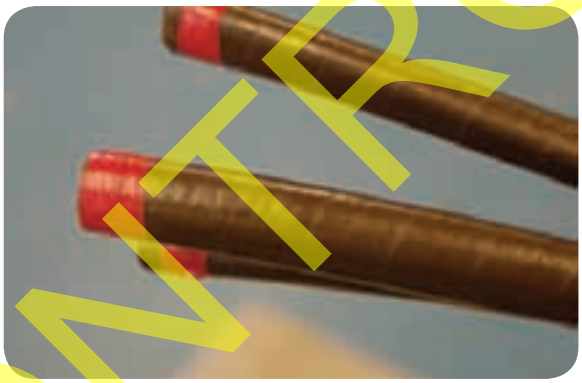


3.4.6 Removing the Insulation Screen (Screened Cables Only)

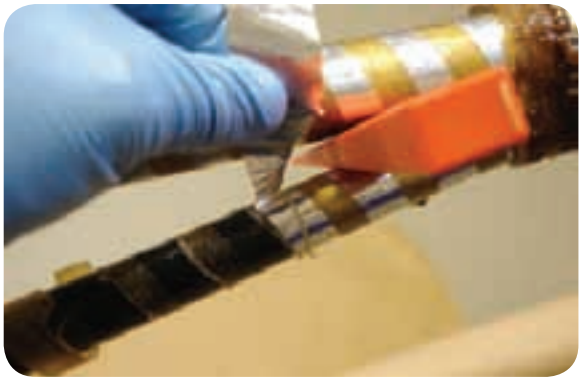
- Mark the screen papers at the removal point indicated on the relevant jointing instruction. Tie a twine or wire binder around the screens at this point.



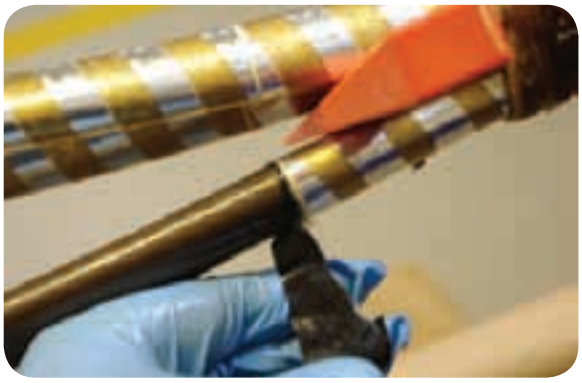
- Carefully unwrap the first 50-75mm of the screen and secure the end of the core insulation papers with PVC tape.



- Unwind the remainder of the screen to the termination point and remove them by neatly tearing against the twine or wire binder.

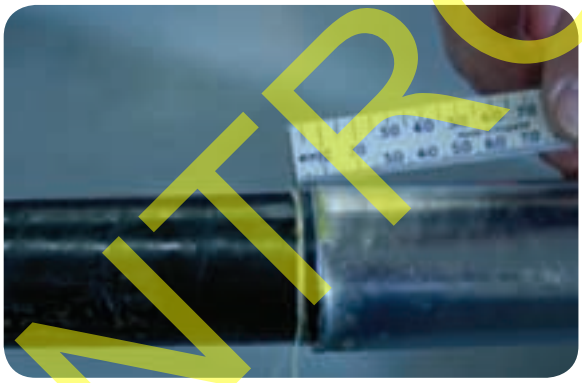


- Remove the number paper and one layer of papers below the screen to the same position as the screen papers, using the same method.



3.4.7 Removing the Conducting and Belt Papers

- Tie a twine binder around the carbon paper layer 5mm from the aluminium sheath cut.



- Carefully unwind the carbon paper(s) and tear them off neatly against the twine binder.

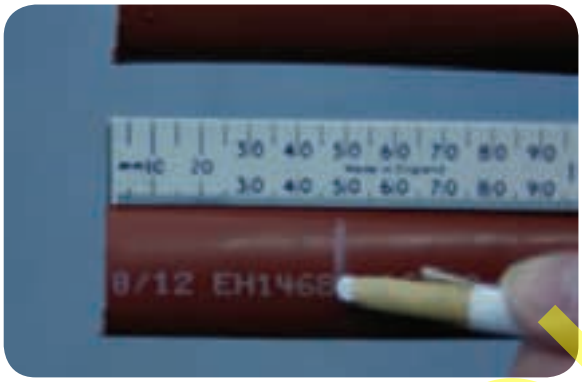
- Now tie a second twine binder around the belt papers 20mm from the aluminium sheath cut.

- Carefully unwind two or three of the belt papers at a time and tear them off neatly against the twine binder.

- Install five layers of PVC tape over the prepared belt and carbon papers, sticky side out, to avoid damaging the papers when the fillers are removed and the heatshrink tubes are fitted.

3.4.8 Removing the Insulation Papers

- Only carry out this process after installing the red insulation tubes as described in Section 4.1.1 or 4.1.3.
- Mark the red tube over the core papers at the point of removal, as indicated on the appropriate jointing instruction.



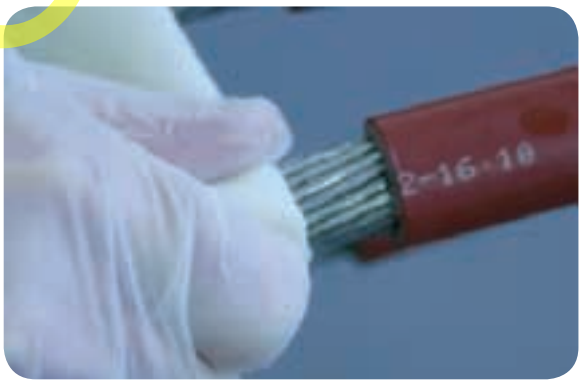
- Using a sharp knife, make a circular cut around the core through the papers, taking care not to damage the conductor below.

- Remove the red tube by pulling towards the end with a gentle twisting movement.

- Rounding of the conductor with water pump or similar pliers eases this operation and helps prepare the conductor for insertion into the appropriate connector.

- Un-wrap the papers up to the cut position and tear off against the remaining red tube.

- Clean any surplus compound from the cable conductor with an approved solvent wipe.



3.5 PILC – Paper Insulated Lead Sheathed Cables

3.5.1 Removing the Outer Serving or Sheath

- Mark the position of the serving or sheath termination as indicated on the relevant jointing instruction.

- Wear suitable gloves while removing the serving. Put a wire binder around the serving at the removal point and score in front of the binder with an approved knife.

- Remove the serving with an approved knife and heat from a gas torch if required.

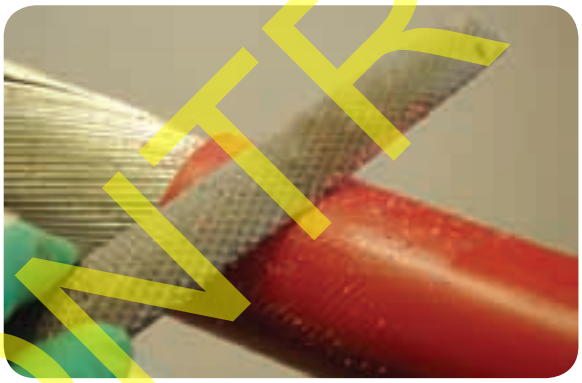
3.5.2 Preparation of Plastic Cable Sheath

3.5.2.1 Polyethylene (PE) Sheaths

- Flame brush the outer sheath for a distance of 150mm from the sheath removal point.

3.5.2.2 PVC Sheaths

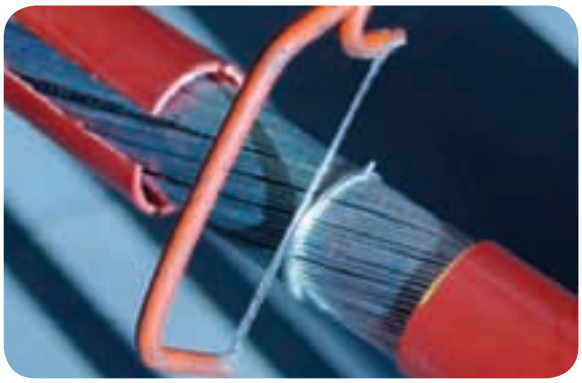
- Abrade the PVC sheath with a rasp for a distance of 60mm.



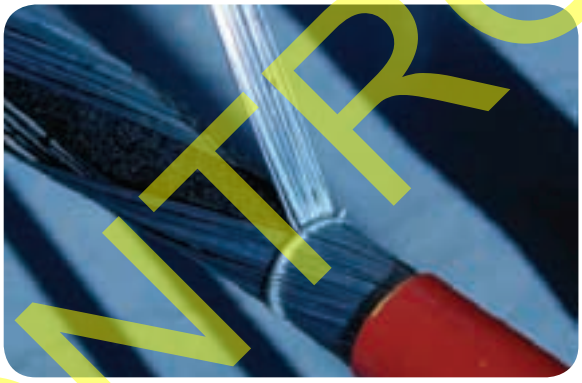
3.5.3 Removing the Steel Wire Armour

- Place a wire binder around the armour wires at the point of removal, as indicated on the relevant jointing instruction.

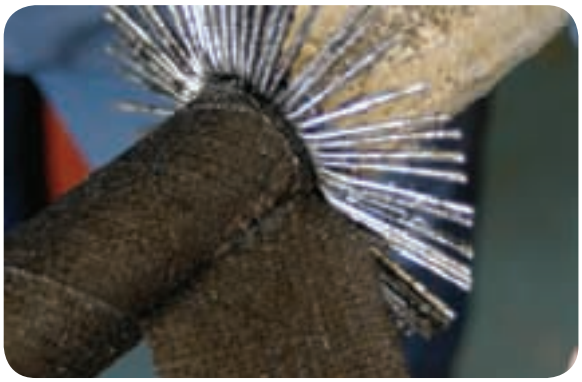
- Using a depth-guarded or junior hacksaw make a circular cut around the armours at the binder position. Cut through only half the width of the armour to avoid damaging the lead sheath below.



- Wear suitable gloves while removing the armour. Lift and unwrap the armour wires a few at a time and break them off against the binder by bending them backwards and forwards.



- Remove the binder and lift the armours with a plastic hack knife so they are at 90° to the cable. Clean of all traces of bitumen from the wires using a gas torch and approved solvent wipes.



3.5.4 Removing the Steel Tape Armour

- Heat the armours for a distance of 150mm with a gas torch and clean them with approved solvent wipes.

- Place a wire binder around the tape armour 60mm from the outer serving removal point.

- Wear suitable gloves while removing the armour. Using a depth-guarded or junior hacksaw, cut through the first layer of tape armour at the binder position.

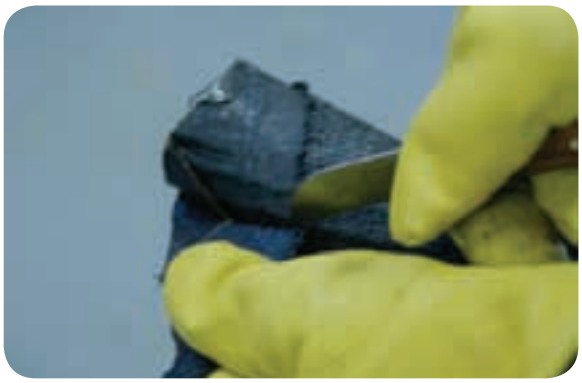
- Lift the point of the armours at the binder position, unwrap and remove.

- Repeat the process with the second layer of tape armour making sure not to damage the lead sheath below.

3.5.5 Removing the Inner Bitumen Layer

- Wear suitable gloves for this operation. Score around the inner bedding layers with an approved knife adjacent to the armour removal point taking great care not to score into the underlying lead sheath.

- At the open cable end lift the bitumen impregnated textile layer with the knife and unwrap it back to the armour position, tearing it against the end of the cut armours. The use of a gas torch assists this process.



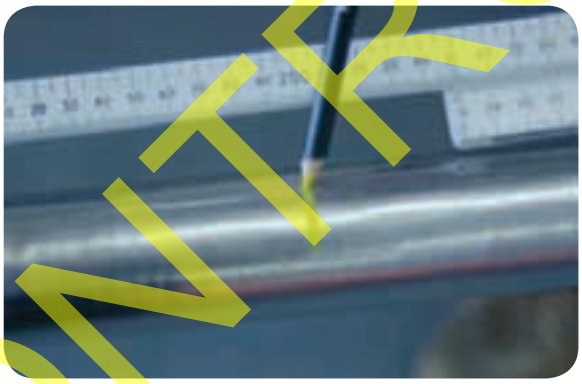
- Apply sufficient heat to the inner bitumen paper layer to soften it before removing it.

- Apply more heat to the final layer of bitumen on the lead sheath and armours and wipe off any traces of bitumen with approved solvent wipes.

- The lead sheath will be clean and bright after this process.

3.5.6 Removing the Lead Sheath

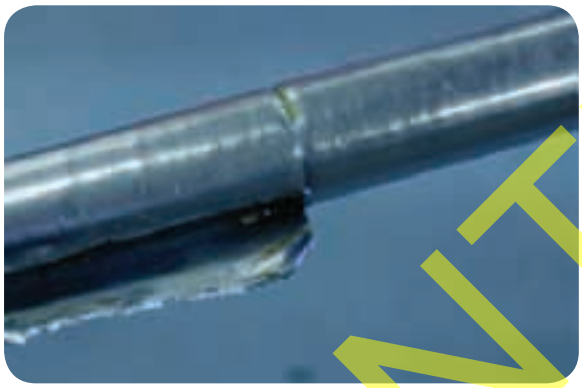
- Clean and degrease the lead sheath using approved solvent wipes. Mark the lead sheath at the removal point as indicated on the relevant jointing instruction, using a Chinagraph pencil.



- Wear suitable gloves for this operation. Using an approved insulated hack-knife, make a circular indented ring cut around the lead sheath, taking care to only cut part-way through the sheath.

- From the cut cable end, cut the lead sheath longitudinally to the round cut, using an approved insulated hack-knife. Take care not to damage the belt papers below.

- Open the lead sheath up along the length of the cut and carefully unwrap the lead sheath against the round cut.



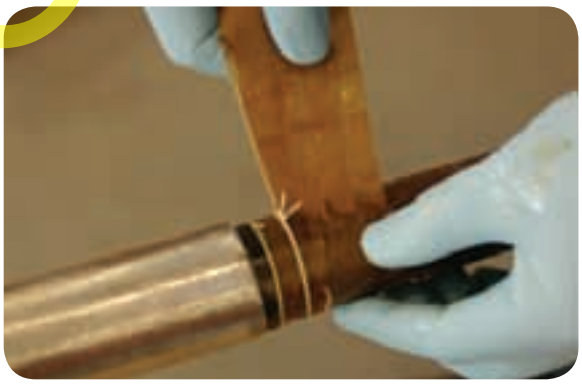
3.5.7 Removing the Conducting and Belt Papers

- Tie a twine binder around the carbon paper layer 5mm from the lead sheath cut.

- Carefully unwind the carbon paper(s) and tear them off neatly against the twine binder.

- Now tie a second twine binder around the belt papers 20mm from the lead sheath cut.

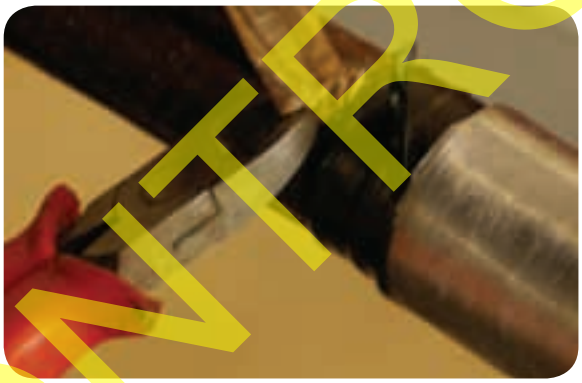
- Carefully unwind two or three of the belt papers at a time and tear them off neatly against the twine binder.



- Install five layers of PVC tape over the prepared belt and carbon papers, sticky side out, to ensure that the papers are not damaged by the next step.

3.5.8 Removing the Core Fillers from Belted Cables

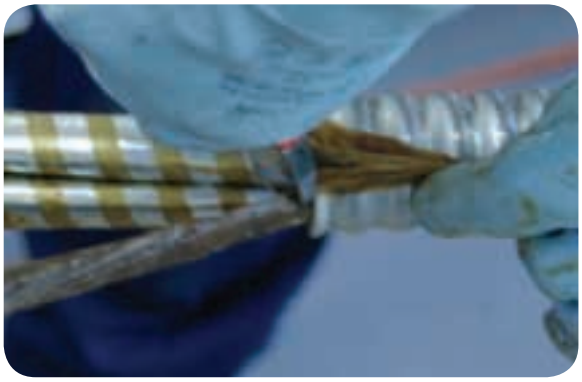
- Un-lay the fillers and carefully remove them at the belt paper position using a pair of side cutters. Do not forget to remove the central filler.



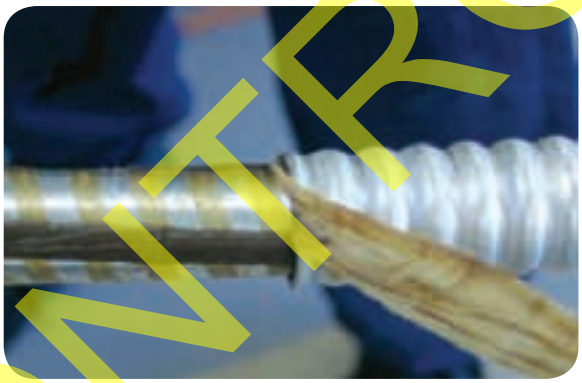
- Carefully separate the cores and secure the core paper ends with PVC tape.

3.5.9 Removing the Copper Woven Tapes (CWT) (Screened Cables Only)

- Unwind the CWT and remove the core fillers carefully with side cutters.

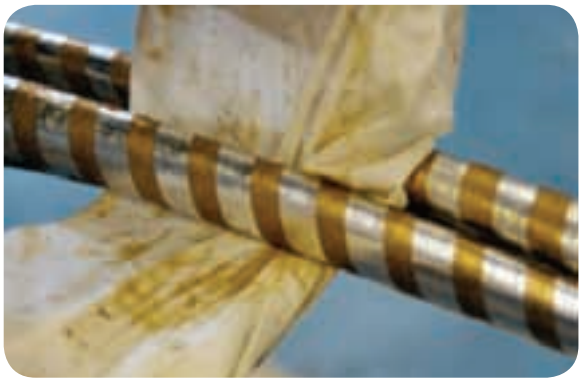


- Rewind the CWT tightly around the cable cores at the crutch position for a distance of 20mm from the aluminium sheath cut and tie off and remove any surplus tape with insulated side cutters.

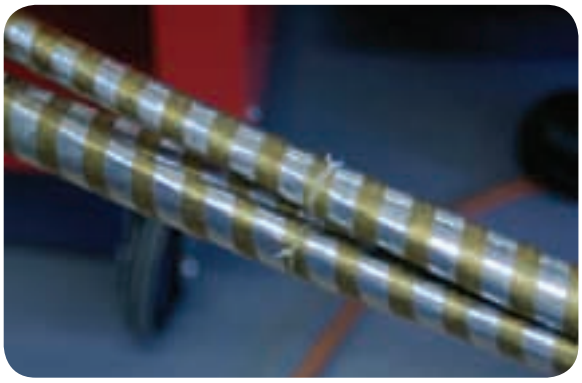


3.5.10 Removing the Insulation Screen (Screened Cables Only)

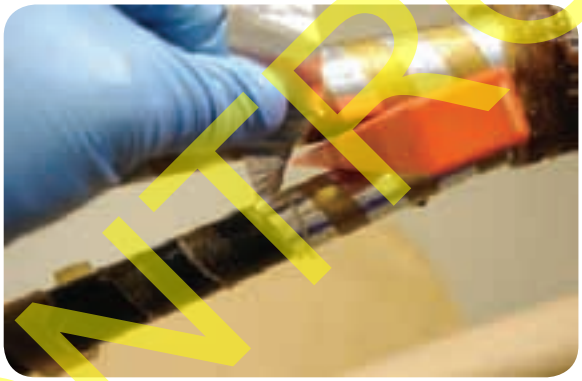
- Using an approved solvent wipe, remove any surplus cable compound from the screened core insulation.



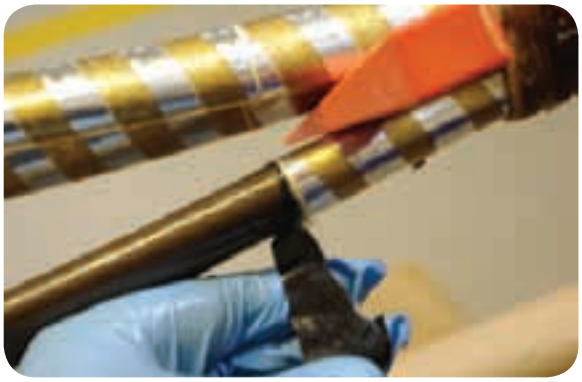
- Mark the screen papers at the removal point indicated on the relevant jointing instruction. Tie a twine or wire binder around the screens at this point.



- Carefully unwrap the first 50-75mm of the screen and secure the end of the core insulation papers with PVC tape. Unwind the remainder of the screen to the termination point and remove them by neatly tearing against the twine binder.

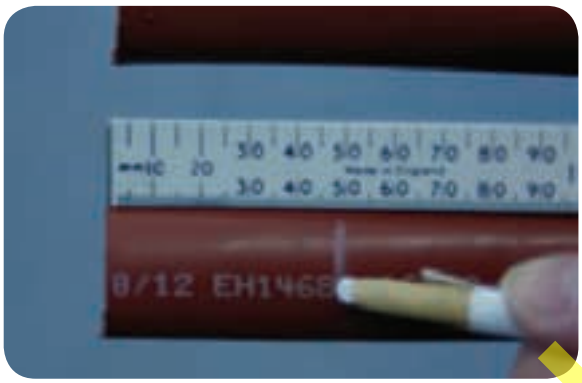


- Remove the number paper and one layer of papers below the screen to the same position as the screen papers, using the same method.



3.5.11 Removing the Insulation Papers

- Only remove the papers after fitting the red insulation tubes as described in Section 4.1.3.
- Mark the red tube over the core papers at the point of removal as indicated on the appropriate jointing instruction.



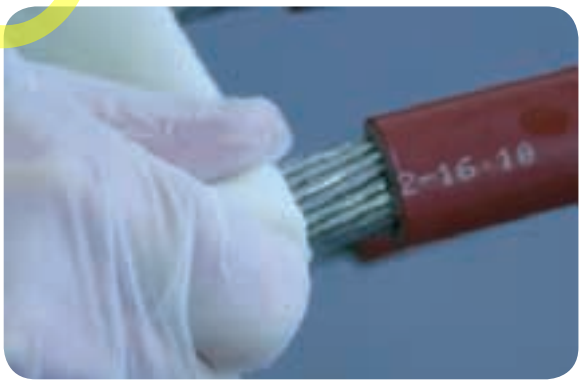
- Using a sharp knife, cut around the core through the papers taking care not to damage the conductor below.

- Remove the red tube by pulling towards the end with a gentle twisting movement.

- Rounding of the conductor with water pump or similar pliers assists this operation and helps prepare the conductor for insertion into the appropriate connector.

- Unwrap the papers up to the cut position and tear off against the remaining red tube.

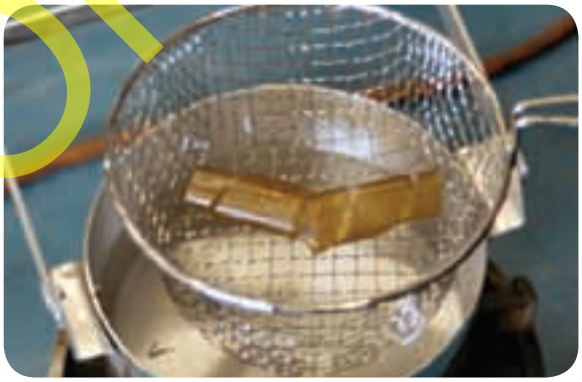
- Clean any surplus compound from the cable conductor with an approved solvent wipe.



3.6 Moisture Testing on Paper Insulated Cables

- Wear full Personal Protective Equipment for this test.
- Gently heat the paraffin wax container on a low heat. Insert the thermometer through one of the rubber grommets in the top and wait until the wax reaches 125°C.

- Always handle the papers to be tested with gloves, as moisture from hands is enough to give a positive test.
- Lift out the basket and place the paper tapes to be tested into it.
- The samples from the following layers shall be tested:
  - Inner and outer belt papers.
  - Paper or string fillers.
  - Inner and outer core papers.



- Immerse the basket complete with papers into the paraffin wax bath and observe the results.
- If there is no reaction from the wax, or it only froths slightly, the papers are dry and the cable is fit to be jointed.

- If the wax froths a lot and makes a crackling noise, this means that the papers are wet and the cable is not to be jointed.

- Remove the heat from the container and leave it to cool before moving it.
- The wax can be re-used until it starts to discolour. There is no need to dispose of it after each moisture test.

4 STANDARD PROCEDURES FOR INSTALLING MATERIALS AND COMPONENTS

4.1 Installing Stress Control and Insulation Materials

- **All heatshrink materials shall only be installed using a soft flame blow torch.**

4.1.1 Belted Paper Cables

- Prepare the cable as described in Sections 3.4 or 3.5.
- Using an approved solvent wipe remove any surplus cable compound from the paper core insulation.

- Tape up the paper insulation on the end of each core to stop them unravelling.

- Slide the correct lengths of red insulating tube over each core, until they are approximately 50mm from the crutch.

- Partly shrink the tubes for a distance of 50mm from the end.


- Whilst the tubes are still hot, gently twist and turn them so that the shrunk section is positioned on the inside and the ends of the tubes are level with the PVC tape protecting the belt papers.

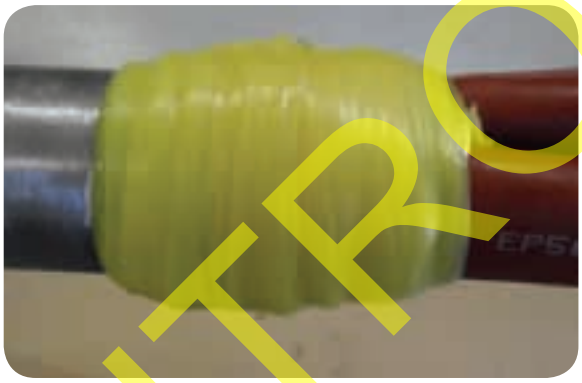

- Continue to shrink the tubes starting from the crutch and working towards the cut ends.


- Whilst the red tubes are still hot slide the supplied yellow mastic wedge into the crutch so that the tip is just below the belt paper. The yellow mastic wedge shall be applied with a thin coating of silicone grease and a plastic wedge insertion tool.

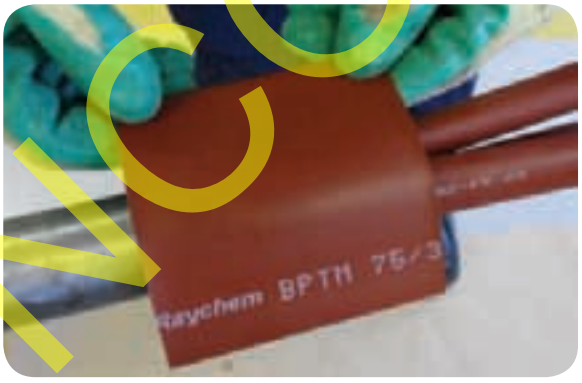
- Remove the PVC Tape from the belt papers and make a Chinagraph pencil mark on the red tubes 40mm from the lead sheath cut.

- Make a second Chinagraph pencil mark 20mm onto the lead sheath.

- Wrap two of the supplied strips of yellow mastic around the crutch between the two Chinagraph pencil marks, applying sufficient tension to stretch the tape to half its original width. Build up the gap between the end of the red tubes and the lead sheath first, before covering the red tubes and the lead sheath. The yellow mastic shall be left to form a domed area.



- Position the red crutch sealing sleeve centrally over the yellow mastic, sheath and red tubes, and then shrink into position. Apply sufficient heat to ensure that the tube has been fully shrunk, thus making sure that the yellow mastic fills any voids in the crutch area.

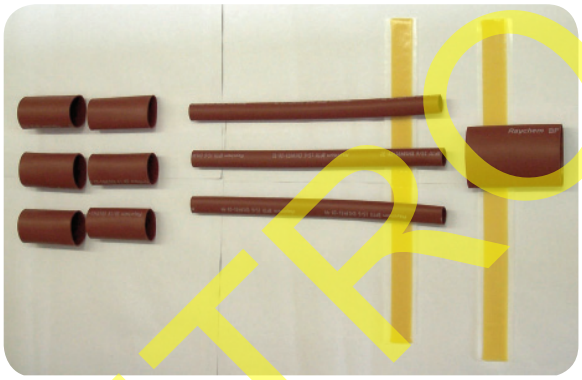


4.1.2 Build-Up Kit for Small Section Paper Cables

- The core tube and sealing sleeves supplied in the two sizes of transition straight joints are not suitable for use with cables that are below the minimum size on the kit label.
- For smaller cross-section cables between 16mm^2 (0.0225sq.in) and 70mm^2 (0.1sq.in) an additional build-up kit is required. How the kit is used is dependant upon which joint is being made.

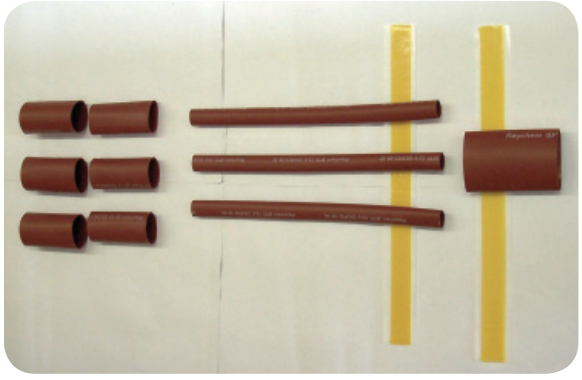
4.1.2.1 95-185mm^2 Joint

- Replace the three red tubes in the base kit with the smaller ones in the build-up kit.
- Use the yellow mastic from the build-up kit.
- Replace the red crutch sealing tube in the base kit with the smaller one in the build-up kit.
- Shrink the three red (MWJS 30/10) build-up tubes on top of the red tubes level with the insulation removal point.



4.1.2.2 240-300mm^2 Joint

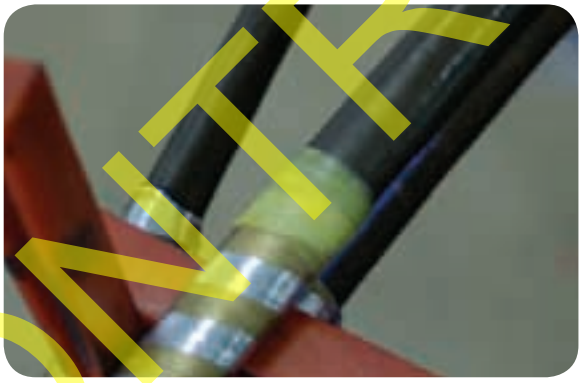
- Replace the three red tubes in the base kit with the smaller ones in the build-up kit.
- Use the yellow mastic from the build-up kit.
- Replace the red crutch sealing tube in the base kit with the smaller one in the build-up kit.
- Shrink the three red (MWJS 30/10) build-up tubes on top of the red tubes level with the insulation removal point.
- Shrink the three red (MWJS 40/16) build-up tubes on top of the first set of red build tubes level with the insulation removal point.



4.1.3 Screened Paper Cables

- Prepare the cable as described in Sections 3.4 or 3.5 before installing these components.
- On each core, remove the twine or wire binder and make a Chinagraph pencil mark either side of the screen cut, one 20mm on to the screen and the other 10mm on to the insulation.

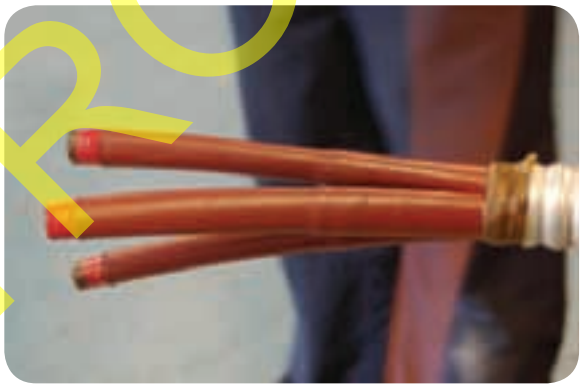
- Wrap a 50mm long piece of yellow mastic, stretched to half its original width, around the screen cuts between the two Chinagraph pencil marks.



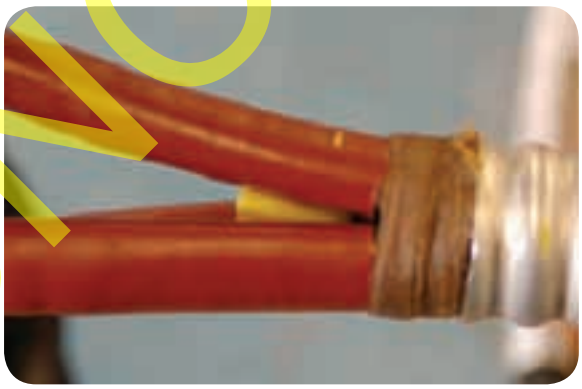
- Slide the correct lengths of red insulating tube over each core, until they are approximately 50mm from the crutch.

- Partly shrink the tubes for a distance of 50mm from the end. Whilst the tubes are still hot, gently twist and turn them so that the shrunk section is positioned on the inside and the ends of the tubes are level with the CWT tape protecting the belt papers.

- Continue to shrink the tubes starting from the crutch and working towards the cut ends.



- Slide the supplied yellow mastic wedge into the crutch so that the tip is just below the copper woven tape. A plastic wedge insertion tool can be used to aid this process.

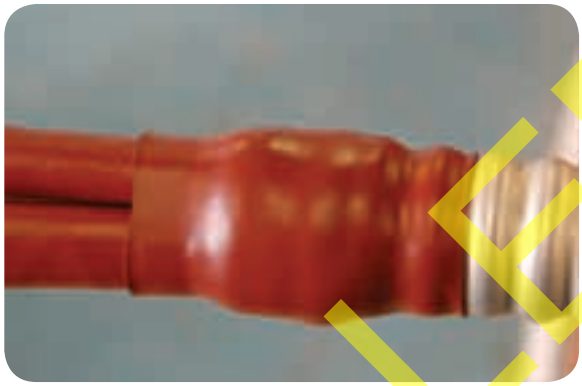


- Make a Chinagraph pencil mark on the red tubes 40mm from the aluminium sheath cut.

- Make a second Chinagraph pencil mark 20mm onto the aluminium sheath.

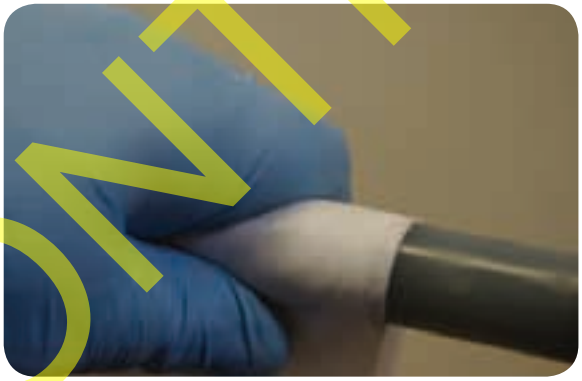
- Wrap two of the supplied strips of yellow mastic around the crutch between the two Chinagraph pencil marks, applying sufficient tension to stretch the tape to half its original width.

- Position the red crutch sealing sleeve centrally over the yellow mastic, sheath and red tubes, and then shrink into position. Apply sufficient heat to ensure that the tube has been fully shrunk, thus making sure that the yellow mastic fills any voids in the crutch area.



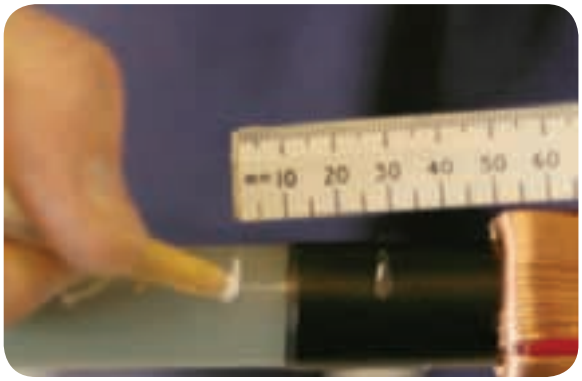
4.1.4 Single Core Polymeric Cables in Single and Triplex Straight/Branch Joints

- Prepare the cables as described in Sections 3.1 or 3.2.
- Clean and degrease the insulation with an approved solvent wipe to remove all traces of conducting material. Always wipe from cut end towards screen wire to avoid contaminating the insulation with carbon from the uncut screen.



- Make a Chinagraph pencil mark on the black insulation screen of the cable 20mm from the screen cut.

- Make a second Chinagraph pencil mark on the insulation 10mm from the screen cut.



- Stretch one of the short yellow mastic strips, supplied in the kit, to half its original width and wrap it around the core screen and insulation between the two Chinagraph pencil marks.

- Slide the black stress control tube over the core until the end is level with the insulation cut. The tube shall fully overlap the yellow mastic tape.

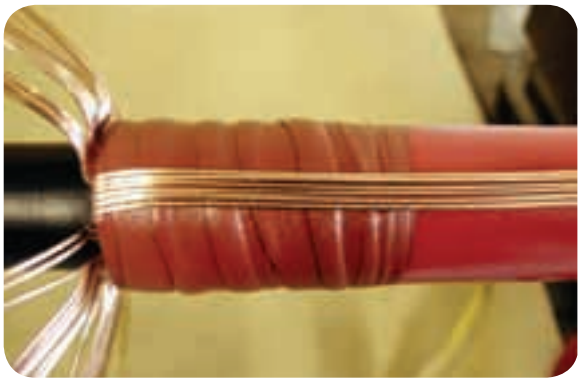
- Shrink the tubing down starting at the insulation cut, then work back towards the cable over sheath.

4.1.5 Single Core Polymeric Cables in Transitional Straight or Branch Joints

- Prepare the cables as described in Sections 3.1 or 3.2.
- Make a Chinagraph pencil mark on the outer sheath of the cable, 60mm from the sheath cut.

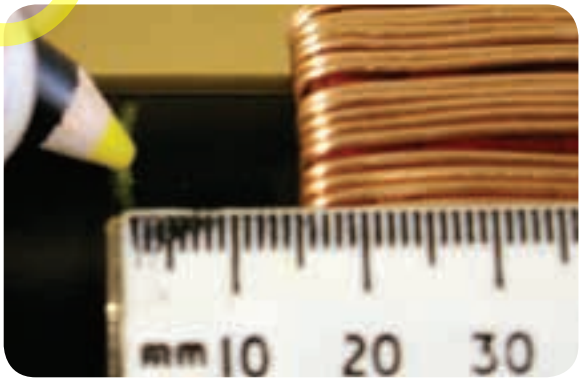
- Wrap a one-third-lap layer of red sealant tape over the cable sheath up to the Chinagraph pencil mark.

- Bend back the screen wires and lay them onto the mastic tape, taking care not to cross over any of the wires.



- Apply a double wire binder to the screen wires level with the end of the red sealant tape.

- Make a Chinagraph pencil mark on the insulation screen 15mm in from the sheath cut.



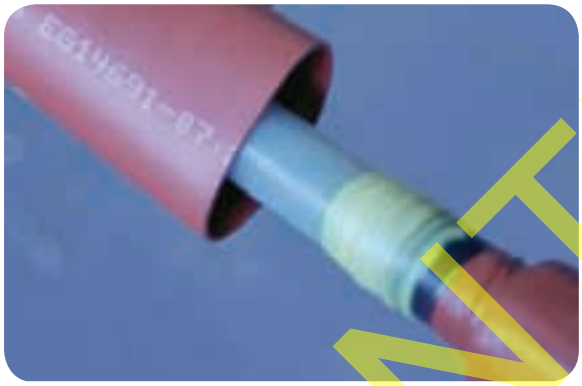
- Wrap a one-third-lap layer of red sealant tape from the mark on the insulation screen up over the copper screen wires to the wire binder. Ensure that there are no gaps in the tape as this is an important moisture seal for the completed joint.

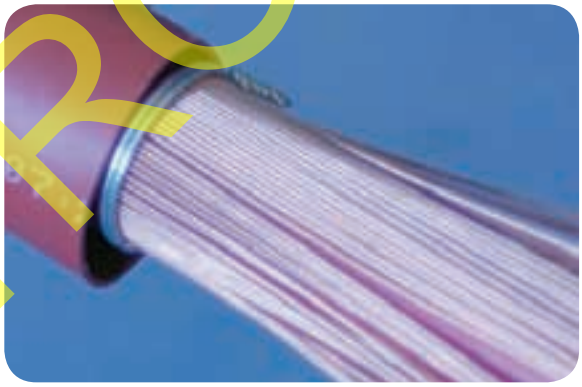
- Make a Chinagraph pencil mark on the insulation 10mm from the screen cut.

- Make a second Chinagraph pencil mark on the black insulation screen of the cable, 20mm from the screen cut.

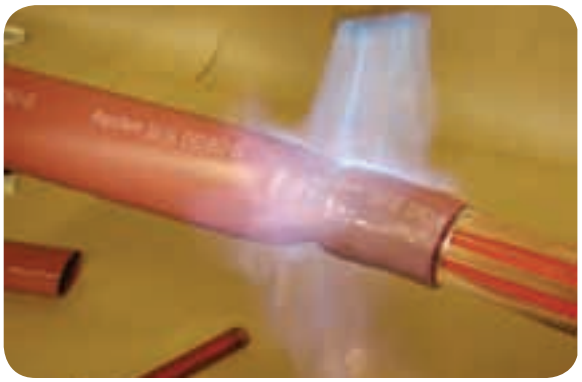
- Wrap the short piece of yellow mastic around the screen cut between the previously made marks. Stretch the tape to half its original width and form a smooth taper with no sharp edges.

- Install the red core tubing over the cable up to the wire binder.





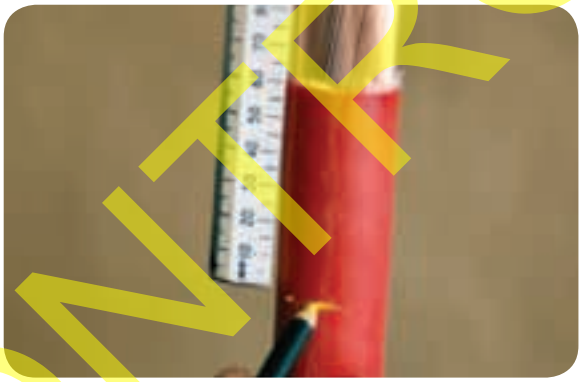
- Shrink the tube into place, starting from the end where the red sealant has been applied to the copper wires.



4.1.6 Single Core Polymeric Cable Terminations

- Fit the mechanical lug as described in Section 4.2.5.
- Use an approved solvent wipe to clean and degrease the outer sheath of the cable for 100mm below the sheath cut.

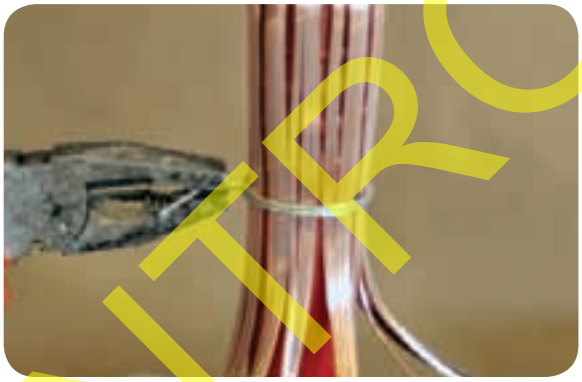
- Make a Chinagraph pencil mark on the outer sheath of the cable, 60mm from the sheath cut.



- Wrap a one-third-lap layer of red sealant tape over the cable sheath down to the Chinagraph pencil mark.

- Bend back the screen wires and lay them onto the mastic tape taking care not to cross over any of the wires.

- Apply a double wire binder to the screen wires level with the end of the red sealant tape.



- Make a Chinagraph pencil mark on the black insulation screen of the cable, 20mm from the screen cut.

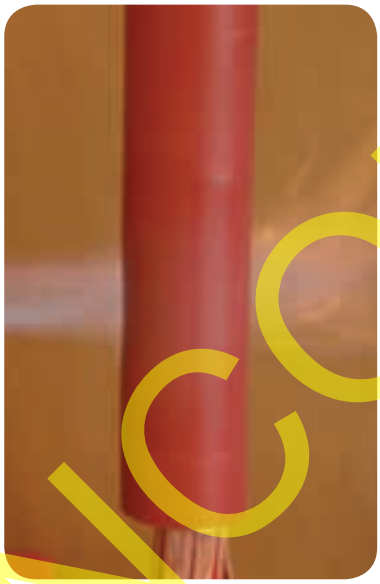
- Make a second Chinagraph pencil mark on the insulation 10mm from the screen cut.

- Wrap the short piece of yellow mastic around the screen cut between the two marks. Stretch the tape to half its original width and form a smooth taper with no sharp edges.

- Preheat the cable lug before placing the red tubing over the core.

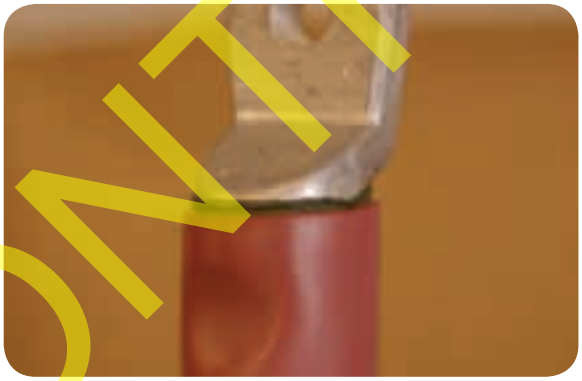
- Place the green-mastic-lined red tube on the termination until the bottom is level with the wire binder.

- Use a soft yellow flame to shrink the red tube starting at the screen cut. Then shrink from the screen cut up to the cable lug, before finally shrinking from the screen cut to the bottom.



- The termination is now ready to be installed in the end box.

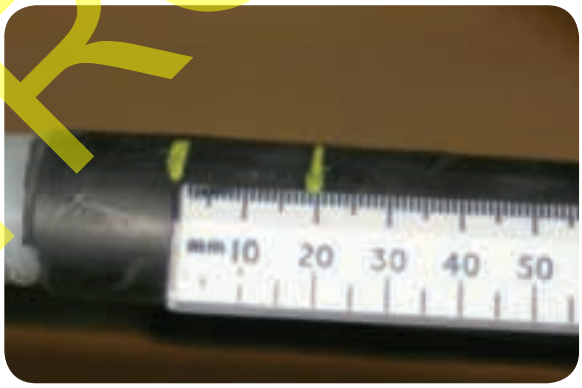
- **Note:** After installing the termination, reheat the cable lug area until a bead of green mastic appears at the top.

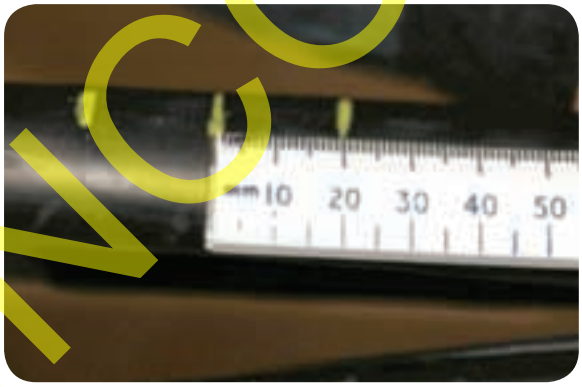


4.1.7 3-Core Polymeric Cables

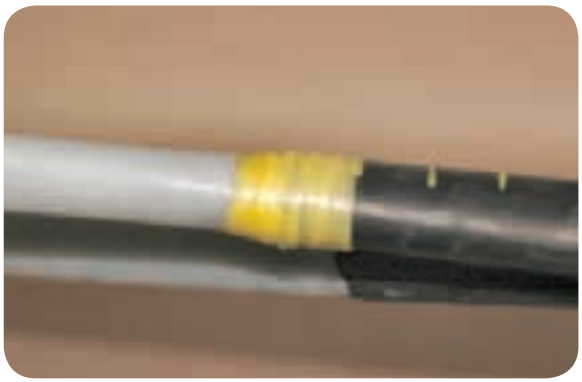
- Remove the insulation screens as described in Section 3.3.7.
- Make a Chinagraph pencil mark on the insulation of each core 10mm from the screen cut.

- Make Chinagraph pencil marks on the black insulation screen of each core at 20mm, 40mm, 60mm and 90mm from the screen cut.

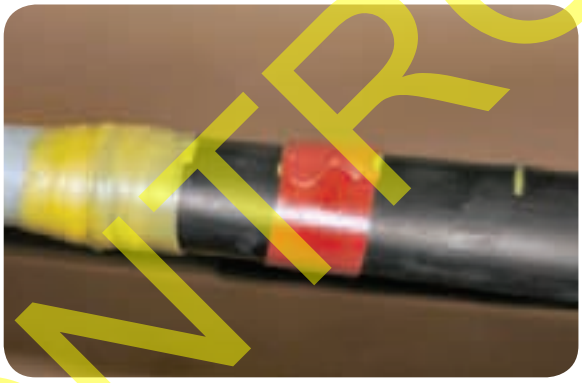




- Wrap one of the short pointed yellow mastic strips around the semi-conducting screen cut of each core, between the first and second Chinagraph pencil marks. Stretch the tape to half its original width during this operation.



- Apply one turn of red sealant tape around the semi-conducting screen of each core between the third and fourth Chinagraph pencil marks.



- Carefully slide the red core tubes over the end of each core until the tubes are level with the fifth Chinagraph pencil mark.

- Shrink the tubes down starting at the insulation screen cut end before working towards the cut cable end.

4.2 Installing Mechanical Connectors and Lugs

4.2.1 Single Core and Triplex Straight Joints

- Remove the insulation as described in Section 3.3.8.

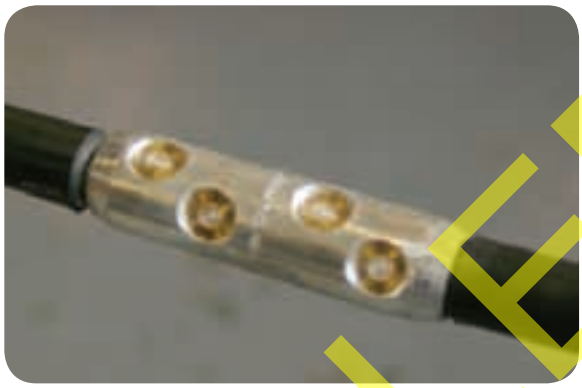
- Check at this stage that any connector insulating tubes have been positioned over one of the cables.

- The connector comes with a metal insert to fit small conductors. If the conductor does not fit the connector, discard the insert and use the connector without it.

- Fit the conductors into the connector. The insulation butts up against the end of the connector.

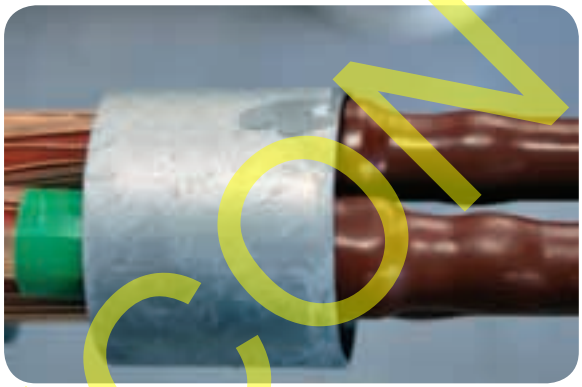
- Using the approved insulated tool to hold the connector, take up the tension on all of the bolts equally without shearing them off.

- Continue to tighten and shear off all four bolts, starting with the bolts at either end of the connector, followed by the two in the centre.

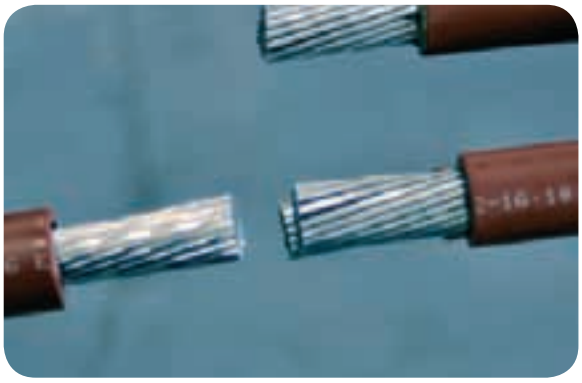


4.2.2 3-Core Transition and 3-Core PICAS/PILC Joints

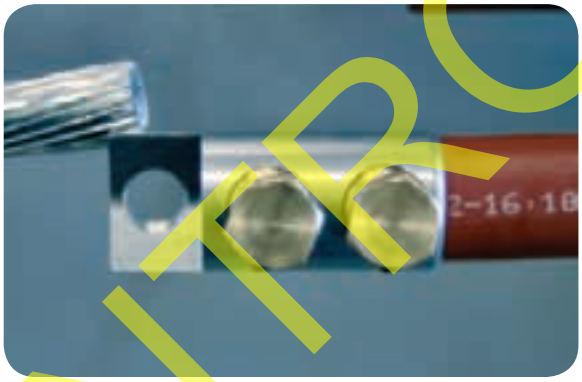
- Remove the insulation as described in the following sections:
  - Belted paper cables – Section 3.4.8.
  - Screened paper cables – Section 3.5.11.
  - Polymeric cables – Section 3.3.8.
- Ensure that the support ring is parked on the triplex cable side of the joint and that the connector insulating tubes are now parked over their respective cores.



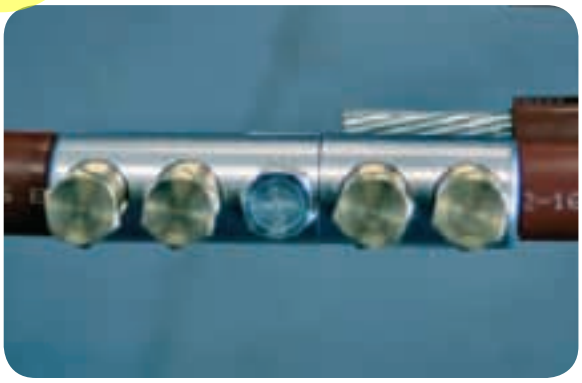
- Set the cores in their final jointing position. Ensure that the conductors have been cut to allow for the connector central moisture block.



- Insert each end of the core into its respective ‘connector half’ and finger-tighten the bolts.



- Align and position the two connector halves so that the central fixing bolt can be inserted into the central fixing hole. The use of force should not be necessary.



- Hold the connector with the approved holding tool and tighten the two bolts on one side until they shear off.

- Repeat this operation on the other side of the connector, then shear off the central fixing bolt.

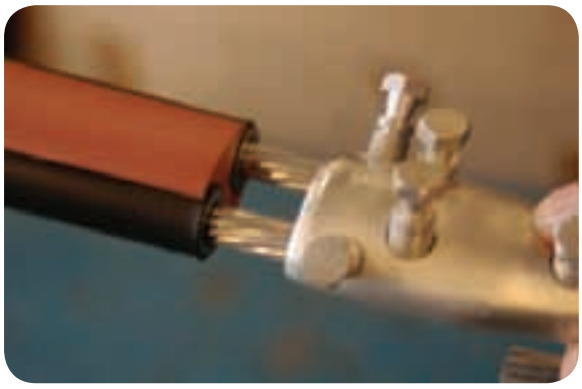
4.2.3 Single Core Branch Joints

- Install the stress control materials and heatshrink tubes as described in Section 4.1.4 before completing this section.
- Position and shrink the red heatshrink shim over the single core cable end, so it is in line with the black stress control tube underneath.

- Line up the two cables of the branch end so that they are parallel and the insulation cuts are level.

- Insert the red and black insulating spacer between the two cores of the double cable end. Ensure that the red spacer lines up with the end of the two insulation cuts.

- Fit the two conductors into the mechanical connector, ensuring that the insulation edge butts against the connector body. Tape the two cables together with the supplied tape to stop the inserts falling out.



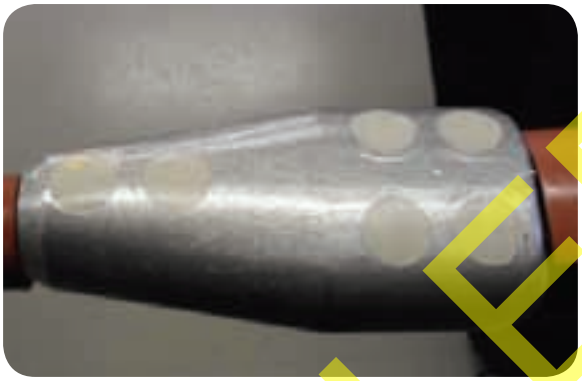
- The connector comes with a plastic centralising insert for the single cable end. If the conductor is able to pass through the hole in plastic insert, fit the insert into the connector and insert the single cable. If the conductor is too large to pass through the insert, discard it.

- Place the black stress-control tube inside the red and black insulation tube and park it on the single cable end. Insert the single cable into the connector and finger-tighten the bolts.

- Starting with the two bolts on the single cable end, tighten all the bolts in sequence in several steps until the heads shear off.

- If any of the bolts shear off proud of the connector surface, remove the edge with a file.

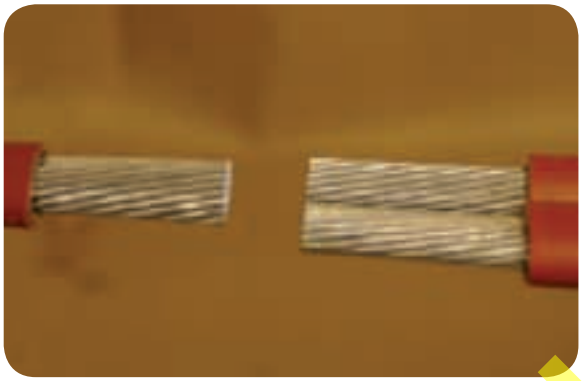
- Clean and degrease the connector, fill the bolt holes with the supplied clay pack to obtain a smooth finish.



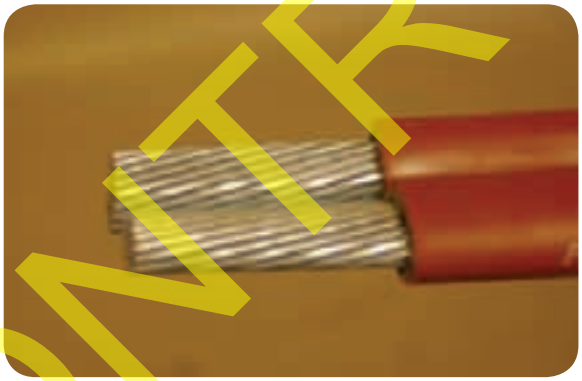
4.2.4 3-Core Transition Branch Joints

- Remove the insulation as described in Section 3.3.8 for polymeric cables and Section 3.5.11 for paper cables. Check that the connector insulating tubes have been positioned over the double cable end and support ring(s) over the triplex cables.
- Slide the three short pieces of red thick-wall tube over each core end on the single cable end of the joint. Position these away from the connector area.

- It is important that the position and setup of the cores is correct at this stage as it helps with installing the connectors.
- Cut each core to length, allowing for the water block in the connector, and remove the core insulation to the connector bore depth.



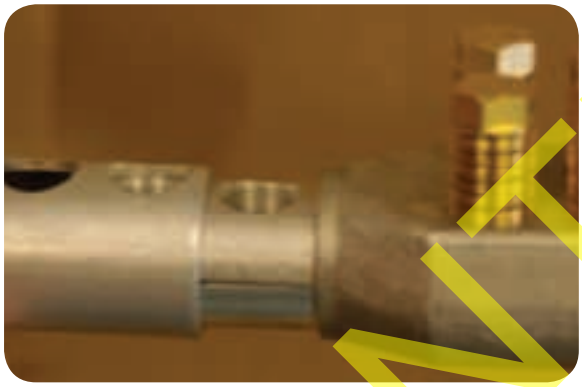
- Bring together each pair of cores on the branch side of the joint and bind them together with the ties provided.



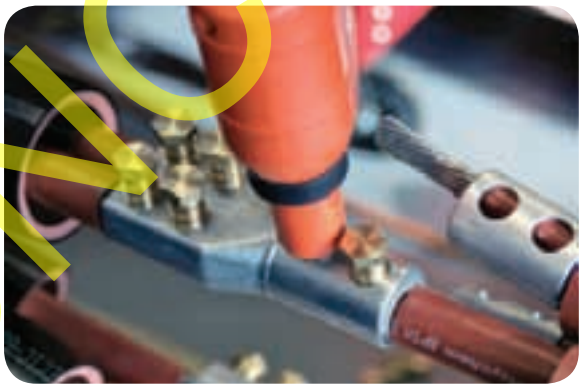
- Slide the (red and black) insulating sleeves carefully over each pair of cores on the branch side as shown in the relevant jointing instruction. Position the connector over the pair of cores on the branch side and finger-tighten the bolts.

- Slide the connector collar over the remaining single core. Place the core into the open channel of the connector and position the connector insert over the conductor.

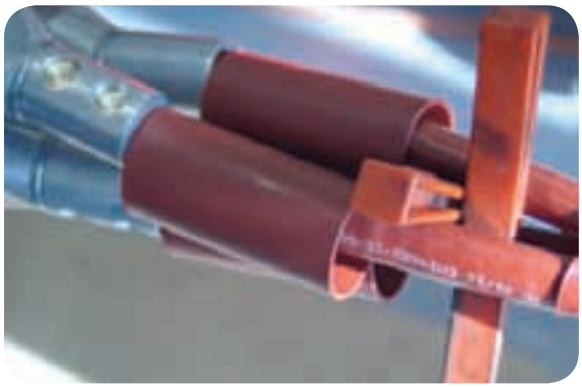
- Slide the connector collar over the insert, locking it in place. Fit the bolts and tighten them by hand.



- Tighten up the bolts in turn until they shear off.



- Position the three pieces of short red tube so that they butt up with the single end of the connector and shrink into position, starting from the end closest to the connector.

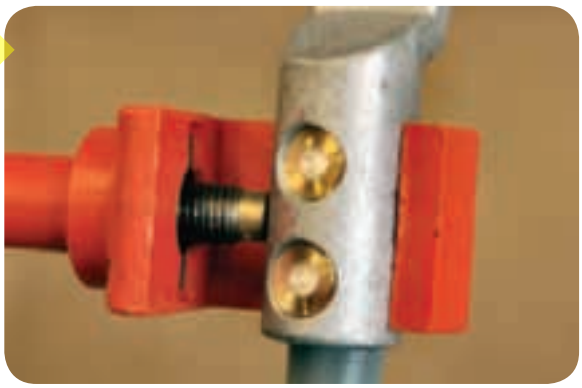


4.2.5 Mechanical Lugs for Indoor and Outdoor Terminations

- Follow the cable preparation procedures for polymeric cables in Sections 3.1 and 3.2 before installing any mechanical lugs.
- Each kit comes with the correct size and types of lug for each termination. Remove the insulation on the conductor to the depth of the thimble.

- Place the lug over the conductor so that the bottom of the barrel butts up against the core insulation.

- Tighten the bolts by hand and check that the palm hole lines up with the bushing or insulator stud.
- Fully tighten the bolts until the bolt heads shear off.

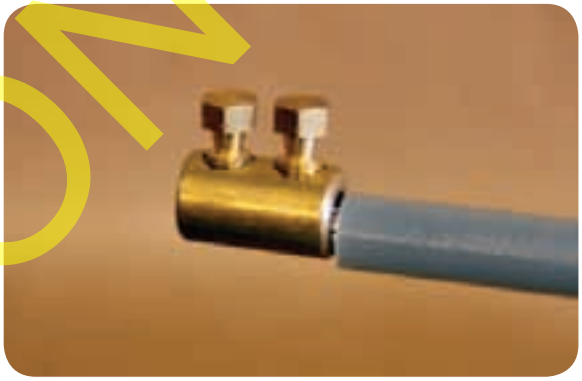


- Complete the termination as detailed in the appropriate instruction.

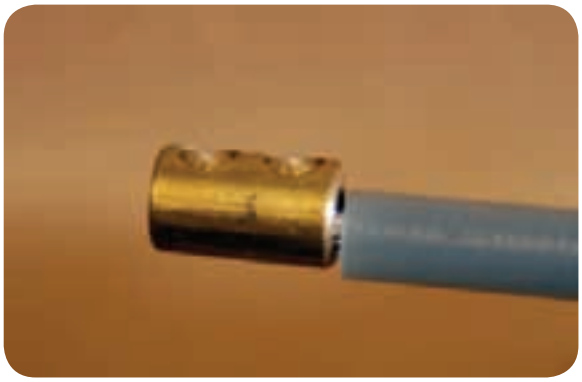
4.2.6 Mechanical Thimbles for Use in T1 Transformer End Boxes

- Prepare the cable following the procedures for polymeric cables in Sections 3.1 and 3.2 before installing any mechanical lugs.
- The kit comes with a mechanical thimble for 95mm^2 stranded aluminium cables only. The insulation on the conductor shall be removed to the depth of the thimble.

- Place the thimble over the conductor so that the top of the barrel is level with the top of the cut core.



- Tighten the bolts by hand and check that the final positioning of the thimble is correctly aligned with the half clamps on the bushing.
- Fully tighten the bolts until the bolt heads shear off.



- Complete the termination as detailed in the appropriate instruction.

4.3 Installing Connector Stress Control and Heatshrink Insulation

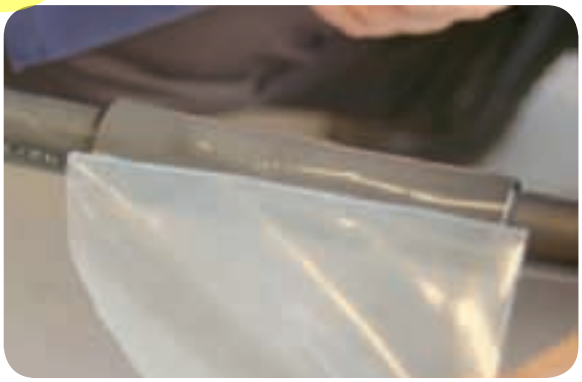
4.3.1 Single Core and Triplex Straight/Branch Joints

- Fit the mechanical connectors as described in Section 4.2.1.
- Clean and degrease the mechanical connector with an approved solvent wipe.

- Fill the bolt holes in the mechanical connector with the grey clay material supplied in the joint kit.

- Remove one of the backing sheets from the black mastic patch and position so that the connector is in the centre of the sticky side.

- Wrap the black mastic patch around the connector and remove the other backing sheet.



- Slide the red and black insulation tube over the installed black patch and position it over the centre of the joint.

- Starting in the middle, shrink the insulation tube using equal heat on all the surfaces. When the tube is properly shrunk, the ridges on the black layer of the tube shall no longer be visible and the tube cannot be moved.

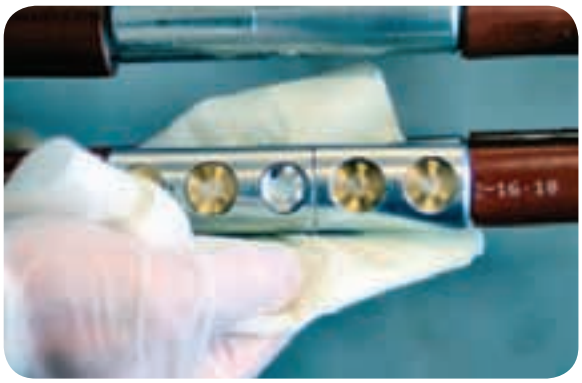
- Continue to shrink the tube from the centre to within 50mm of one end.

- Remove the heat from that end and start shrinking from the middle again towards the other end. Stop again 50mm from the end. This ensures that as the tube shrinks, any air inside is pushed out.

- Return to each end in turn and continue to shrink the tube completely.

4.3.2 Transition and Paper to Paper Straight Joints

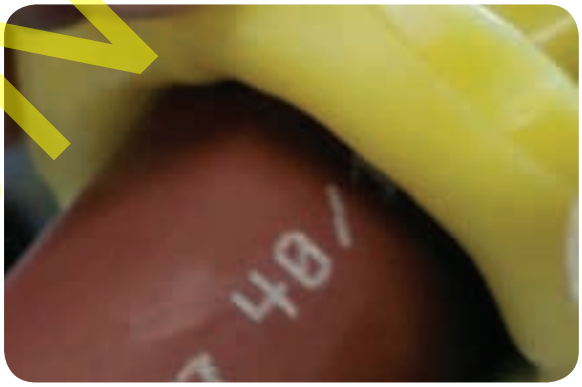
- Fit the mechanical connectors as described in Section 4.2.2.
- Clean and degrease the mechanical connector with an approved solvent wipe.

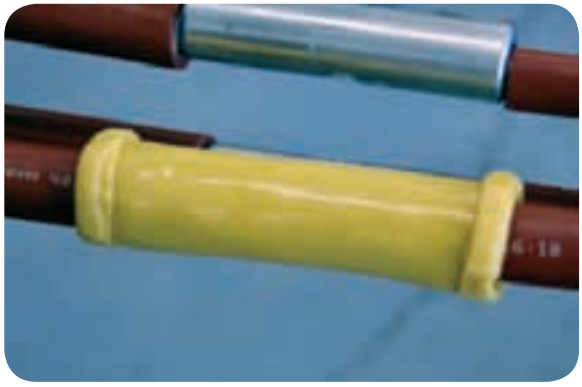


- Remove one of the backing sheets from the yellow mastic patch and position it underneath the connector, so it is in the centre of the sticky side and the overlap is over the bolt holes.

- Wrap the yellow mastic patch around the connector. Leave the outer backing sheet in place so the patch for the next connector does not stick to the first one.
- Remove all the release papers from the wrapped connectors.

- Roll the overlapped ends of the yellow mastic patch over to help with filling the gap between the edge of the connector and the core tubes. Complete this stage for all three cores before attempting to shrink the red and black insulation tubes in place.



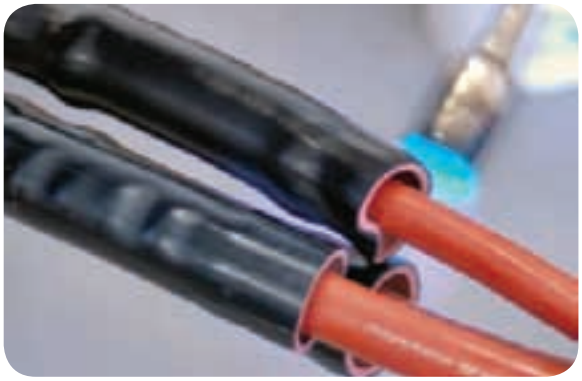


- Slide the red and black insulation tube over the installed yellow patch and position over the centre of the joint. Position all three before starting the shrinking process.

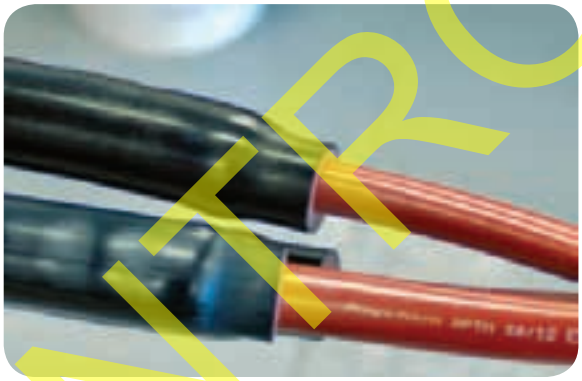
- Starting in the middle, shrink the insulation tubes, using equal heat on all the surfaces. When the tubes are properly shrunk, the ridges on the black layers of each tube shall no longer be visible and the tube cannot be moved.

- Continue to shrink the tubes from the centre to within 50mm of one end.

- Remove the heat from that end and start shrinking from the middle again towards the other end. Stop again 50mm from the end. This ensures that as the tubes shrink any air inside is pushed out.



- Return to each end in turn and continue to shrink the tubes completely.



4.3.3 Single Core Branch Joints

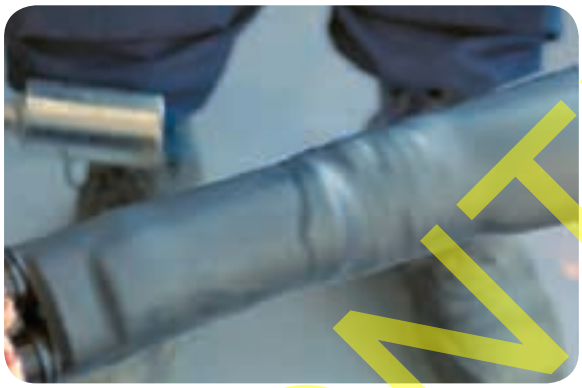
- Fit the mechanical connectors as described in Section 4.2.3.
- Remove one release paper from a long strip of yellow mastic. Starting from the single core side, wrap it around the core, stretching it to approximately half its original width.

- Fill in the gaps between the core and the connector, continuing across the connector and on to the red insulating piece. Ensure that a smooth profile is formed so that when the heat shrink tubes are applied all the voids are filled with yellow mastic.

- Lubricate the yellow mastic with the supplied silicone tissue to stop the black stress control tube sticking when it is pulled across the joint.

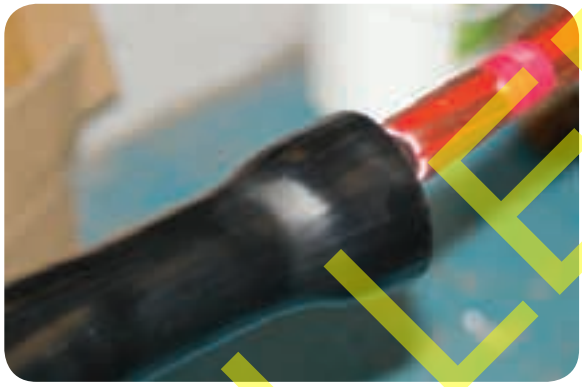
- Push the black stress control tube over the connector and onto the rubber spacers, until it lines up with the end of the black spacer.

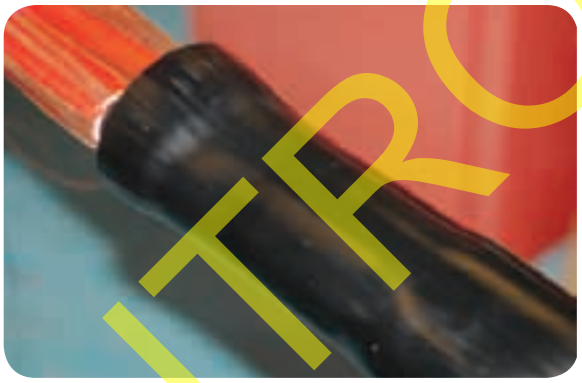
- Shrink the stress control tube down, starting at the branch side before working towards the single core side.



- Apply additional heat over the connector to ensure that the tube is fully shrunk and wrinkle free. The second picture below shows what the finished tube should look like.

- Now position the red and black insulating sleeve centrally over the stress control tube.
- Start shrinking the sleeve from the centre, continuing to within 50mm of each end. Finally complete the shrinking process on both ends. Following this sequence ensures that no air is trapped in the tube.

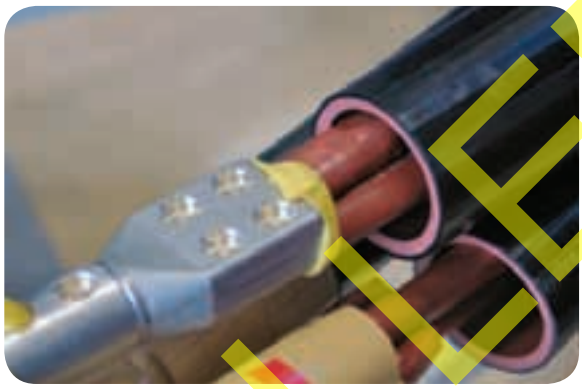




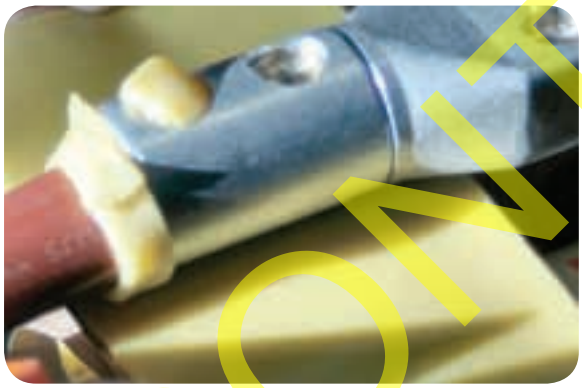
- When complete, the sleeve shall be fully shrunk, with no visible ridges on the sleeve surface.

4.3.4 3-Core Transition Branch Joints

- Fit the mechanical connectors as described in Section 4.2.4.
- Using one of the thin lengths of yellow mastic, stretched to half its original width, tape around both ends of the connector to reduce the size of the step.

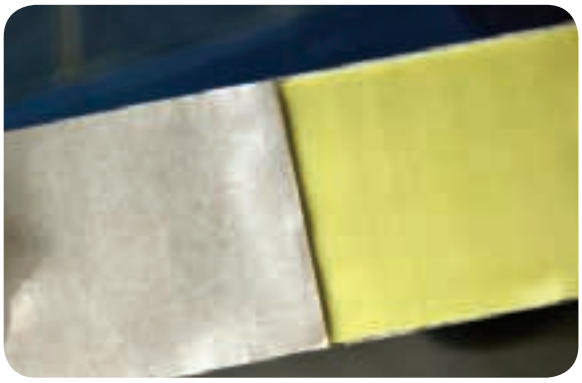


- Remove one of the backing sheets from the yellow mastic patch and position it underneath the connector, so it is in the centre of the sticky side and the overlap is over the bolt holes.



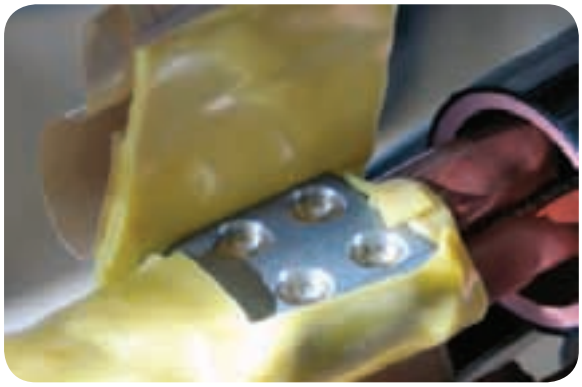
- Wrap the yellow mastic patch around the single end of the connector, leaving the outer backing sheet in place to prevent other patches sticking to it.

- Take two yellow mastic patches and remove the backing sheet from one side. Stick the two patches together with a 50% overlap.

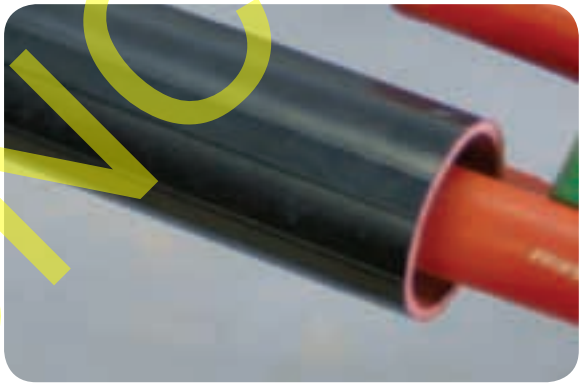


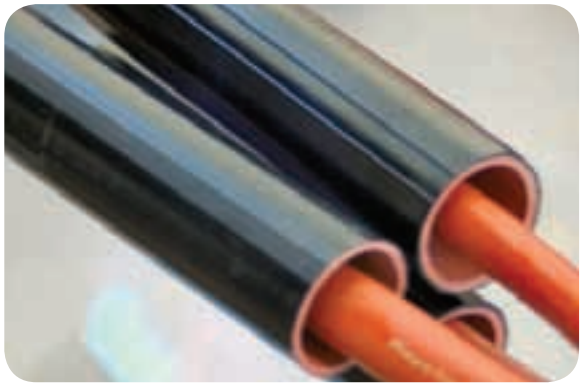
- Wrap the double length yellow mastic patch around the bottom of the double cable end of the connector.

- Remove the backing sheet partly from the yellow mastic patch on the top of the connector and continue to wrap it around the connector until it is evenly covered.

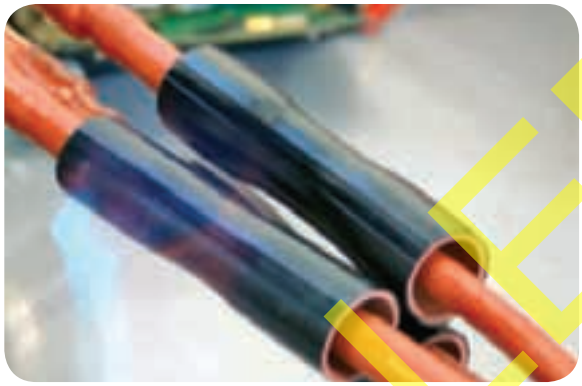


- To help with the application of the yellow mastic on the remaining cores, wrap each completed core with two of the removed backing sheets. This stops the yellow mastic from one core sticking to another.
- Apply a thin smear of silicone grease over the yellow mastic on each core and position the red and black insulating sleeves centrally over each connector. Position all three before starting the shrinking process.



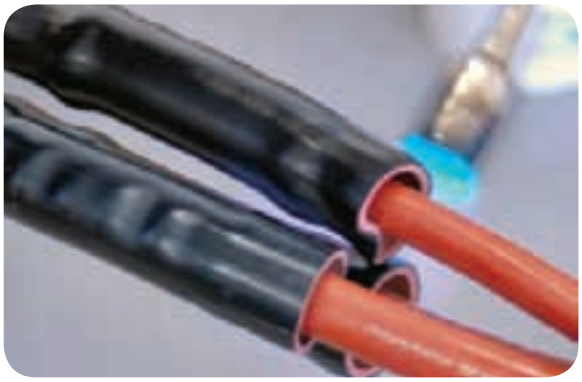


- Starting in the middle, shrink the insulation tubes, using equal heat on all the surfaces. When the tubes are properly shrunk, the ridges on the black layers of each tube shall no longer be visible and the tube cannot be moved.

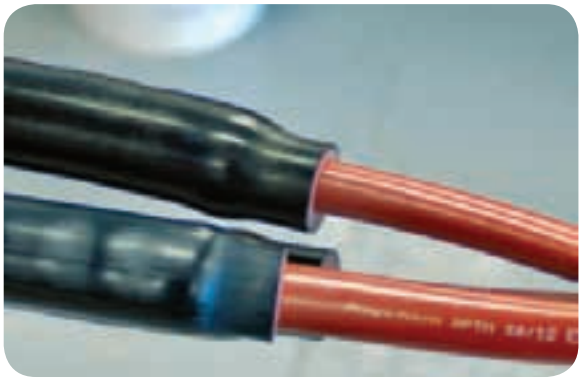


- Continue to shrink the tubes from the centre to within 50mm of one end.

- Remove the heat from that end and start shrinking from the middle again towards the other end, stopping again 50mm from the end. This ensures that as the tubes shrink any air inside is pushed out.

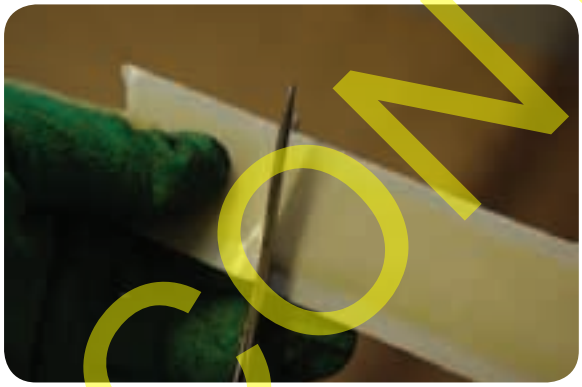


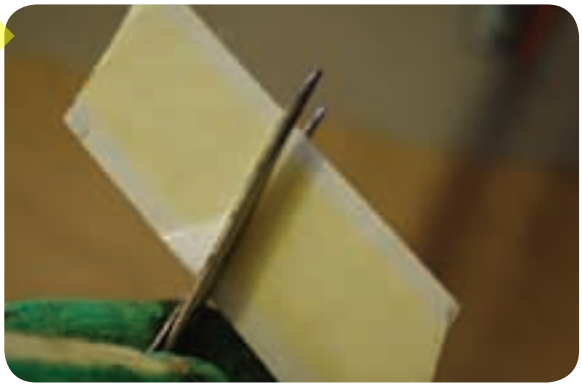
- Return to each end in turn and continue to shrink the tubes completely.



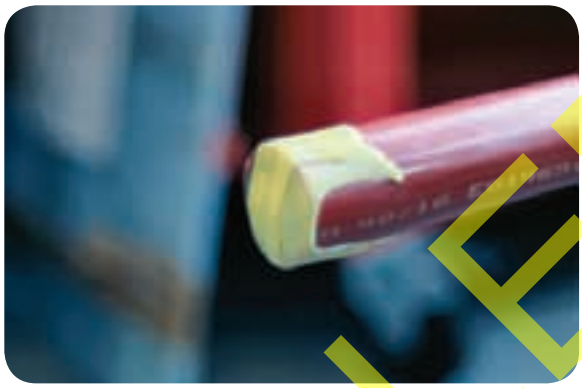
4.3.5 Polymeric and Paper Pot End Joints

- Install stress control and insulation materials on the following cable types before installing any of the following materials:
  - Belted paper cables – Section 4.1.1.
  - Screened paper cables – Section 4.1.2.
  - Single core polymeric cables in transitional straight/branch joints – Section 4.1.4.
  - 3-core polymeric cables – Section 4.1.7.
- Cut one of the short lengths of yellow mastic into three equal lengths with scissors.





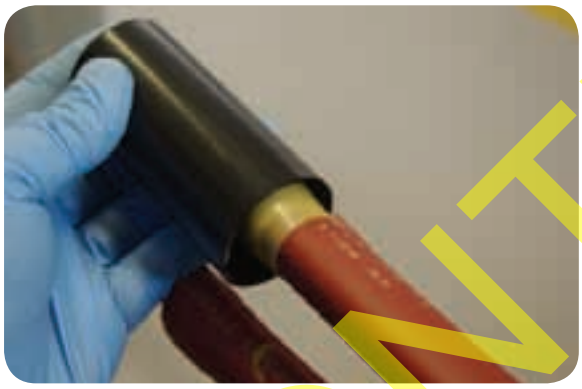
- Stretch each piece of yellow mastic to half its original width and use it to cover the cut end of the cable.



- Make a Chinagraph pencil mark on the insulation, 40mm from the cut end.

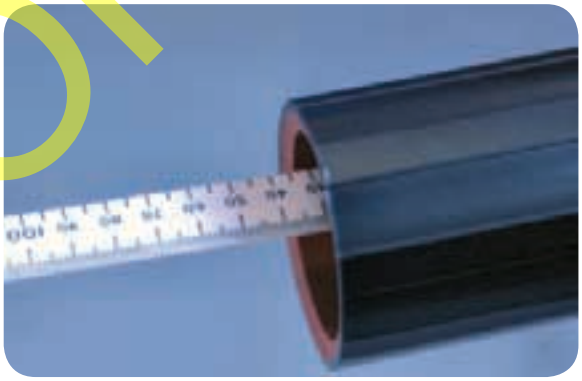
- Apply another short piece of yellow mastic, stretched to half its original width, between the Chinagraph pencil mark and the end of the core

- Place the black heatshrink cap over the end of the core so that it fully covers the yellow mastic.



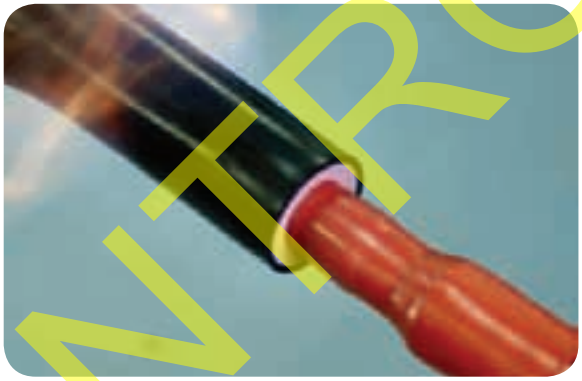
- Heatshrink the cap into place starting from the end. Hold the cap in place with a hammer handle to ensure that the cap doesn't come off while it is being shrunk.

- Position the red and black insulation tube over the core so that it is 30mm past the end.



- Starting in the middle, shrink the insulation tube, using equal heat on all the surfaces. When the tube is properly shrunk, the ridges on the black layer of the tube shall no longer be visible and the tube cannot be moved.

- Continue to shrink the tube, moving from the centre up to within 50mm of one end.



- Remove the heat from that end and start shrinking from the middle again towards the other end. Stop again 50mm from the end. This ensures that as the tubes shrink any air inside is pushed out.

- Return to each end in turn and continue to shrink the tube completely.

- Repeat the process for the other two cores.

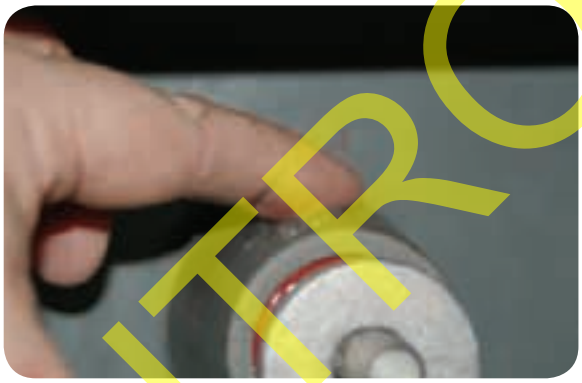
4.4 Installing Bushing Boots

4.4.1 Cold Applied Switchgear Boots

- Fit the single core termination as described in Section 4.1.6.
- Clean and degrease the terminations and the bushings using an approved solvent wipe.
- Apply a thin layer of silicone grease to the top 50mm of each termination. Slide the concertina flexible boots over the termination and park them below the lugs.

- Apply a thin layer of silicone grease to the top 50mm of the termination.

- Apply a thin layer of silicone grease to the bushing.



- Bolt the lugs to the bushings using the nuts and bolts supplied with the switchgear. Tighten the connections up to the required torque.

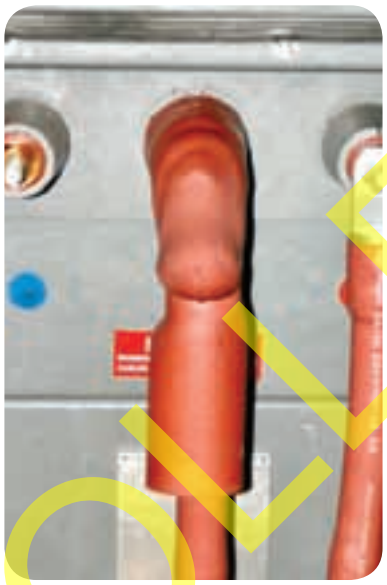
- Now push the boot upwards and over onto the bushing as far as it will go. When installed it shall not be more than 15mm away from the back plate of the end box.

4.4.2 Heat Shrink Boots

- Fit the single core termination lug or thimbles as described in Section 4.2.5 and 4.2.6.
- Clean and degrease the terminations and the bushings using an approved solvent wipe.
- Slide the heat shrink boots over the terminations and park them below the lugs.

- Bolt the lugs to the bushings using the nuts and bolts supplied with the switchgear. Tighten the connections up to the required torque.
- Apply the supplied black mastic to the bushing nut and the exposed metal work of the connector. Ensure that any sharp edges are fully covered by the mastic.

- Push the boots up and over the bushings as far as they will go. Begin shrinking each boot in place with a soft flame, starting at the inside leg/body interface, before moving up the bushing. Finally shrink from the centre of the boot down to the bottom of each leg.



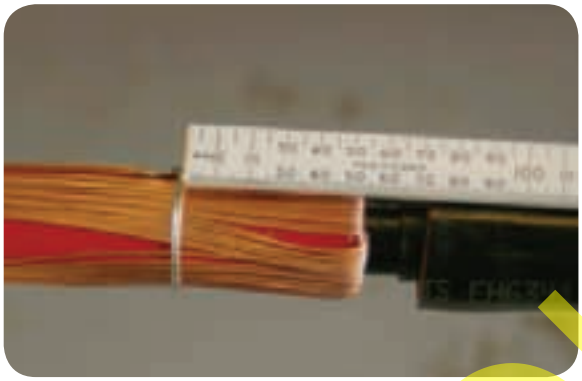
- The boots shall form into a right angle. If the position does not look right, reposition the boot while it is still hot, using suitable protective gloves.

- Allow to cool before moving the termination.

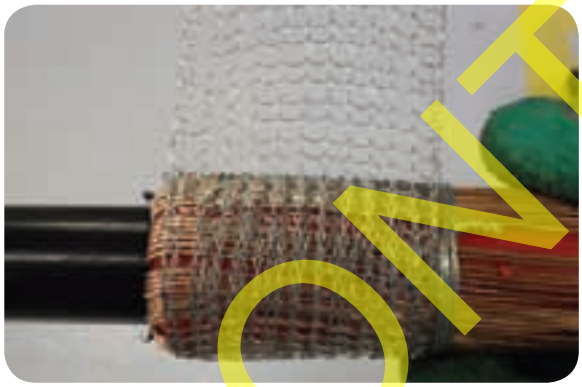
4.5 Installing Mechanical Earth Bonds and Associated Components

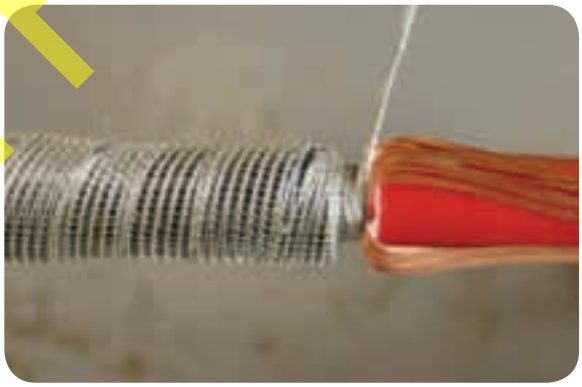
4.5.1 Single Core Straight Joints

- Complete the joint as described in Section 4.3.1 before fitting this earth bond arrangement.
- Install a double wire binder onto the copper wires at the end of the joint with the shortest length of copper wire screens, 50mm from the outer sheath cut.

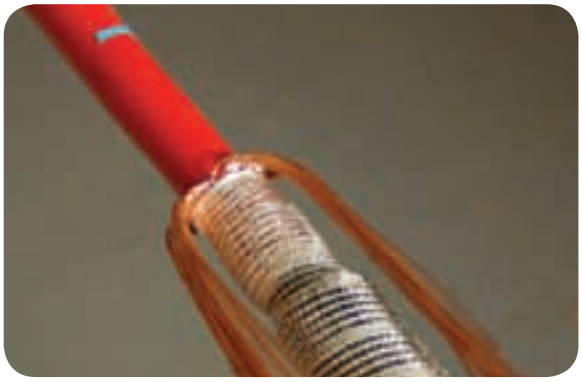


- Wrap one half-lap layer of copper woven tape over the length of the joint, starting from the wire binder up to the copper screen wire at the other end, tying off with a half hitch.



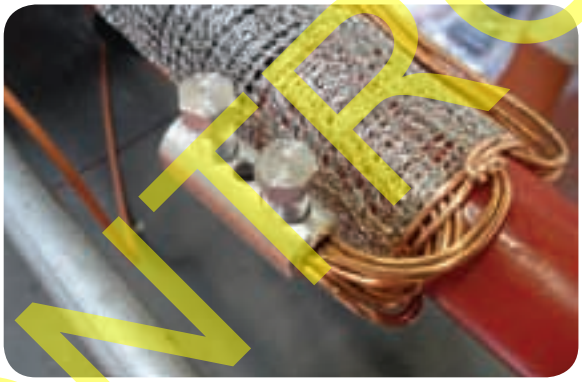


- Form the copper wire screens at both ends of the joint into two equal bunches, one on each side.



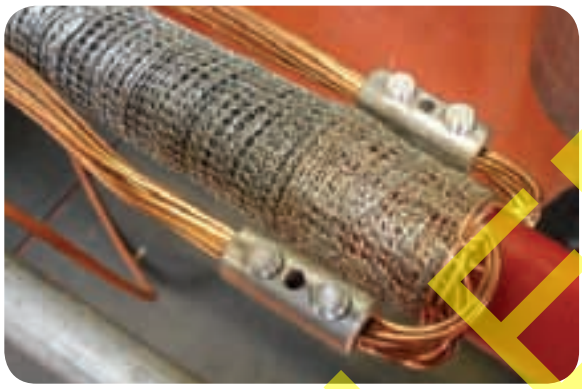
- Using one of the tinned aluminium connectors as a guide, cut the copper wire screens to length so that the connectors sit in the gap between the wire binder and the end of the insulation tube.

- Shear off one bolt on each connector, ensuring that space is left in the connector to fit the rest of the copper wires in the other end.



- Offer up the copper wire screen bunches from the opposite end of the joint and cut to length using the installed connector as a guide.

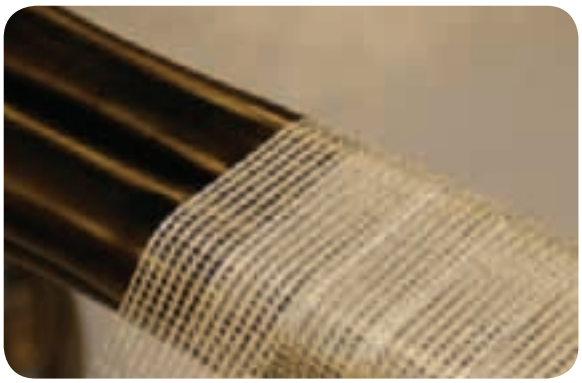
- Insert each bunch into each of the connectors and shear off the second bolt.



- Wrap a half-lap layer of copper woven tape over the complete joint from end to end.

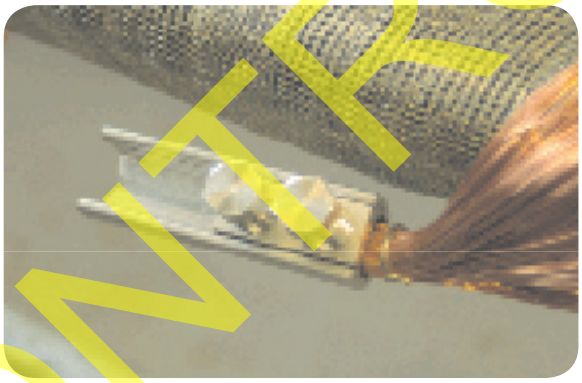
4.5.2 Triplex Straight Joints

- Complete the joint as described in Section 4.3.1 before fitting this earth bond arrangement.
- Pull the three completed cores of the joint together into a trefoil arrangement and apply a half-lap layer of copper woven tape between the two sheath cuts, tying off with a half hitch at one end.



- Form the three sections of copper wire screen at each end of the joint into a single conductor. Position each bunch in such a way to ensure that they fit into the plastic joint shell.

- Cut one bunch of copper wire screens in the centre of the joint and fit into one half of the mechanical connector. The copper wire screens may have to be doubled over to make the connector fit. The copper wires shall be held together with tinned copper mesh.



- Cut the other bunch of copper wire screens to length and fit into the other end of the mechanical connector.

- Shear off all four bolts on the mechanical connector, ensuring that the top plates do not slip out.

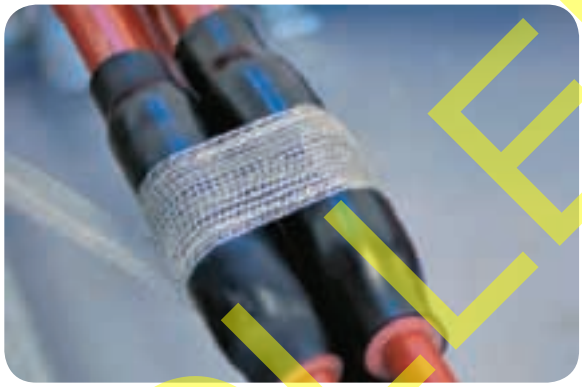
4.5.3 Single Core Branch Joints

- Complete the joint as described in Section 4.3.3 before fitting this earth bond arrangement.
- Starting on the branch side of the joint, apply a half-lap layer of copper woven tape over the insulation sleeve until it is fully covered. Tie off the mesh with a half hitch knot at the single cable end.

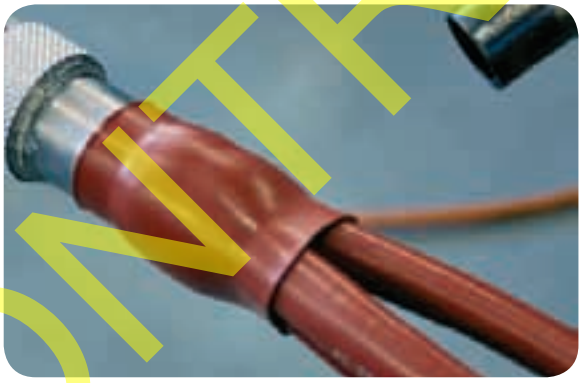
- Form the three bunches of copper wire screens into three separate conductors.
- Lay the three separate conductors across the joint and connect them together using the two mechanical shear bolt connectors provided in the kit. Use the branch cable with the longest length of copper wire to bridge the gap between the copper wires on the main.

4.5.4 Triplex Cables into Transition Joints Using a Support Ring

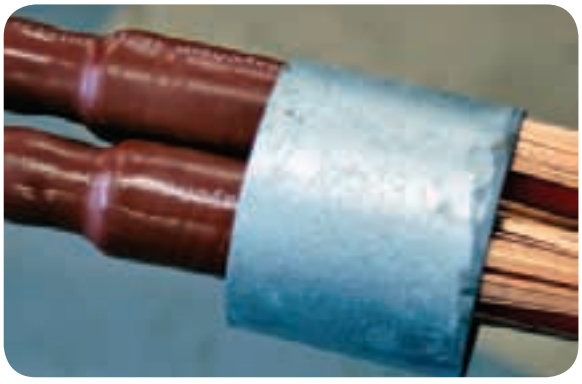
- Complete the joint as described in Section 4.3.2 or 4.3.4 before fitting this earth bond arrangement.
- Pull the three cores of the joint together and tie them together with the supplied length of copper woven tape, secured with a half hitch.



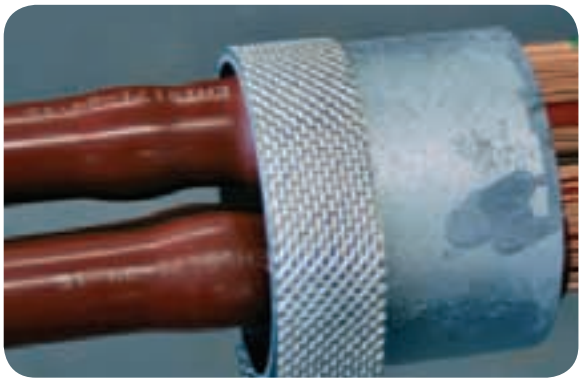
- Reheat the crutch sealing sleeve of any paper insulated cables before proceeding.



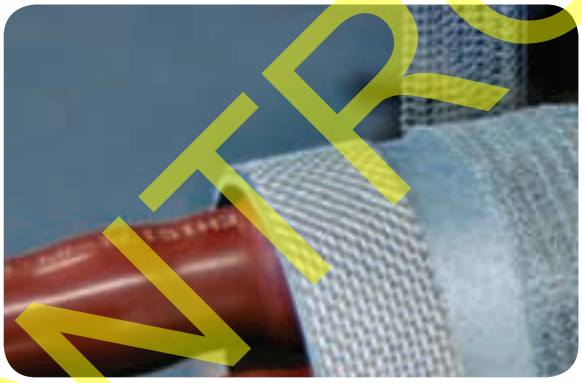
- Position the support ring so that the inner end is level with the end of the red tubes. The screen wires shall stick out from the outer edge of the support ring.



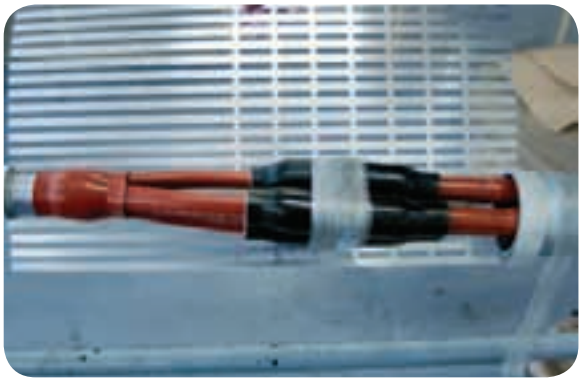
- Bend the long length of ‘cheese-grater’ strip to form a circle and position it on the support ring, at the opposite end from where the copper wires are sticking out.



- Fold a length of copper mesh in half over its full length so that its width is reduced to approximately 30mm. Wrap two layers of the mesh around the edge of the support ring (furthest away from the joint) and temporarily secure them.



- Offer up the aluminium cage to the joint to check that the support ring is in the right place. The petals at each end line up with and overlap the ‘cheese-grater’s at both ends.



- Turn back and lay the copper wires of the single core cables over on to the copper mesh, so they are tidy and do not cross each other.

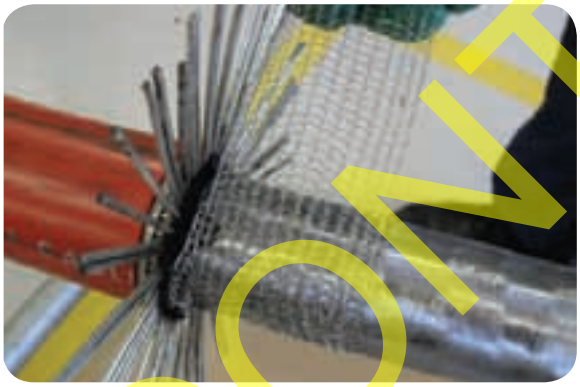
- Wrap the remaining copper mesh over the wires and secure with a half hitch. Clamp the copper wires and mesh down on to the support ring with the worm drive clip provided. Trim the copper wires with side cutters, so that they are level with the inner end of the copper wire mesh.

- Apply two half-lap layers of red sealant tape to the space between the end of the copper wires and the ‘cheese-grater’ on the support ring.

4.5.5 Standard PILC Earth Steel Wire Armour Cables (EPN and Pot Ends Only)

- Prepare the lead sheath as described in Section 3.5 before fitting this earth bond arrangement.
- Using one of the lifted armours as a guide, make a mark on the lead sheath with a Chinagraph pencil.

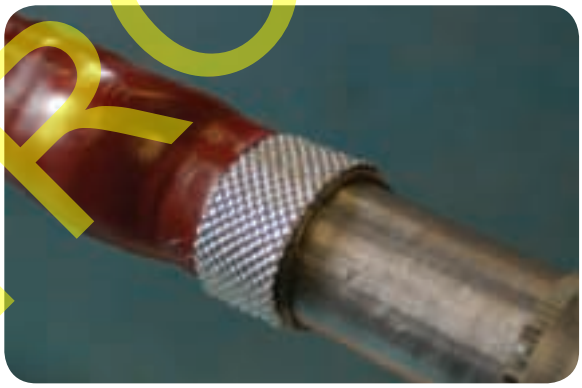
- Fold a length of copper mesh in half over its full length so that its width is reduced to 30mm. Wrap the mesh around the lead sheath level with the end of the armour wire mark, so that the armours cover it when they are folded down.



- Bend the steel wire armours back down and secure in place with the worm drive clip supplied in the kit.

- Fold a length of copper mesh in half over its full length so that its width is reduced to 30mm. Wrap the mesh around the lead sheath level with the end of the red crutch tube.

- Trim the ‘cheese-grater’ strip to length and form it into a circular shape, so that it fits neatly and securely around the copper mesh.



- Fit the metallic cage to the joint, overlapping the cage fingers fully on to the ‘cheese-grater’ area.

4.5.6 PICAS Earth (SPN Only)

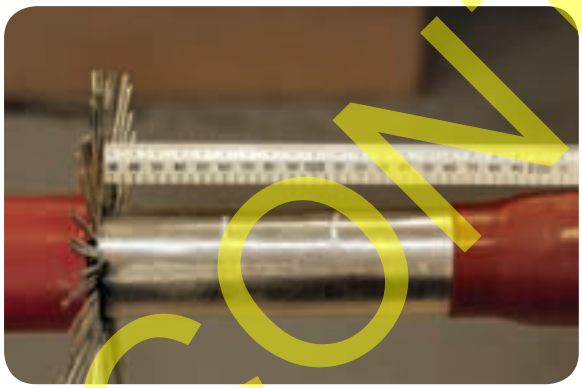
- Form the short ‘cheese-grater’ strip into a circular shape, so that it fits around the aluminium sheath.

- Install the ‘cheese-grater’ strip next to the red crutch sealing sleeve, ensuring that it bridges two adjacent peaks on the corrugated aluminium sheath.

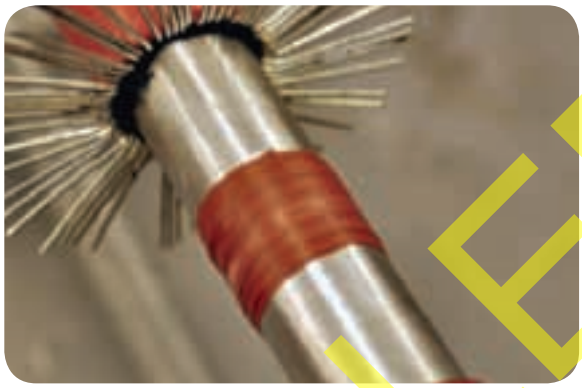
- Fit the metallic cage to the joint, overlapping the cage fingers onto the ‘cheese-grater’ area.

4.5.7 13kA PILC Earth Kit – Steel Wire Armoured Cables (LPN and SPN Areas Only)

- Lift and clean the armours as described in Section 3.5.3.
- Abrade and degrease the lead sheath between the lifted steel wire armours and the red crutch sealing tube. Make two Chinagraph pencil marks on the lead sheath, at 60mm and 100mm from the outer sheath cut.

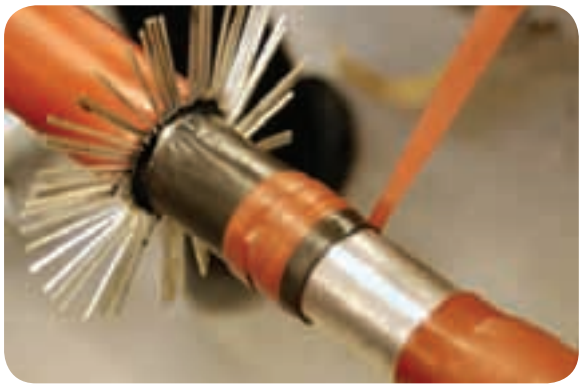


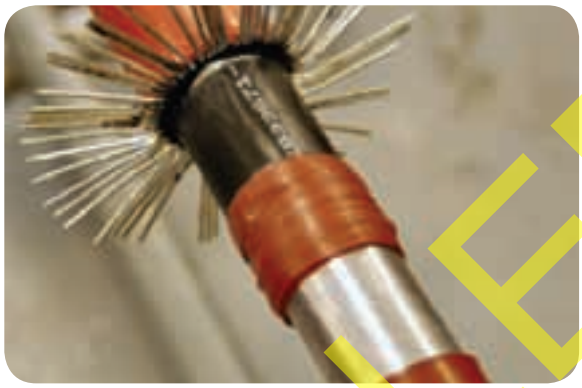
- Apply two half-lap layers of red sealant tape for 40mm between the two Chinagraph pencil marks.



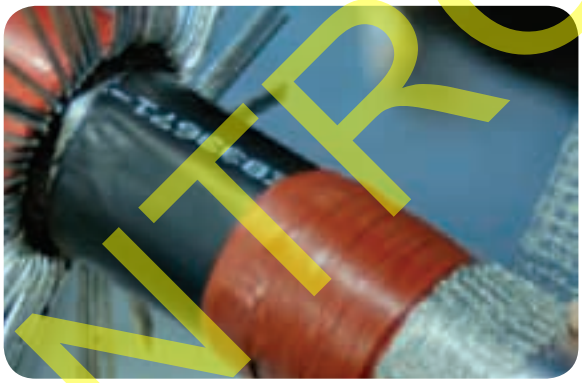
- Position the black sealing sleeve provided in the kit against the raised armours and shrink into place keeping the sleeve as close to the armours as possible.

- Apply two layers of red sealant tape over the black sealing sleeve for 40mm, starting at the end nearest to the lead sheath and working towards the armours.





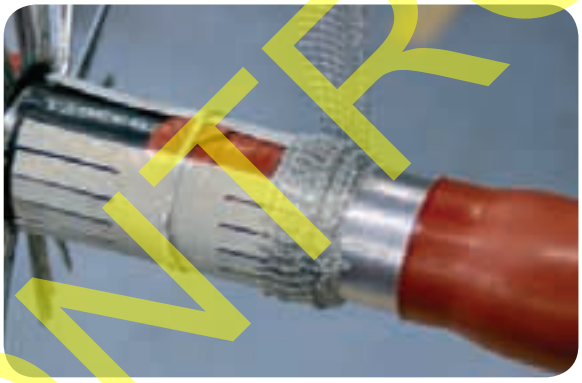
- Fold a length of copper mesh in half over its full length, so that its width is reduced by half, and wrap it around the lead at the end of the black sealing sleeve.



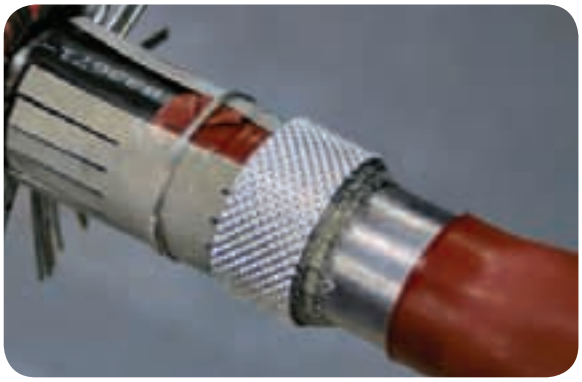
- Remove the backing paper from one piece of red sealant tape and stick it down the centre of the tinned copper earth strip with fingers each end. This is an important moisture seal and shall not be left out.

- Wrap the earth clip around the cable so that the red sealant strip is located over the red sealant on the sealing sleeve, and that the fingers of the earth strip are positioned over the copper mesh. Secure in place with a double width copper wire binder. ‘Dress down’ the ends of the clip to suit the size of the lead sheath.

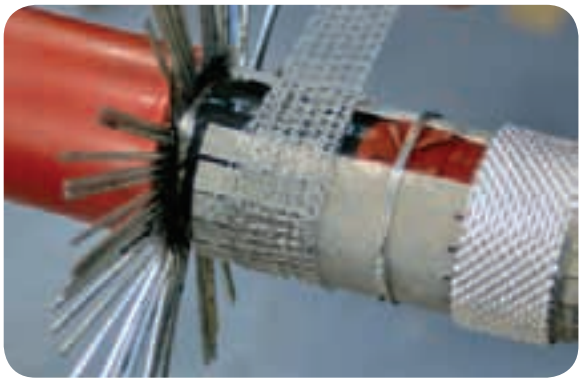
- Fold a length of copper mesh in half over its full length, so that the width is reduced by half, and wrap it around the fingers on the lead sheath end of the clip.



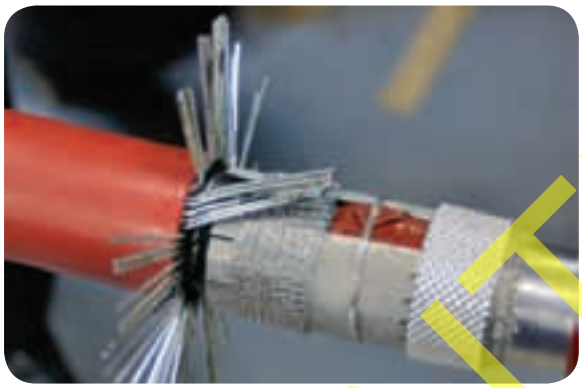
- Form the short length of ‘cheese-grater’ strip in the kit into a circle and fit over the copper woven mesh at the lead sheath end.

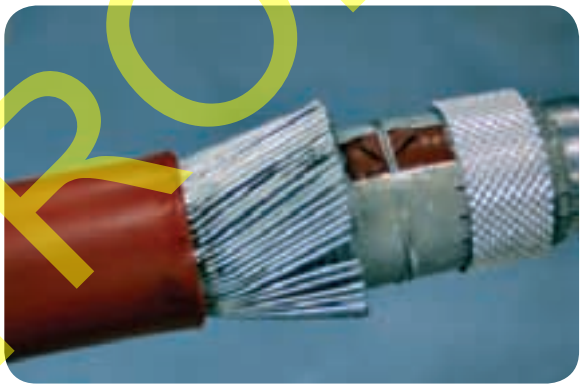


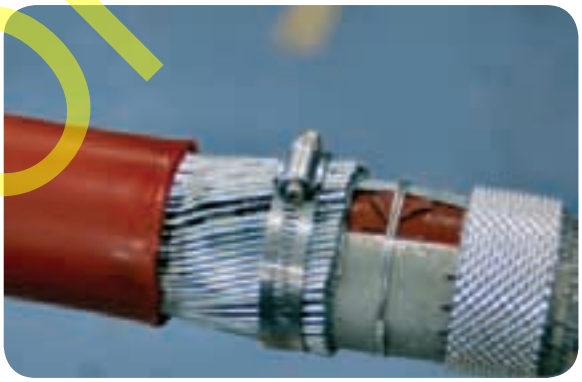
- Fold another length of copper mesh in half over its full length, so that the width is reduced by half, and wrap it around the fingers on the armour end of the clip.



- Now lay the armours down over the copper mesh and secure them with the worm drive clip supplied in the kit.

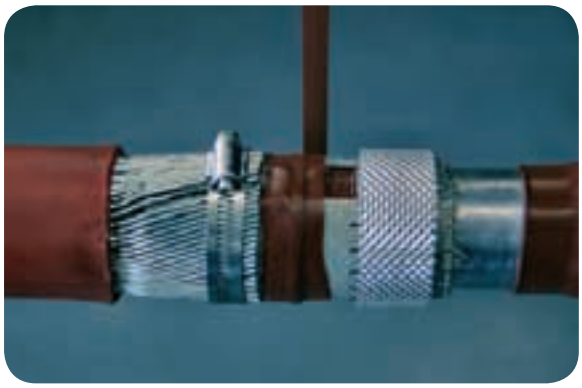


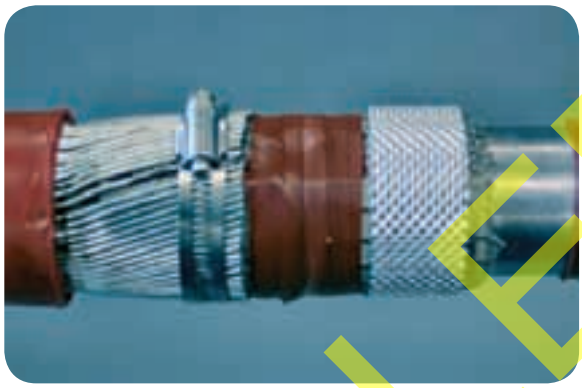




- If the wire binder becomes loose, cut it with insulated side cutters and remove.

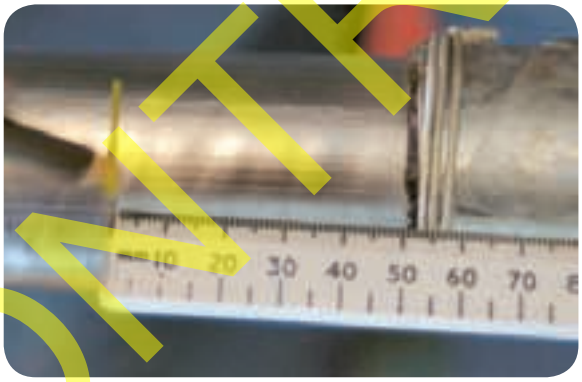
- Wrap two lapped layers of red sealant tape around the exposed earth clip between the armours and the ‘cheese-grater’.



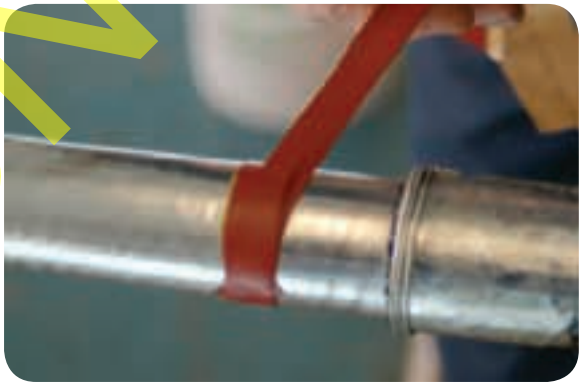


4.5.8 13kA PILC Earth Kit – Steel Tape Armoured Cables (LPN and SPN Areas Only)

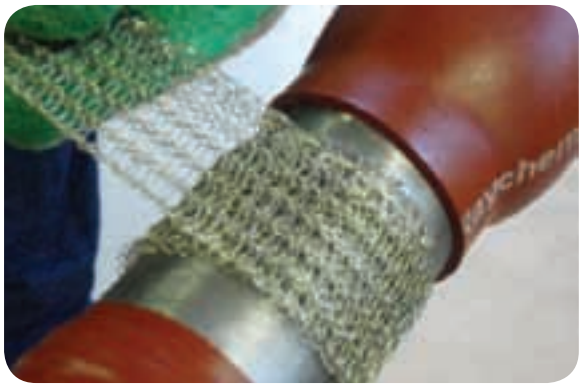
- Prepare and clean the armours as described in Section 3.5.4.
- Abrade and degrease the lead sheath between the armours and the red sealing sleeve in the crutch. Make a Chinagraph pencil mark on the lead sheath 50mm from the armour cut.

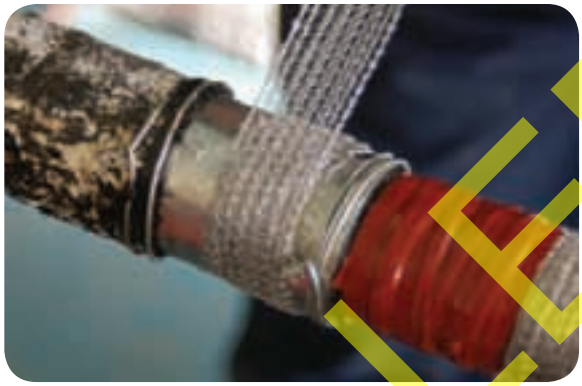


- Wrap two layers of red sealant tape around the lead sheath, starting at the armour cut up to the Chinagraph pencil mark.

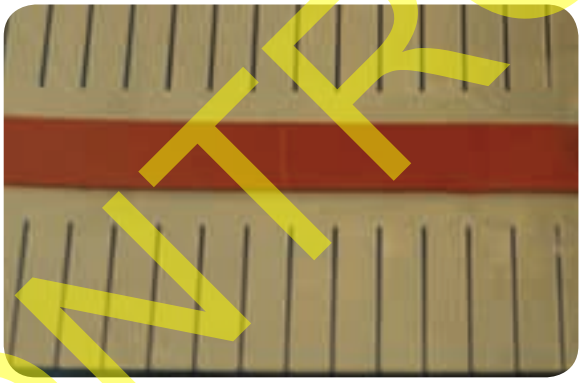


- Fold two lengths of copper mesh in half over their full length. Wrap one length around the lead sheath 10mm from the (red) mastic tape and the other around the armours 10mm back from the edge.



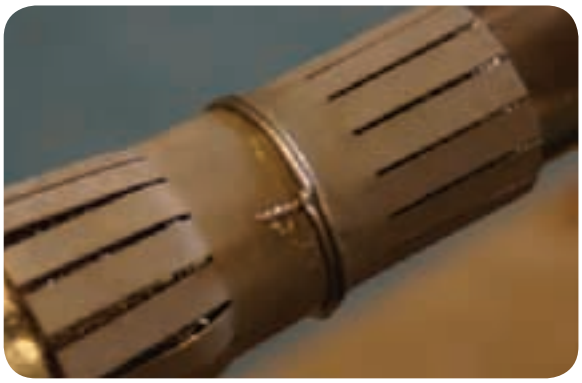


- Lay a red sealant tape strip down the centre of the tinned copper strip with fingers at each end. This is an important moisture seal and shall not be left out.

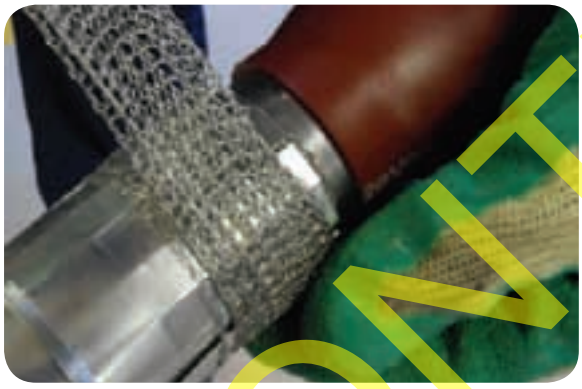


- With the strip face down, slightly raise the fingers on the edge of the clip which will be fitted to the steel tape armour. Wrap the strip around the cable so that the red sealant strip is located over the red sealant strip on the lead sheath. Position the fingers of the strip over the copper mesh on the lead sheath and the copper mesh on the armours.

- Dress down the earth strip fingers onto the copper mesh, over the lead sheath and armours area at the other end. Secure the earth strip in this position with a double binder around the centre.

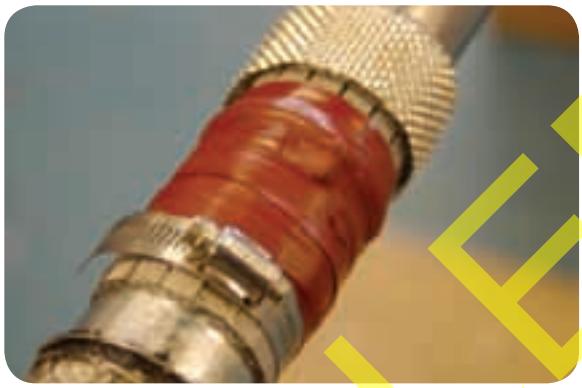


- Fold the remaining copper mesh roll in half lengthways. Wrap it around the end of the earth strip over the lead sheath end. Form the ‘cheese-grater’ strip into a circle and fit it over the mesh.



- Fasten the other ends of the fingers onto the armours using a worm drive clip.

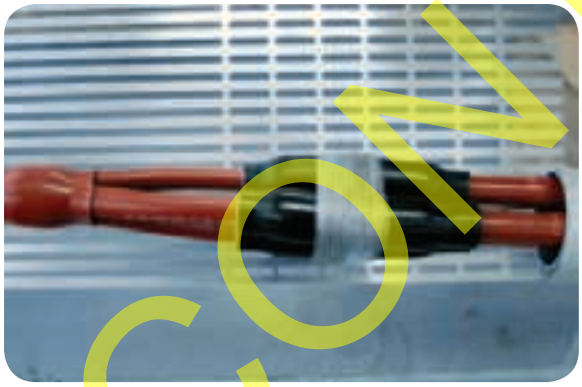
- Apply two one-third-lap layers of red sealant tape on the earth strip between the ‘cheese-grater’ and the worm drive clip at the armour end.

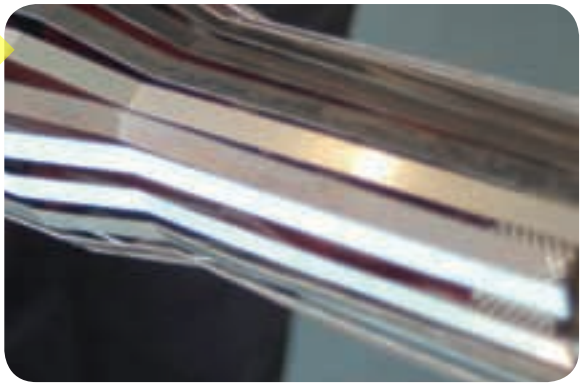


- Fit the metallic cage to the joint, overlapping the cage fingers fully onto the ‘cheese-grater’ area.

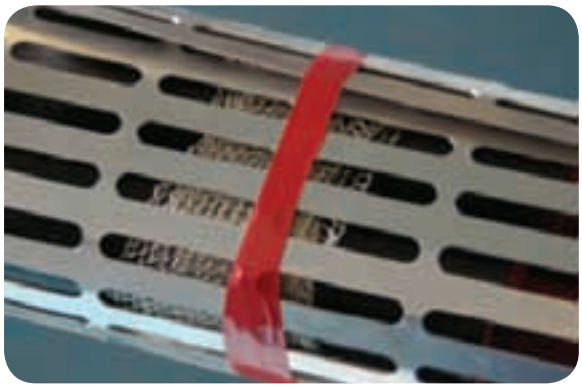
4.5.9 Installing Aluminium Cages

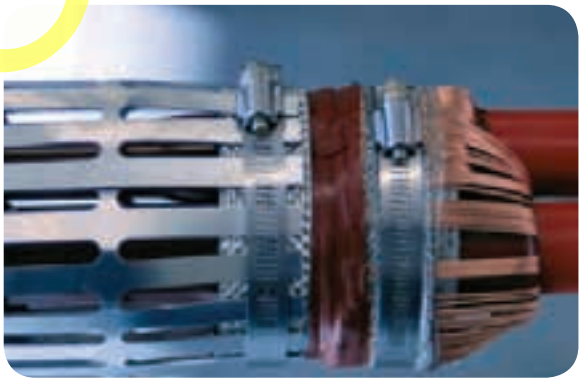
- Install the ‘cheese-grater’ connection strips as described in Sections 4.5.4 to 4.5.8 before fitting the aluminium cage.
- Position the aluminium earth cage around the joint, spacing the fingers equally over the ‘cheese-grater’ areas.





- Apply a temporary tape binder around the cage to secure it in position and clamp the earth cage securely at each end, using the worm drive clips provided in the kit.



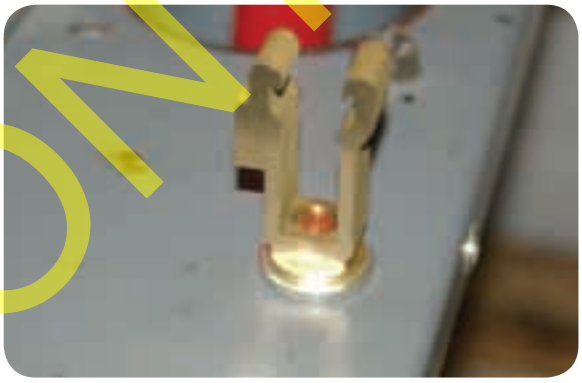


- Remove the temporary PVC tape binder.
- On pot ends, bend the last fingers of the aluminium cage into the centre, so they overlap and close in the end of the joint.

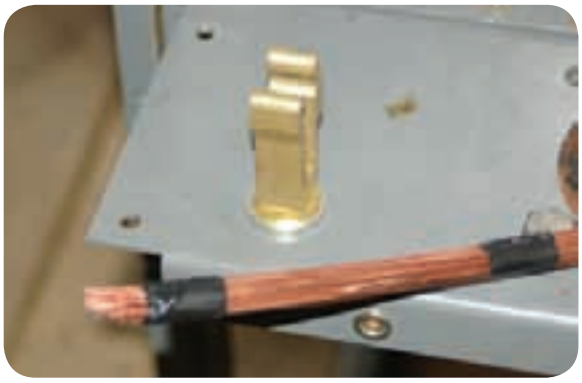
- On branch joints, separate the cage fingers equally between the two cable entries and shape them such that they lie flat on top of the ‘cheese-grater’ areas.

4.5.10 Connection of Earth Screens on Indoor and Outdoor Terminations

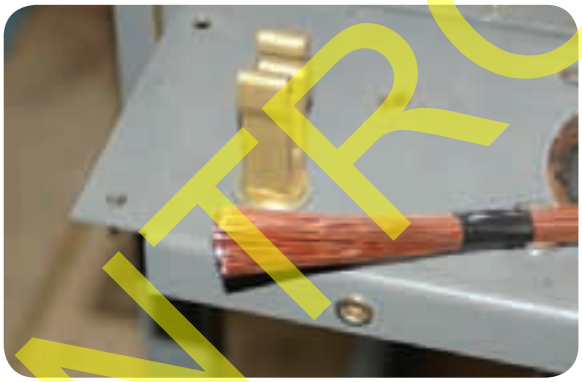
- Prepare the termination as described in Section 4.1.6.
- Ensure that the mechanical connector has been installed in the cable end box or on to the crucifix. Form the outdoor termination.



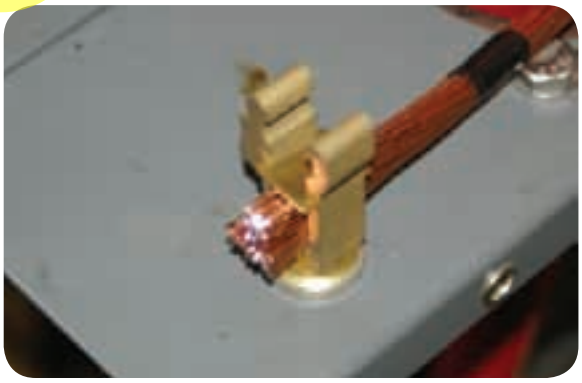
- Form the copper wire screens from each cable into a conductor, using PVC tape to keep the wires in a bunch.



- Cut each bunch of copper wires to the correct length using the installed mechanical connector as a guide.



- Install all three bunches into the connector, followed by the brass pressure plate.



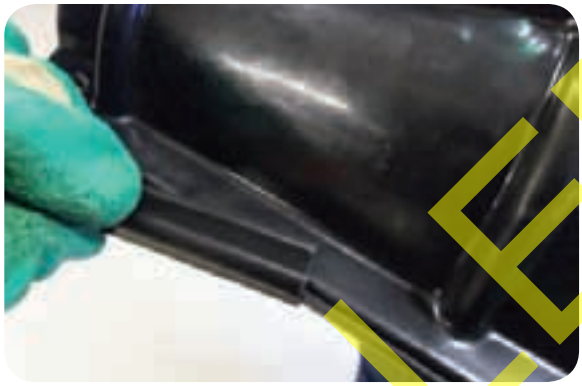
- Install the brass bridge piece and tighten until the brass head shears off.

4.6 Fitting Plastic Joint boxes

- Trim off the ends of the joint box supplied with the kit, so that it fits over the cables entering the box.
- Offer the joint box up to the joint and mark the stand-off positions on the aluminium cage with a Chinagraph pencil.

- Remove the backing from the rubber patches supplied in the kit and apply centrally, sticky side out, over the Chinagraph pencil marks on the aluminium cage. Ensure that any mechanical earth connectors are pulled tight into the mesh.

- Place the two halves of the joint shell over the joint and clip the two halves together with the metal clips or plastic slider provided. Ensure enough clips are used to stop the resin leaking out when it is poured in.

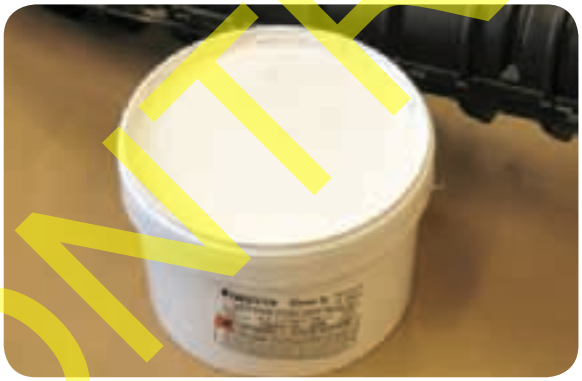


- Tape the joint box to the incoming cable with PVC or another suitable tape. If necessary, pack the ends of the joint shell out with the clay pack supplied in some kits.

- For extra security, run a length of PVC tape down the seams of the joint shell and fit the plastic lid.

4.7 Mixing and Installing Polyurethane Resin

- Fill all 11kV joints with three-part polyurethane resin. Wear the correct Personal Protective Equipment at all times and do not mix the resin in a confined space.
- Check the label on the bucket to ensure that the resin has not passed it use by date.



- Empty the contents of the bucket and check for any damage to the packaging.

- Pick up the foil bag containing the resin and hardener. Apply pressure to the large resin pouch so that the resin breaks the seal between the two sections and mixes with the hardener.

- Mix the contents of the bag by kneading the foil bag for at least two minutes.

- Carefully cut one of the corners off the foil bag and pour all the contents into the supplied plastic bucket.

- Pour approximately half of the sand supplied in the plastic bag into the bucket and stir until it is thoroughly mixed into the resin.

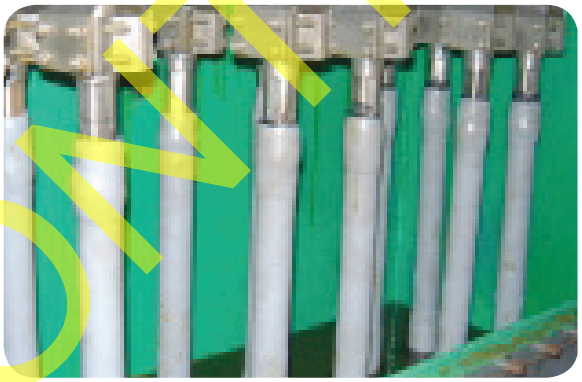
- Pour the rest of the sand into the bucket and mix until no raw sand is visible and the resin has no lumps in it.

- Pour the mixed resin into the joint shell.

4.8 Mixing and Installing Guruflex

- Guruflex is a cold pour replacement for bitumen compound. Use it in switchgear end boxes where the clearances are too small to allow the use of cold applied or heatshrink bushing boots.
- Guruflex comes in two metal tins; the larger one is the resin and the smaller one the hardener.

- Before filling the cable box, the inner metallic surface shall be coated with a thin film of petroleum jelly. This makes it easier to remove the Guruflex, if and when it needs to be removed.



- Open both tins and pour the small tin into the large one.
- Mix the two liquids together until they are a uniform light blue colour with no streaks of dark blue.
- Pour the mixture into the box to be filled and leave to cure.
- The box can be energised as soon as it is sealed.

4.9 Removing Guruflex

- Remove the cable box covers.
- Cut the Guruflex out with a sharp knife, taking care not to damage the termination inside.
- The Guruflex should pull away easily from the metallic surfaces that have been previously coated with petroleum jelly.