Prepare terminations of cable ends

Objectives : At the end of this exercise you shall be able to
- **prepare a loop termination**
- **prepare the cable end of fine multistranded wire**
- **identify the connecting parts of the socket of an appliance and connect it to cable with earth contact**
- **connect the appliance to the cable with earth contact**
- **identify the connecting parts of a 3-pole (plug) pin and connect the cable.**

Scan the QR Code to view the video for this exercise

Requirements

Tools/Instruments

- Steel rule 300 mm - 1 No.
- Electrician's knife 100 mm - 1 No.
- Wire stripper (manual) 150 mm - 1 No.
- Combination pliers 200 mm - 1 No.
- Screwdriver 100/150 mm x 4 mm - 1 No.
- Screwdriver 100 mm x 2 mm - 1 No.
- Long round nose pliers 150 mm - 1 No.
- Side cutting pliers 150 mm - 1 No.

Materials

- Pieces of 250 to 300 mm long aluminium and copper - asreqd.
- Single conductor cable 1.5 sq.mm - asreqd.
- Single conductor cable 2.5 sq. mm - asreqd.
- Bare copper wire No.10 SWG - small pieces 300 mm long or as available.
- Multistrand cable 14/0.2 mm - small pieces 300 mm long or as available. - asreqd.
- Multistrand cable 23/0.2 mm - asreqd.
- Multistrand cable 48/0.2 mm - 2 Nos.
- Single pole plug (double banana plug) 4 mm screw type connection - 4 Nos.
- Crocodile clips insulated 2A and 6A, 250 V - 2 Nos.
- Test lamp with bulb 40 W, 240 V - 1 No.
- PVC cable 3-core copper 23/0.2 mm - 5 m
- Socket 2-pole with earthing contact 6A, 250 V grade - each of different rating and make - 4 pairs
- Plug 2-pole with earthing contact - 4 pairs
- Socket 2-pole with earthing contact 6A - 5 Nos.
- PVC Cable 3-core 48/0.2 mm - 3.5 m
- Plug 3-Pole 6A, 250 V different makes - 2 Nos.
- Plug 3-Pole 16 A, 250 V different makes - 2 Nos.
- Metal clad plug 2-pin with earth 20A - 2 Nos.

PROCEDURE

TASK 1: **Preparation of loop termination (Solid conductor)**

1 Collect a single conductor cable of 1.5 sq.mm (copper) about 250 to 300 mm long from scrap.

2 Mark on the insulation the length 'L' from the cable end. The length 'L' is five times the diameter of the terminal screw. (Fig 1)

3 Skin the insulation over the length 'L'. (Fig 1)

4 Grip the bare conductor with the round nose pliers as shown in Fig 2.

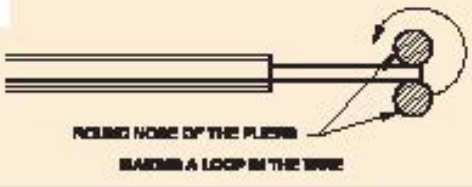
The diameter of the jaw at the gripping point of the round nose pliers is little more than the terminal screw diameter.

5 Turn the firmly gripped nose pliers to form the required loop. (Fig 3)

6 Finally set the loops with the nose pliers as shown in Fig 4.

Fig 1

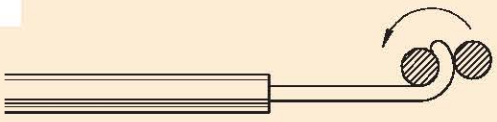
Fig 2



The hook (loop) should go at least about three quarters of the way around the screw.

Check the inner diameter of the loop with the terminal screw.

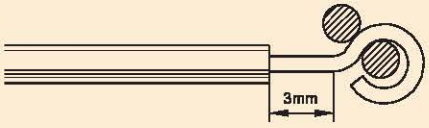
Fig 3



MAKING A LOOP IN THE WIRE

ELN1324H7

Fig 4



MAKING A LOOP IN THE WIRE

ELN1324H8

Never make the hook long as the conductor may overlap.

Keep the length of the exposed conductor to the minimum, not more than 3 mm, to prevent accidental contact with other wires. (Fig 4)

7 Repeat the task for 2.5 sq.mm copper single conductor cable.

8 Repeat the task for aluminium cable single conductor of 1.5 sq. mm and 2.5 sq. mm.

9 Repeat the task for bare copper wire of 10 SWG and other available sizes.

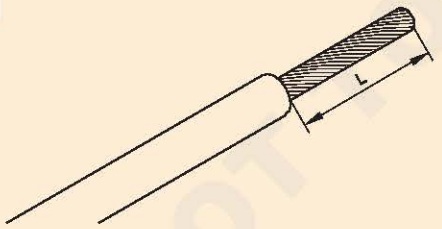
Preparing a fine multistrand cable end for termination to screw-on terminal of terminal blocks

10 Collect a piece of fine multistrand flexible copper cable, of size 14/0.2 mm.

11 Mark the length 'L' from the end of cable. Length 'L' is equal to five times the diameter of the terminal screw.

12 Remove the insulation to the length 'L' (Fig 5) using a pair of wire stripping pliers.

Fig 5

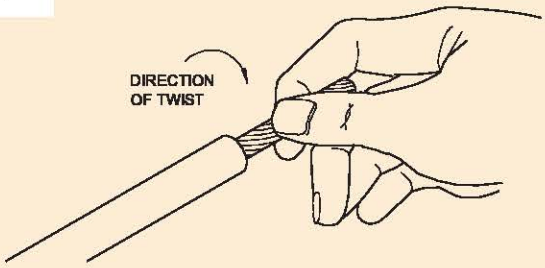


MULTI STRAND CABLE

ELN1324-I9

13 Retwist the bared strands in the same direction with your fingers. (Fig 6) Note, that the strands are twisted in the wire in a certain direction.

Fig 6

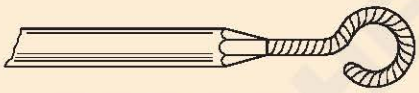


TWISTING THE MULTI-STRAND CABLE CORE

ELN1324-HA

14 Loop in fine multistrand conductor. (Fig 7)

Fig 7

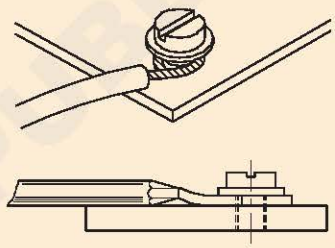


LOOP IN FINE MULTI-STRAND CONDUCTOR

ELN1324-I2

15 Make termination in screw on terminal. (Fig 8)

Fig 8

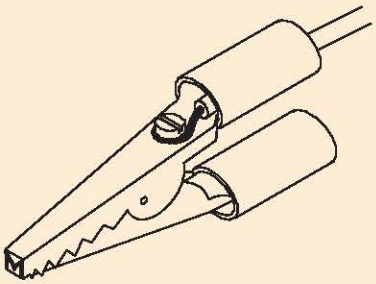


TERMINATION IN SCREW ON TERMINAL

ELN1324H3

16 Repeat the task for terminating flexible cable end on crocodile clips. (Fig 9)

Fig 9



ELN1324-IB

Practice on skinning, twisting and crimping

Scan the QR Code to view the video for this exercise

Objectives : At the end of this exercise you shall be able to
- **skin the cable insulation using the electrician's knife**
- **skin the cable insulation using manual stripper**
- **skin the cable insulation using auto-stripper**
- **practice on making a straight twist joint**
- **prepare termination of cable lugs using crimping tool.**

Requirements

Tools/Instruments

- Electrician tool kit - 1 No.
- Electrician's knife 100 mm blade - 1 No.
- Wire stripper, manual 200 mm - 1 No.
- Wire stripper auto–eject 150 mm - 1 No.
- Combination pliers 150 or 200 mm - 1 No.
- Steel rule 300 mm - 1 No.
- Diagonal cutter or side cutting pliers 150 mm - 1 No.

Materials

Aluminium cables of the following sizes:
- PVC single strand cable 1/1.4, 1.5 sq. mm - 3 m
- PVC single strand aluminium cable 1/1.8, 2.5sq. mm - 3 m

Flexible cables with copper conductor of size:
- PVC cable 14/0.2 mm - 3 m
- PVC cable 23/0.2 mm - 3 m
- PVC cable 48/0.2 mm - 3 m
- PVC cable 80/0.2 mm - 3 m
- PVC cable 128/0.2 mm - 3 m
- PVC cable, PVC sheathed cable – assorted small pieces - as reqd

PROCEDURE

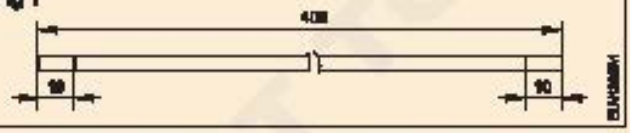
TASK 1 : **Skinning cable insulation using the electrician's knife**

1 Mark the length of the 1.5 sq. mm cable at 400 mm from its end.

2 Cut the cable using combination pliers on the mark.

3 Mark the length of insulation to be skinned from either end. (Fig 1)

Fig 1



4 Check the sharpness of the knife blade and re-sharpen, if necessary.

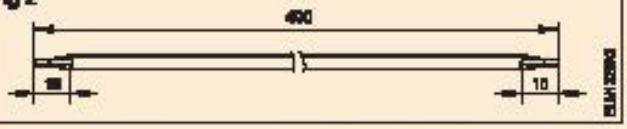
Use an oilstone to sharpen the knife's blade.

Visible thickness at the cutting edge of the knife blade indicates a blunt edge. In the case of a sharp edge, the thickness or end will not be visible.

5 Remove the insulation of the cable for about 10 mm at the ends using a knife. (Fig 2) Keep the knife blade at an angle less than 20° to the cable.

6 Check for nicking over the conductor. Also check if the cable is not shaved.

Fig 2



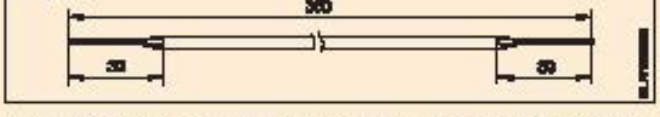
7 Clean the surface of the bare conductor and show it to the instructor.

8 Cut the cable at 12 mm from either end using a combination plier.

9 Repeat steps No. 5 to No. 8, until the cable is of 350 mm length

10 Mark the insulation that is to be removed as in Fig 3 and repeat steps 5 and 6.

Fig 3



11 Repeat the skinning of cable insulation of 2.5 sq. mm, 14/0.2 mm, 23/0.2 mm, 48/0.2 mm, 80/0.2 mm and 128/0.2 mm flexible cables.

The length of the cable after skinning both the ends shall be suitable for termination using crimping and screw.

12 The length of the finished skinned cable should be 300, 500, 600, 800, 1000 mm.

These cable pieces are to be used for later exercises.

In the case of flexible stranded cables to ensure that the strands are not cut is essental.

TASK 2**: Skinning cable insulation using a manual stripper**

1 Mark the length of the cable to be trimmed off.

2 Trim the cable at the mark using a combination plier diagonal cutter.

3 Straighten the ends where the insulation is to be skinned.

4 Mark the point where the insulation is to be skinned.

5 Adjust the jaws of the manual stripper and set them to suit the cable conductor.

6 Set the jaws at the mark, press the handle of the stripper and turn to cut the insulation.

Do not nick the conductor. For better practice try on a small waste piece.

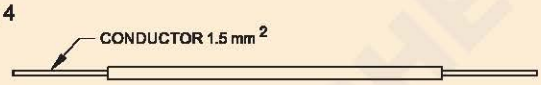
7 Pull the stripper to remove the insulation.

Partially cut insulation can be removed only with more force. Excessive force, indicates improper cutting of insulation.

8 Repeat the skinning of insulation for 10 mm to develop skill in the use of the wire stripper.

9 Remove insulation to the required extent at the ends as per Fig 4.

Fig 4



10 Be careful with flexible cables to ensure that you do not nick even a single strand.

TASK 3 **: Skinning cable insulations using auto-stripper**

1 Mark the length of the insulation to be removed from the ends.

2 Straighten the cable ends.

3 Select a proper set of stripper.

4 Locate the jaws of the stripper exactly on the mark.

5 Press the stripper.

Further pressing may damage the insulation from the cable end, that is also to be removed.

6 Check that the cable conductor is not nicked.

7 Repeat steps No 1 to 7 for different sizes of cables.

Skill sequence

Hand tools for skinning - knife

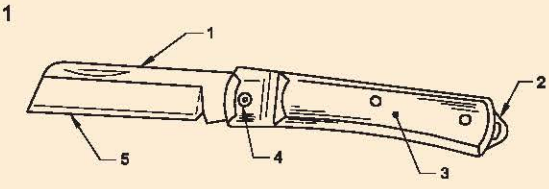
Objectives : This shall help you to
- **identify the parts of the knife used for skinning**
- **perform care and maintenance in using the knife.**

The most frequently used tool for skinning is the knife

A knife may have a single or double blade. A single blade knife is the most commonly used one. (Fig 1)

- back of the blade
- hanger
- haft
- hinge pin
- blade

Fig 1

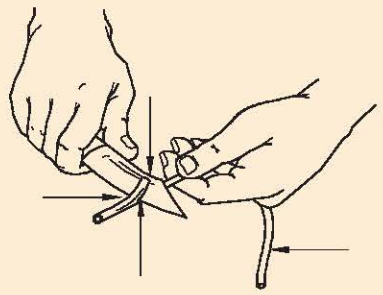


Be careful while using the knife.

Always cut keeping the object to be cut away from your body.

Slice the insulation at an angle of approximately 15° to avoid cutting into the conductor. (Fig 2)

Fig 2



ELN132552

Knives should not be used to remove insulation on very fine single or stranded conductors.

Knives should not be used to cut conductors.

Hand tools for skinning - manual wire stripper

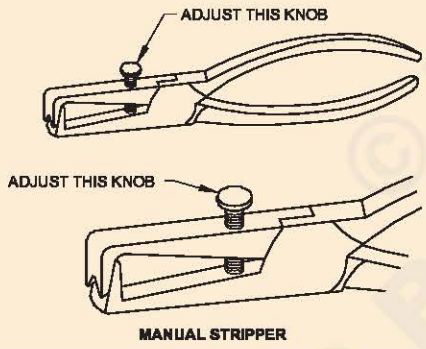
Objectives: This shall help you to
- **identify the parts of the manual wire stripper**
- **perform care and maintenance of manual wire stripper.**

Hand operated wire stripping tools can be used to remove P.V.C. or rubber insulation from a single core cable without damaging the conductor. They are of two types manual and auto-eject.

Manual wire stripper: The jaws have V shaped notches to cut the insulation.

The adjuster screw allows to cut a wide range of wire diameters. (Figs 1 and 2).

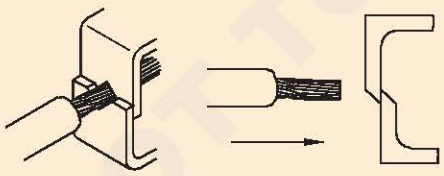
Fig 1



MANUAL STRIPPER

ELN1325C1

Fig 2



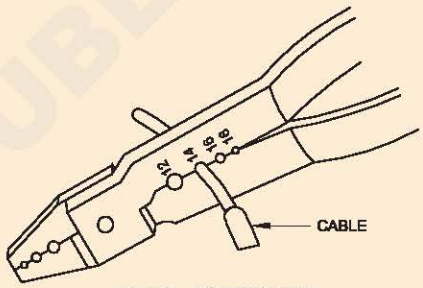
MANUAL STRIPPER

ELN1325C2

Often one cutter becomes sharper than the other, and cuts more than halfway through the wires, damaging the conductors. In such an event, the blunt cutter should be sharpened.

Fig 3 shows manual wire stripper.

Fig 3



MANUAL WIRE STRIPPER

ELN1325C3

This tool has a series of sharp openings in its scissor blade to allow stripping of wire in gauge of different sizes or diameters. The gauge size of the wire must match with the opening in the wire stripper to prevent cutting into the wire and weakening it.

Precautions:

- **When using this tool, make sure that it is correctly adjusted before trying to strip the insulation from the cable so that it does not damage the conductor.**
- **Do not use this tool to cut metallic conductors.**

Hand tools for skinning - auto-eject stripper

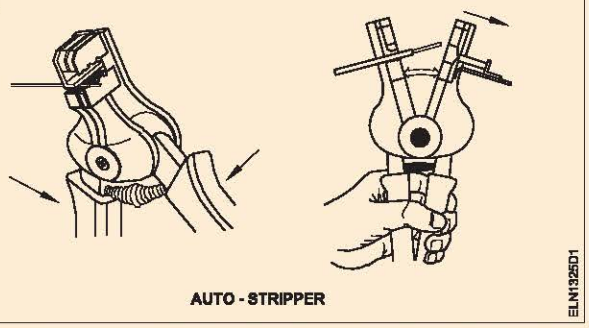
Objectives: This shall help you to
- **identify an auto-eject stripper**
- **take care while using an auto-eject stripper.**

Auto-eject strippers are used to cut the insulation from electrical wire without damaging the wire strands. They remove the insulation automatically. (Fig 1)

This stripper has two sets of jaws: one set grips the insulation while the other set has cutting edges.

When the handles are apart, both sets of jaws are open. (Fig 2)

Fig 1



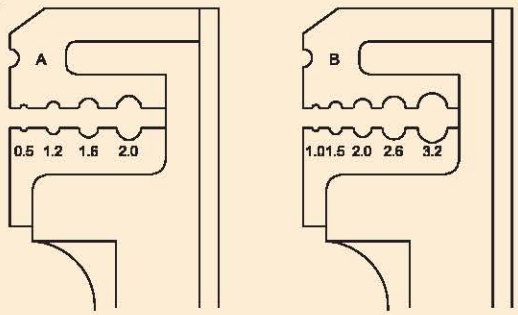
AUTO - STRIPPER

ELN1325D1

This stripper operates automatically when the correct position on the blade matching the diameter of conductor in mm is selected, and the handles are compressed together.

In an auto-eject stripper, we can select different blade sizes to match different sizes of conductors.

Fig 2



JAWS OF AN AUTO STRIPPER

ELN1325D2

Precautions: While using this stripper the cable insulation should be put in the proper slot to avoid damage to the conductor.

Sub Exercise (S.Ex.) 1.2.18 - 1

Prepare termination of cable lugs by using crimping tool

Objectives: At the end of this exercise you shall be able to

- **skin the cable end**
- **select the pressure terminal (compression connector) that suits the size of the wire and that of the terminal**
- **select the pressure pliers that match the size of the pressure terminal**
- **use the crimping tool to crimp the lugs at the cable end.**
- **use an eyelet crimping plier for eyelet termination.**

Requirements

Tools/Instruments

- Pressure pliers 200 mm - 1 No.
- Electrician's knife 100 mm - 1 No.
- Wire stripper (manual) 200 mm - 1 No.
- Combination pliers 200 mm - 1 No.
- Crimping pliers 150/200 mm - 1 No.
- Wire stripper auto-eject 200 mm - 1 No.
- Steel rule 300 mm - 1 No.
- Side cutting pliers 150 mm - 1 No.
- Eyelet closing pliers 200 mm with eyelets having inner diameter of 3,4,5,6,7 mm. - 1 No.

Materials

- Crimping eyelet, eye hole dia. 6 mm - 12 Nos.
- Crimping ferrule 4 mm,10 mm long - 6 Nos.
- Crimping spade lug 6A - 6 Nos.
- Crimping spade lug 10A - 6 Nos.
- Crimping spade lug 16A - 2 Nos.
- Conducting paste - 1 tube

PROCEDURE

TASK 1 **: Crimping of lug connector**

1 Collect the cable (fine multistrand copper conductor).

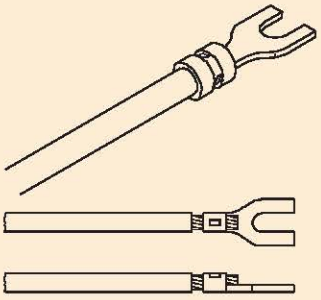
2 Collect the spade connector suitable for the wire thickness and terminal size of 6 mm diameter (Fig 1).

3 Select the wire stripper blade size to match the wires thickness (auto-eject) or adjust the jaws of the stripper. (Fig 2)

4 Strip a length of insulation that suits the terminal size (spade connector) (Fig 3)

Be sure not to cut or damage the wire core.

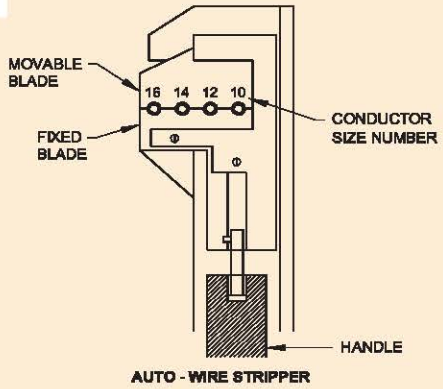
Fig 1



CRIMPED ON SPADE CONNECTOR

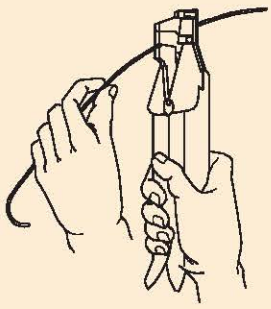
ELN1325G1

Fig 2



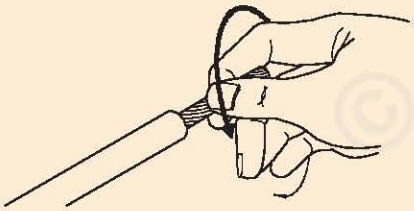
AUTO - WIRE STRIPPER

Fig 3



5 Twist the strands of the wire lightly in the direction of strands. (Fig 4)

Fig 4

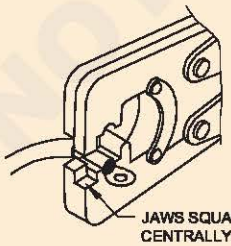


6 Select the crimping pliers that matches the terminal size.

7 Clamp the spade connector with the crimping pliers with the matching position of jaws.

8 Insert the wire far enough in the compression connector. (Fig 5)

Fig 5



Do not clamp the insulation in the terminal. (Fig 6)

Strands must not stick out of the connector. (Fig 7)

Fig 6

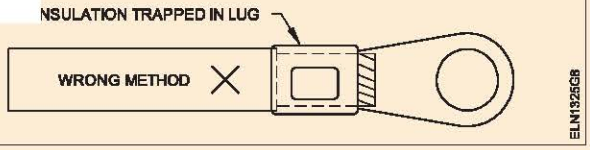
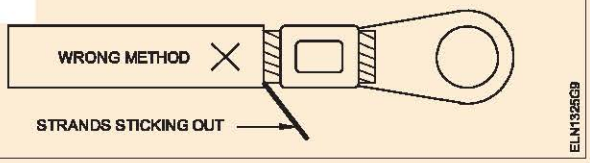


Fig 7



Do not strip too much insulation. (Fig 8)

Adjust the length of the wire so that it does not interfere with the terminal hole. (Fig 9)

Fig 8

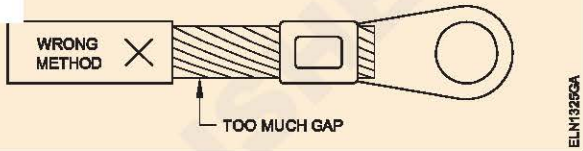
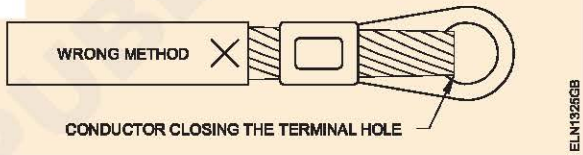


Fig 9

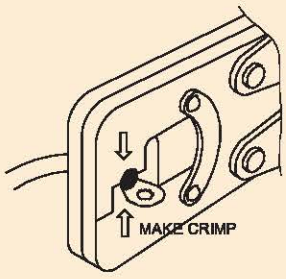


9 Apply light pressure to create a light impression on the compression connector.

10 Check whether the press is located in the middle of the band of compression connector and, if necessary, make final adjustment.

11 Apply sufficient pressure in the handle to press the compression connector fully, as shown in Fig 10.

Fig 10



12 Check whether the prepared compression/crimping joint is firm by pulling the cable and compression connector.

13 Repeat the crimping of compression in the connectors of various sizes of copper and aluminium conductors of different lengths.

Trim the appropriate length of the skinned cable ends to suit the compression connectors.

TASK 2: **Crimping an eyelet**

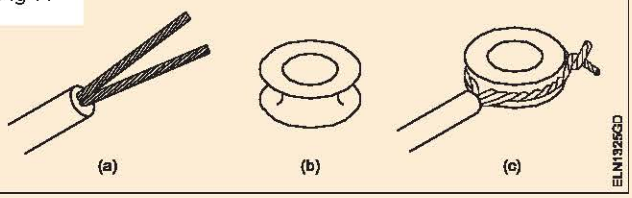
1 Collect the multistrand cable.

2 Split the number of strands into two equal parts and twist them. (Fig 11a)

3 Collect the eyelet. (Fig 11b)

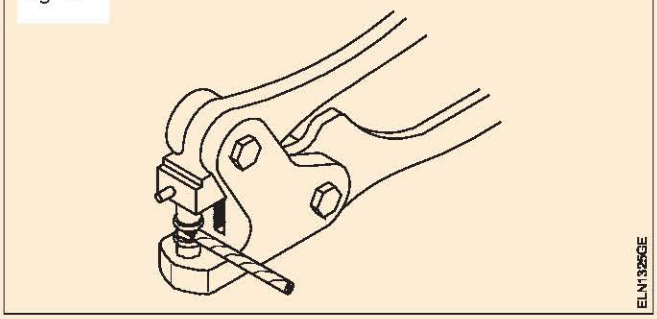
4 Fix the eyelet by placing the eyelet between the grouped strands close to the insulation and twist the free ends of the strands as shown in Fig 11c.

Fig 11



The eyelet is then pressed on to the wire end by the two formers of the eyelet closing pliers. (Fig 12)

Fig 12



5 Trim the excess length of the multi-strand wire after closing the eyelet using side-cutting pliers.

6 Repeat the exercise with different sizes of eyelets for cable end termination.

7 Get it checked by your instructor.

TASK 3**: Practice on twisting of single strand wires**

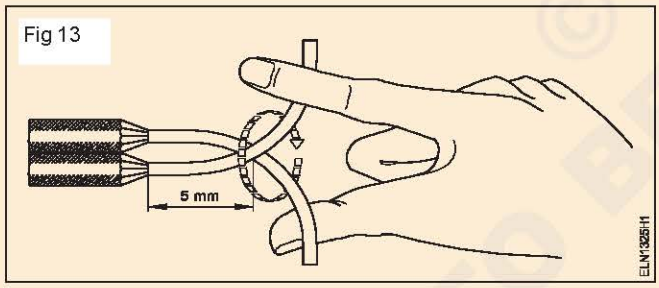
1 Take 300 mm of 1/1.5 mm^2 aluminium wire, or 1/1.2 mm P.V.C copper cable.

2 Cut it into two pieces of 150 mm each.

3 Remove the insulation of 50 mm in each piece by using stripper and clean it with cotton cloth.

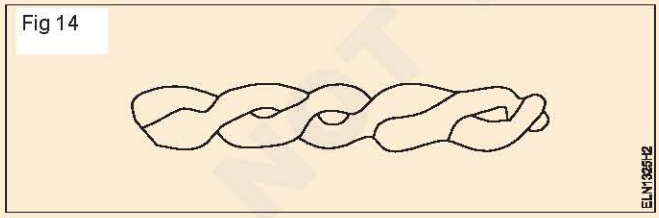
4 Cross the bare wires at 45° and at a distance of 45 mm from the cable end. (Fig 13)

Fig 13



5 Twist the ends tightly at least 6-8 twists. (Fig 14)

Fig 14



While twisting 2 wires together avoid gaps between the twists. If it twisted with gap, it will trigger sparks and overheat as shown in Fig 14.

6 Finish twisting the wires as shown in figure 15 & 16.

7 Get it checked by your instructor.

Fig 15

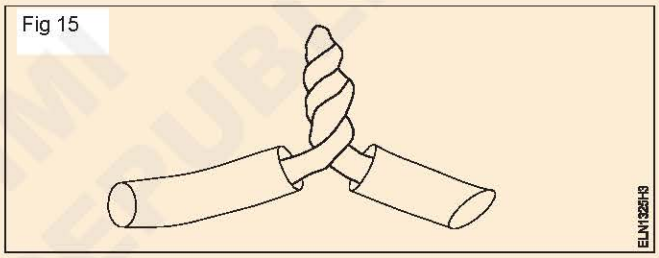
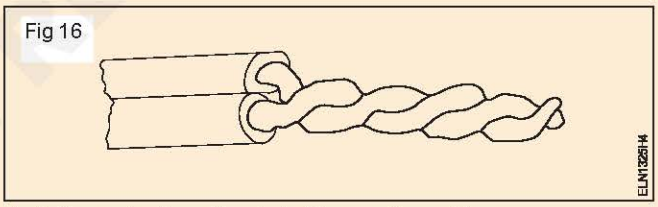


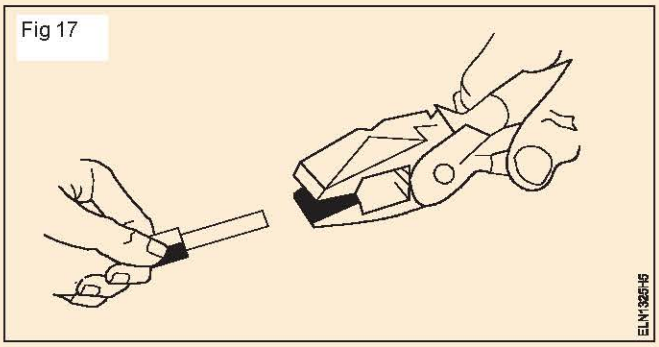
Fig 16



Joining of wires by twisting using plier

8 Hold wires together near the plier. (Fig 17)

Fig 17



9 Grab both the copper ends with pliers.

10 Rotate your wrist while using pressure on pliers.

When joining three large wires, strip the insulation more.

Identify various types of cables and measure conductor size using SWG and micrometer

Objectives: At the end of this exercise you shall be able to
- **identify types of wires and cables**
- **verify their specifications referring to the data book**
- **measure wire sizes using SWG**
- **measure wire size using micrometers.**

Requirements

Tools / Instruments

- Standard Wire Gauge (SWG 0-36) - 1 No.
- Micrometer (0-25) - 1 No.
- Electrician's knife - 1 No.
- Manual wire stripper 150 mm - 1 No.
- Combination pliers 150 mm - 1 No.

Materials

- Wires (assorted size) - as required.
- Cables (underground armoured and unarmoured cable) - as required.
- Wire/ cable specification data book - 1 No.

PROCEDURE

TASK 1: **Identify types of wires and cables**

The instructor will arrange and provide the various types of cable and wire pieces (assorted sizes) on the table and label them with alphabets and explain them to trainees on, how to identify the types of insulation, conductors, size of wires. Demonstrate how to measure the size of wires using SWG and micrometer.

1 Take any one wire from the table, note down its aplhabet in Table 1.

2 Identify the type of insulation, type of conductor material and size of wires. Note it down in Table 1.

3 Take at least five different types of wires and repeat steps 1 and 2 Note down the details in Table 1.

4 Verify the specifications of the wires by referring with the data book.

5 Take any one cable from the table, note down its alphabet.

6 Identify the type of cable (unarmoured and armoured cable) and note down in Table 1.

7 Identify the type of insulation, core and record in Table 1.

8 Verify the specifications of the cable by referring with the data book.

9 Repeat steps 1 to 8 for various wires and note the data in Table 1.

Table 1

Sl. No.	Alphabet	Type of insulation	Type of conductor material	Type of cable		Type of core single/3/3½	Core size in mm
				Armoured	Unarmoured		
1	A						
2	B						
3	C						
4	D						
5	E						

TASK 2: **Measuring the wire sizes by SWG in gauge number**

1 Skin the insulation of the cable.

Exercise care to prevent from nicking.

2 Clean the surface of the wire with a cotton cloth. Remove insulation particles and any adhesive coating from the surface of the conductor.

Do not use abrasives to clean the conductor. Use of abrasive material, reduces the size of the conductor.

3 Straighten the end of the conductor to be measured.

Do not straighten conductors by directly using hand tools on them.

4 Insert the conductor in the slot of the wire gauge and determine its close fit. (Fig 1)

5 Read the marking at the slot, Fig 2. It gives the wire size in SWG. The other side will give you the diameter. of the wire in mm.

6 Record the measured size in the notebook.

Fig 1

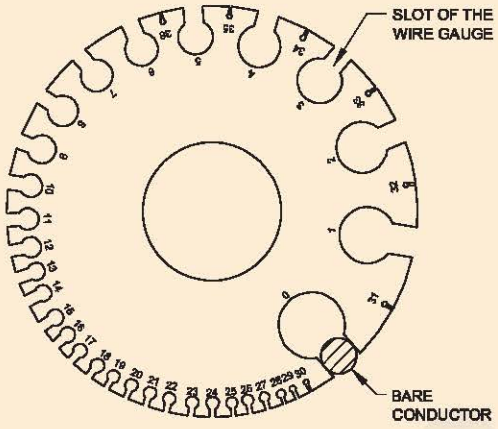
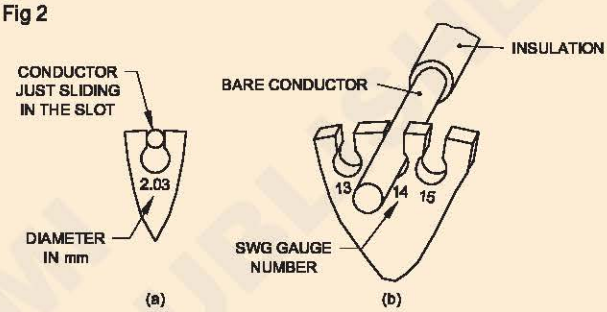


Fig 2



TASK 3: **Measuring the wire size, using micrometer**

1 Repeat steps 1-3 of TASK 2.

2 Check the micrometer for zero error by operating the spindle.

3 Record the error value with the sign- +ve or –ve.

4 Place the cleaned, straight portion of the conductor between the jaws (anvil and spindle) of the micrometer. (Fig 3)

5 Close the spindle of the micrometer by turning the thimble.

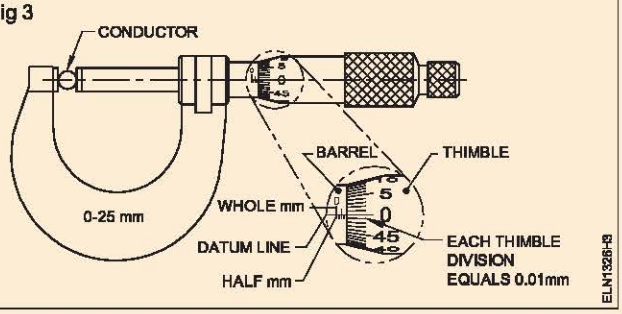
Use the ratchet drive to avoid overtightening.

6 Read and record the diameter in the notebook after computing zero error.

7 Refer to the conversion table which is available with the instructor to get the size of the conductor in the standard wire gauge.

8 Repeat the steps to find the measurement for the given cables.

Fig 3



Make simple twist, married, Tee and western union joints

Objectives : At the end of this exercise you shall be able to
- **mark the length of the insulation to be removed**
- **skin the insulation**
- **prepare simple twist joint**
- **prepare married joint in stranded conductor**
- **prepare 'T' joint in multistranded conductor**
- **prepare western union joint in bare conductor.**

Scan the QR Code to view the video for this exercise

Requirements

Tools/Instruments

- Electrician's knife with two folding steel blades of 75 mm and 100 mm - 1 No.
- stainless steel rule 300 mm, with graduations on either edge cm/mm and inches - 1 No.
- Diagonal cutting pliers 150 mm with 660 volts grade insulated handle suitable for cutting hard wires - 1 No.
- Combination pliers 200 mm with 660 volts grade insulated handles with pipe grip, side cutter and two joint cutters - 1 No.
- Wooden mallet 75 mm - 1 No.
- Flat file - bastard 250 mm - 1 No.
- Hard vice 58 mm - 1 No.

Materials

- PVC insulated copper cable 1/1.12 - 2 m.
- PVC insulated aluminium cable 1/1.40 - 2 m.
- Cotton cloth 30 cm square - 1 No.
- Sandpaper `OO'(smooth) - 1 sheet
- PVC insulated copper cable 7/0.914/600V - 1 m.
- PVC insulated copper cable 3/0.914/250V - 1 m.
- Bare copper wire 4 mm 30 cm - 2 Nos.
- GI wire 4 mm 30 cm - 2 Nos.
- Sand Paper 'O' grade - 1 sheet

PROCEDURE

TASK 1: **Make simple (straight) twist joint as shown in Fig 1**

Fig 1

1 Collect 2 pieces of 1/1.12 PVC copper cable of 0.5 m length.

2 Straighten the cables.

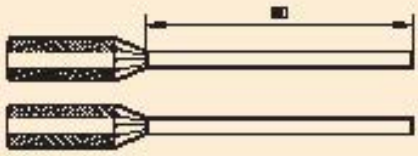
3 Mark 80 mm length on one end of each piece of the cable.

4 Use the knife at 20° as shown in Fig 2.

Fig 2

5 Remove the insulation from each conductor for a length of 80 mm. (Fig 3)

Fig 3



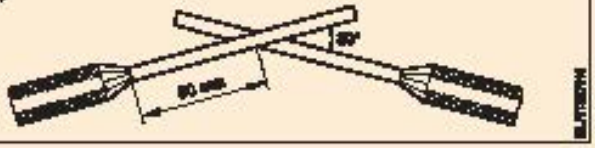
Avoid nicks in the conductor.

6 Clean the ends with the help of a cotton cloth.

Use smooth sandpaper, if necessary, to clean the conductor.

7 Place the conductors together, about 50 mm from the ends. (Fig 4)

Fig 4



8 Twist them tightly around each other in the opposite directions. (Fig 1)

Pliers can be used to just grip the crossed conductors.

Each side should contain about 6 turns.

Each turn of the conductor should closely fit to the adjacent turn.

9 Cut the excess length of the conductor using side cutters.

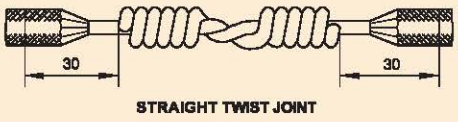
10 Press the sharp edge of the conductor end and smoothen it.

Soldering the joint and insulating it with tape should be completed before putting the jointed cable in use.

11 Show the joint to your instructor.

12 Cut the joint after leaving 30 mm cable from the joint. (Fig 5)

Fig 5



13 Repeat steps 3 to 9 and make at least 4 more joints for practice, using the remaining cable.

TASK 2: **Prepare married joint in 7/0.914 stranded conductors as shown in Fig 1**

Fig 1

1 Collect 2 pieces of PVC sheathed copper cable 7/0.914 0.5 metre in leagth.

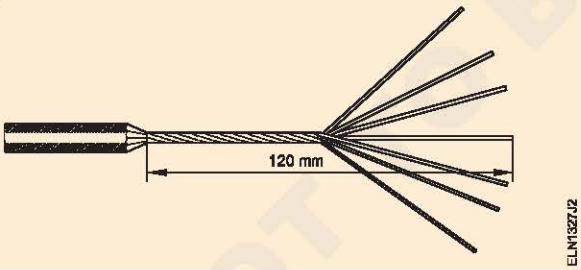
2 Mark both the the cables at 120 mm from the cable ends.

3 Remove the insulation for 120 mm on both the cables.

Carefully remove the insulation. Do not nick or shave the conductor.

4 Open the strands, clean the wires, and re-twist the strands in the original direction up to 50 mm from the cable insulation. (Fig 2)

Fig 2



5 Cut the centre strand of both the cables close to the twist (about 70 mm from the free end).

6 Bind on the twisted part of one cable end as shown in Fig 3.

7 Interlace the strands keeping the centres butt. (Fig 4)

Fig 3

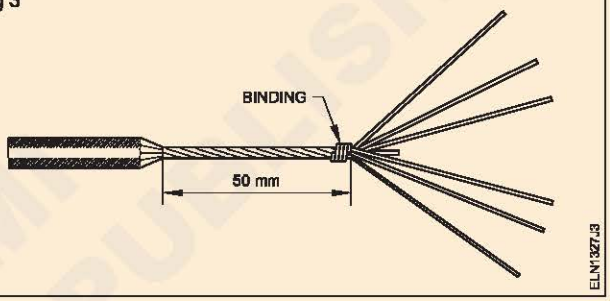
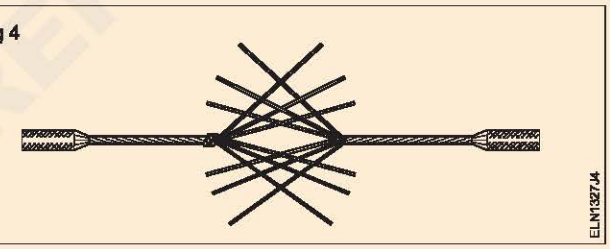


Fig 4



8 Hold the cable end (that is without the binding) in one hand and twist the strands of the other cable end over it, one by one, closely and tightly. Each strand has to be twisted half a turn at a time.

The direction of twist to form the shoulder should be the same as that of the cable twist .

9 Remove the binding made in step 6.

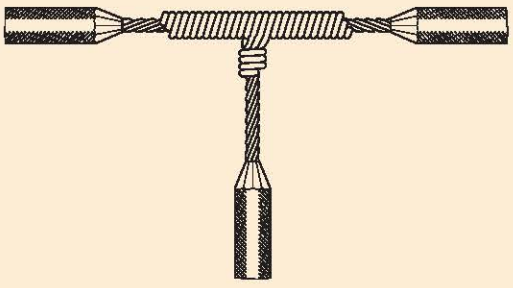
10 Repeat the operation as in step 8 on the other side with the 2nd cable end.

11 Complete the joint as shown in Fig 1 by rounding off the twisted strands with a mallet or pliers, and cut the excess wires.

TASK 3: **Prepare 'T' joint in multi-stranded conductor**

Fig 1 shows a completed Tee joint in strandard conductors.

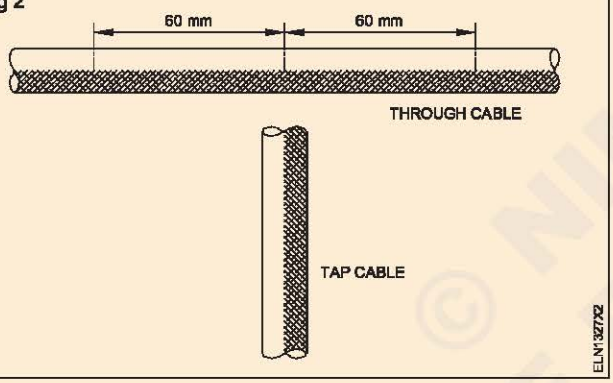
Fig 1



1 Collect two pieces of PVC insulated stranded copper cable 7/0.91. Indicate one piece as `through cable' and the other one as `tap cable'.

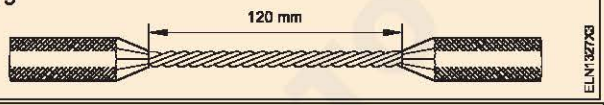
2 Mark the point of tap in the `through cable' and mark 60 mm on either side of the tap point for the insulation to be removed as shown in Fig 2.

Fig 2



3 Remove 60 mm insulation on either side of the `through cable' from the point of tap. (Fig 3)

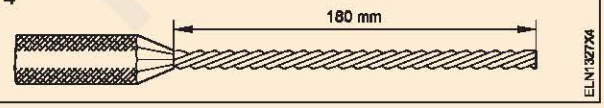
Fig 3



Do not nick or shave the conductor while removing insulation.

4 Remove the insulation for 180 mm at the end of the `tap cable'. (Fig 4)

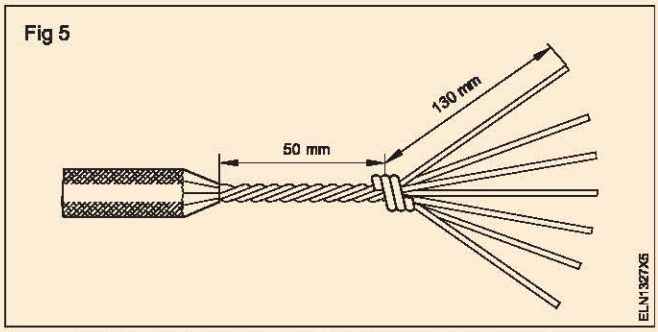
Fig 4



5 Open the strands of the `tap cable' and clean it. Use smooth `00' sandpaper, if necessary.

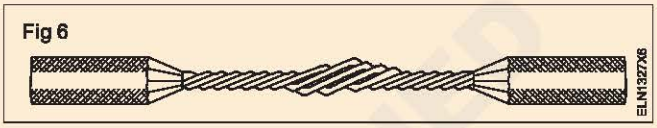
6 Re-twist the strands in the original direction up to 50 mm from insulation, and make a binding on the twisted part of the `tap cable' as shown in Fig 5.

Fig 5



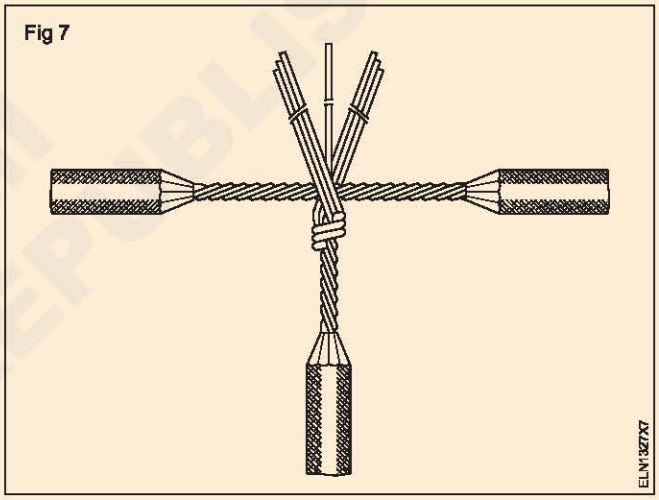
7 Untwist the `through cable' to provide opening at the point of tap. (Fig 6)

Fig 6



8 Insert the centre (middle) strand of the `tap cable' in the opening of the 'through cable' as shown in Fig 7.

Fig 7



9 Wrap 3 strands of the `tap cable' around the `through cable' on either side of the tap point to form shoulder on `through cable'.

10 Wrap the strands up to 50 mm to leave a 10 mm gap between insulation and shoulders (Fig 1) and trim the excess length of strands.

11 Remove the binding from the `tap cable', wrap the centre strand of the `tap cable' around the `through cable' and wrap it in the place of the binding. (Fig 1)

12 Round the ends with the combination pliers or mallet to avoid sharp edges of the strands.

13 Collect two pieces of PVC stranded aluminium cable 19/1.12, or 19/1.63, 500 mm long and repeat working steps 2 to 12.

With 19/1.2, 19/1.63 mm cable, 9 strands of the `tap cable' are to be wrapped on either side of the `through cable'. Insulation that has to be removed is 170 mm on the `through cable' and 250 mm on the `tap cable'.

TASK 4: **Prepare western union joint in bare conductor**

(A completed western union joint is shown in Fig 1)

Fig 1

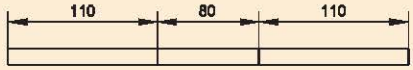
ELN132721

1 Collect two pieces of bare copper conductor of 4 mm diameter. and 30 cm long.

2 Straighten the conductor with a mallet.

3 Mark the conductor as shown in Fig 2.

Fig 2

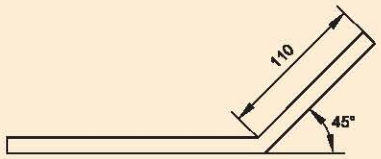


ELN132722

4 Clean both the conductors with `00' grade sandpaper to a length of 250 mm from one end.

5 Bend both the pieces of conductors at a distance of 110 mm from one end to 45° as shown in Fig 3.

Fig 3

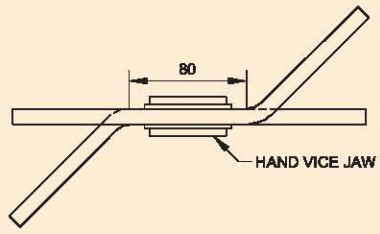


ELN132723

6 Hold the conductors in the hand vice as shown in Fig 4.

To avoid nicks on the conductors while gripping in a hand vice, always use soft materials like aluminium sheets between the jaws.

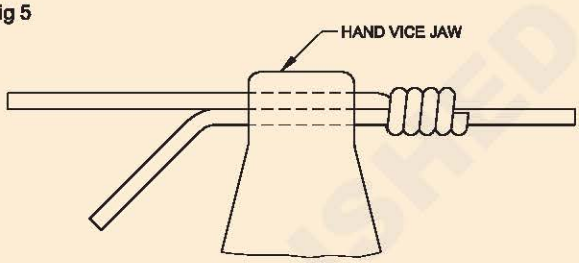
Fig 4



ELN132724

7 Wrap one conductor over the other conductor using combination pliers. Make at least 5 to 6 turns as shown in Fig 5.

Fig 5



ELN132725

8 Repeat the same procedure in the other end of the conductor, but wrap the conductor in the opposite direction.

9 Cut the surplus conductor ends with a diagonal cutter.

10 Use a mallet to mesh the ends with the straight conductor.

11 Smoothen the ends of the conductors with a flat file to avoid sharp edges.

12 Repeat the Western union joint with G.I. wire of diameter 4 mm.

Make britannia straight, britannia 'T' (Tee) and rat tail joints

Objectives : At the end of this exercise you shall be able to
- **make britannia straight joint in solid copper conductor**
- **make britannia 'T' (Tee) joint in solid copper conductor**
- **make rat tail joint.**

Requirements

Tools/Instruments

• Steel rule 300 mm	- 1 No.
• Diagonal cutting plier 150 mm	- 1 No.
• Combination plier 200 mm	- 1 No.
• Hand vice 50 mm jaw	- 1 No.
• Flat file bastard 200 mm	- 1 No.
• Wooden mallet 75 mm diameter.	- 1 No.

Materials

• Hard drawn bare copper wire 4 mm diameter 0.2 metre	- 4 Nos.
• Tinned copper wire of dia. 0.91 mm	- 4 m.
• Sandpaper `0 0'	- 1 sheet
• Cotton cloth 300 x 300 mm	- 1 No.
• PVC copper cable 1/1.2 mm 8.5 m	- 2 Nos.

PROCEDURE

TASK 1: **Make britannia straight joint**

(A completed brittannia 'T' joint is shown in Fig 1).

Fig 1

BRITANNIA TEE JOINT

ELN1328H1

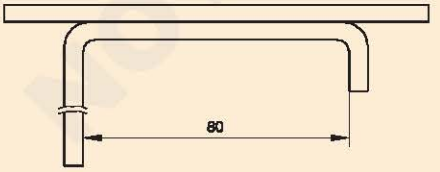
1 Collect two pieces of 4 mm diameter Hard Drawn Bare Copper (H.D.B.C) . wire, 0.2 m long.

2 Straighten the conductors using a mallet and clean it using fine sandpaper and cotton cloth.

Use the mallet to make the wires straight. The two pieces should be free from twists over the entire length of the joint.

3 Bend each piece at one end for about 20 mm length at 90° as shown in Fig 2.

Fig 2



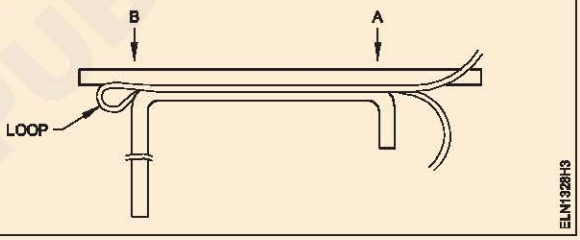
ELN1328H2

4 Collect the binding wire and straighten it without any kink.

5 Hold the two ends of the bare copper wire to be joined in the hand vice as shown in Fig 2.

6 Form a loop of binding wire leaving one end about 250 mm at the right side of the joint. Place the binding wire in the groove formed in between the main conductors as shown in Fig 3.

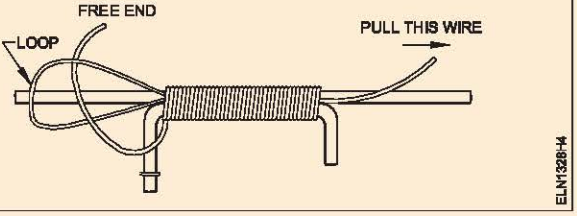
Fig 3



ELN1328H3

7 Start binding the wire tightly over the joint from position `A' and continue till position `B'. (Fig 4)

Fig 4



ELN1328H4

8 Insert the free end of the wire inside the loop as shown in Fig 4.

9 Grip the 250 mm loose end of the wire with a pair of pliers, and carefully pull it so that the loop and the free end of the wire go inside the joint.

10 Wrap the free end and the loose end over the conductors as shown in Fig 1.

11 Press the ends of the binding wire to the conductors with pliers .

12 Smooth the sharp edges of the protruding wire ends with a flat file.

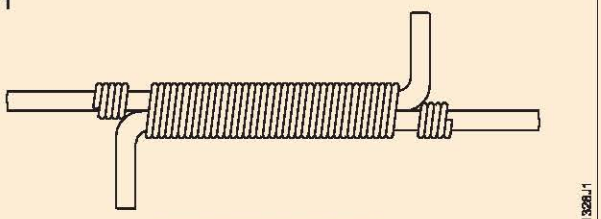
13 Repeat the above steps and make two or more joints to get more practice.

After completion thejointmust be soldered before putting it to use.

TASK 2: **Make britannia straight joint**

(A completed britannia `Tee' joint is shown in Fig 1.)

Fig 1

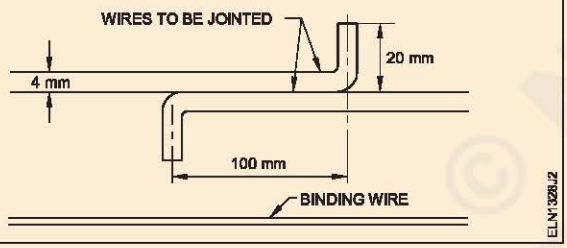


1 Collect two pieces of 4 mm diameter Hard Drawn Bare copper (H.D.B.C) 0.2 m long.

2 Straighten the conductors using a mallet and clean it with fine sandpaper and cotton cloth.

3 Bend and shape of one of the conductors according to the size shown in Fig 2, with the help of combination pliers.

Fig 2



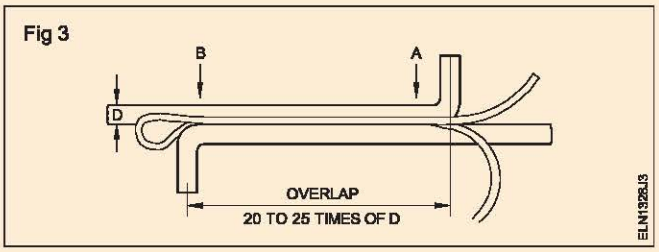
4 Straighten the (0.914 mm diameter.) binding wire.

5 Hold the two copper conductors to be joined with the help of a hand vice as shown in Fig 2 .

6 Form a loop of binding wire leaving one end about 250 mm at the right side of the joint. Place the binding wire in the groove formed between the conductors as shown in Fig 3.

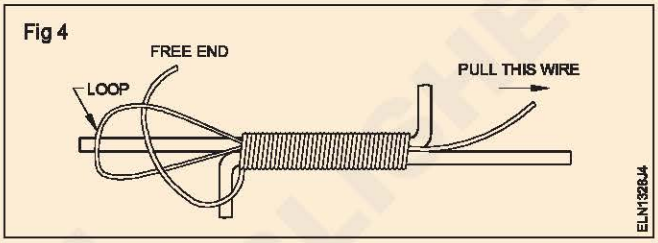
7 Start binding the wire tightly over the joint from position `A' and continue till the position `B'. (Fig 3)

Fig 3



8 Insert the free end of the wire inside the loop as shown in Fig 4.

Fig 4



9 Grip the 250 mm loose end of the wire with a plier, and carefully pull it so that the loop and the free end of the wire go inside the joint.

10 Wrap the free end and the loose end over the conductors as shown in Fig 1.

11 Press the ends of the binding wire to the conductors with plier.

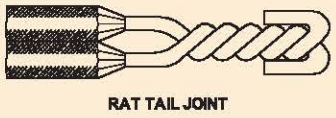
12 Smooth the sharp edges of the binding wire ends with a flat file.

13 Repeat the above procedure to make two or more joints to get more practice.

The joints need to be soldered before putting them into use.

TASK 3: **Make rat-tail joint** (Fig 1)

Fig 1



RAT TAIL JOINT

ELN1328X1

1 Collect 2 pieces of 1/1.2 mm PVC copper cable of 0.5 m length.

2 Straighten the cables.

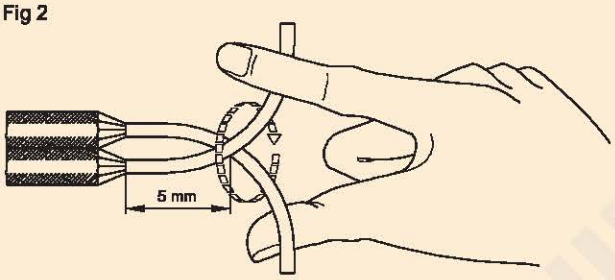
3 Skin both the cable ends for 50 mm.

4 Clean the conductor ends with the help of cotton cloth.

5 Cross the bare wires at of 45° and at a distance of 45 mm from the cable end.

6 Tightly twist the ends as shown in Fig 2.

Fig 2

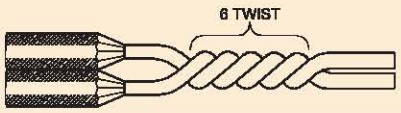


ELN1328X2

The twist on the wire should be uniform and close.

7 Make at least 6 twists. (Fig 3)

Fig 3



ELN1328X3

8 Fold the remaining wire back on the twists. (Fig 1)

9 Press the ends of the wire with the help of combination pliers (Fig 1) to avoid sharp ends, and cut the excess wire.

10 Repeat the steps.3 to 8 of TASK 3 for at least 4 more joints for practice, using the remaining cable.

Electrician - Wires, Joints, Soldering - U.G. Cables

Practice in Soldering of joints/lugs

Objectives: At the end ofthis exercise you shall be able to
- **solder the copper conductor joints using a soldering iron and rosin solder**
- **solder the lugs in copper conductor with the help of a blowlamp.**

Scan the QR Code to view the video for this exercise

Requirements

Tools/Instruments

- Electrician tool kit - 1 No.
- Combination piler 200 mm - 1 No.
- Electric soldering iron 125W, 250V, 50Hz - 1 No.
- Flat file bastard 250 mm - 1 No.
- Electrician's knife 100 mm - 1 No.
- Steel rule 300 mm - 1 No.
- Diagonal cutting plier 150 mm - 1 No.
- Blowlamp 1 litre capacity - 1 No.
- Tongs 300 mm - 1 No.
- Sheet steel tray 150 x 150 x 20 mm - 1 No.

Materials

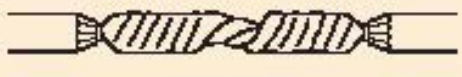
- Finished simple twist joint - 1 No.
- Sandpaper 'OO' grade - 9 Sq.cm
- Resin-cored solder - 25 gms
- VIR or PVC copper cable 7/1.06 mm or 7/0.914 - 250 mm long - 2 pieces
- Lug 30 amperes - 1 No.
- Resin flux - 10 gms.
- Solder stick 60/40 - 100 gms.
- Matchbox - 1 No.
- Cotton tape or cloth - as required.
- Sandpaper `O' grade - 9 sq. cm.
- Blowlamp pin - 1 No.
- Kerosene - 1 litr.

PROCEDURE

TASK 1: **Solder the copper joints**

(A finished soldered joint will look like Fig 1)

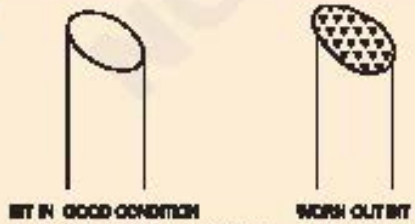
Fig 1



1 Select a 60W, 240V AC 50 Hz. soldering iron and check that the iron has no physical damage, the body is well insulated from the element and is of the correct voltage and power rating.

2 Check the bit (Fig 2) to see whether the surface is smooth and clean.

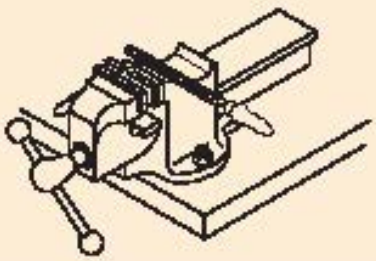
Fig 2



3 If found corroded, file the tip with a flat file, so that the surface is smooth and clean. (Fig 3)

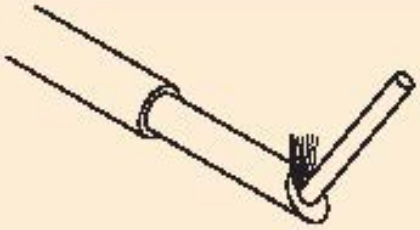
4 Connect the soldering iron to the supply and switch it `ON'.

Fig 3



5 When the bit becomes sufficiently hot, apply a small quantity of rosin-cored solder, and tin the bit. (Fig 4)

Fig 4

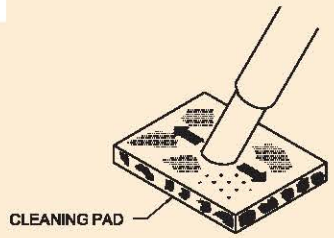


If the bit is not completely and evenly covered with solder, clean and tin it again.

Never flick excess solder off the bit. The hot solder may cause burns to someone or fall on the work and cause a short circuit.

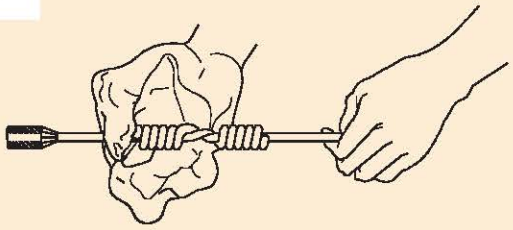
6 Wipe the bit gently on the cleaning pad to remove excess solder as shown in Fig 5.

Fig 5



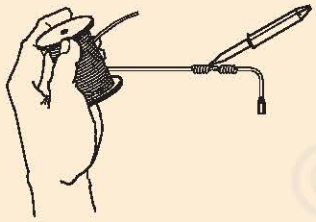
7 Clean the joint to be soldered with the help of sandpaper `0 0', grade as shown in Fig 6, and wipe the dust with a wire brush.

Fig 6



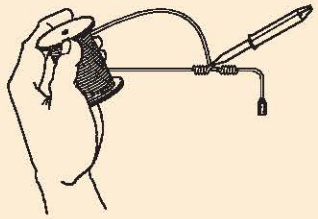
8 Keep the soldering iron bit on the joint and heat it for soldering as shown in Fig 7.

Fig 7



9 Keep the rosin-cored solder on the wire joint and allow it to melt as shown in Fig 8.

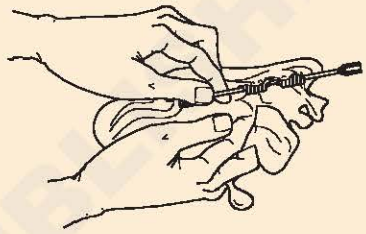
Fig 8



10 Melt the solder with the heat of the bit and make sure that the solder flows freely and evenly on the joint.

11 Remove the soldering iron. use cotton cloth to wipe off the excess solder from the surface of the joint when it is still hot as shown in Fig 9.

Fig 9



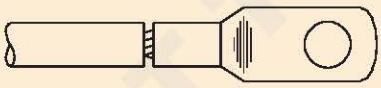
12 Allow the joint to cool naturally. Do not blow air for cooling.

A shining solder surface indicates good soldering. Do not move the joint until the solder solidifies.

TASK 2: **Solder lug to a copper conductor**

(A soldered lug should look as shown in Fig 1.)

Fig 1



1 Collect a 30 amps cable lug, copper cable 7/1.06 or 7/ 0.914(6 sq.mm) of 250 mm length, blowlamp, match-box, cotton cloth, solder stick, tray and flux.

2 Clean the inner and outer surfaces of the 30 amps cable lug using `00' grade sandpaper.

3 Put the cable lug to one end of the cable and mark the cable according to the depth of the cable lug, as shown in Fig 2.

4 Add about 2 mm to the marking, remove the insulation from the cable (Fig 3) and clean the strands.

Fig 2

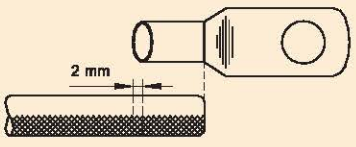
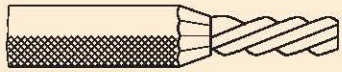


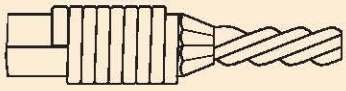
Fig 3



Avoid damage to the strands of the cable while skinning. Clean the tray thoroughly. The tray should be free from dirt and water.

5 Wrap a cloth/cotton tape on the insulation of the cable to a length of 30 mm as shown in Fig 4, and wet it with water.

Fig 4



WRAPPED WITH WET CLOTH

ELN1329J4

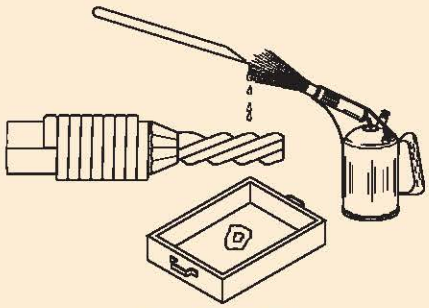
Use minimum water to wet the cloth/tape. Do not allow water to drip.

6 Light the blowlamp and let it emit a blue flame.

7 Apply a thin coat of flux to the cable end.

8 Tin the cable end by monitoring the blowlamp on the solder stick and allowing the molten solder to fall on the bare stranded cable end as shown in Fig 5.

Fig 5



TINNING CABLE END

ELN1329J5

A thin coating of tin should be on the stranded cable end.

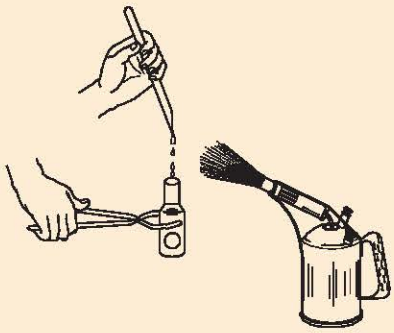
9 Apply a small quantity of flux inside the lug socket. Tin the lug by melting the solder stick to fill the socket and pour the molten solder in the tray.

Pouring out the molten solder from the lug socket a couple of times will make the tinning perfect.

10 Apply some flux to the cable end and the interior of the socket.

11 Fill the socket of the lug with molten solder. (Fig 6)

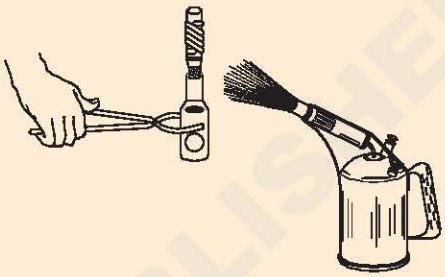
Fig 6



ELN1329J6

12 Monitor the blowlamp flame on the socket, insert the cable in the socket and hold the cable vertically as shown in Fig 7.

Fig 7



ELN1329J7

13 Remove the blowlamp and firmliy hold the cable and socket without shaking.

14 Remove the extra solder from the lug and cable by wiping it with a piece of cotton cloth while the solder is still hot.

15 Keep on holding the cable and lug as in Fig 7 and allow the solder to solidify.

Do not use water to cool the lug. This will crystallize the solder and make it weak.

Scan the QR Code to view the video for this exercise

Identify various parts, skinning and dressing of underground cable

Objectives: At the end of this exercise you shall be able to
- **identify the voltage grade of the cable**
- **skin the UG cable**
- **dress the UG cable.**

Requirements

Tools/Instruments

- Insulated combination piler 200 mm - 1 No.
- DE Electrician's knife 100 mm - 1 No.
- Hacksaw adjustable 300 mm with blade - 1 No.
- Handvice 50 mm jaw - 1 No.

Materials

- UG cable multicore eu/Al. 30 cm - 1 piece
- Binding wire 16 SWG - as required.

PROCEDURE

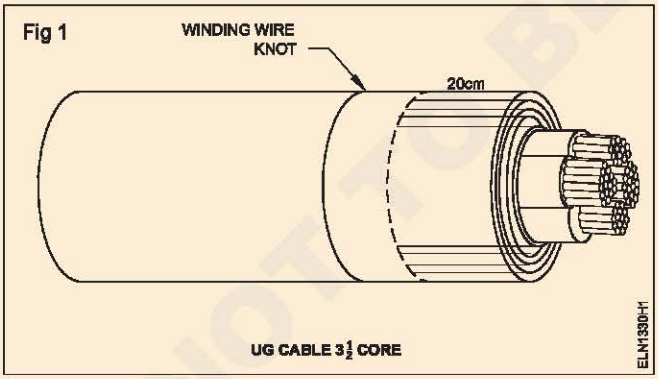
Paper insulated 3, 31/2 core cable may be taken. This instructor has to demonstrate the steps for skinning and dressing of cables in this exetcise.

1 Collect the UG cable piece and examine it for physical damage.

2 Bind the winding wire at 20 cm (20 cm at one side) of the UG cable.

3 Mark 18 cm at one end near the binding wire knot from the end where skinning is to be done, as shown in Fig 1.

Fig 1



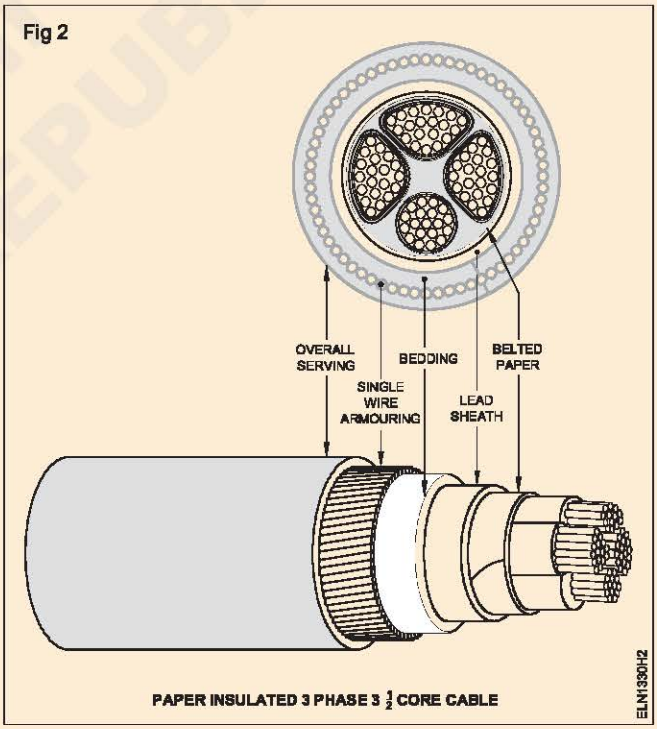
4 Cut the overall serving using the knife and remove the overall serving.

5 Mark 3 cm from the cutting edge and cut the single wire armouring using hacksaw.

6 Mark 3 cm from cutting edge and cut the bedding using knife/hacksaw.

7 Repeat steps 2-6 to skin all other layers till it is visible as shown in Fig 2.

Fig 2



Carefully examine the skinned portion for any damage/excess cutting.

8 Dress the protruding parts of the cable using a knife for a better finish.

9 Get your work approved by your instructor.

Make straight joint of different types of underground cable

Objectives: At the end of this exercise, you shall be able to
- **cut the cable according to requirement**
- **prepare the cable as per measurement**
- **join the cables using split sleeves or ferrules and epoxy compound**
- **insulate the wires, cable joints.**

Requirements

Tools/Instruments

- Insulated combination plier 200 m - 1 No.
- Screwdriver 200 mm - 1 No.
- D.E. Spanner 6mm to 25 mm - 1 set
- DE Electrician's knife 100 cm - 1 No.
- Melting pot with 1 set of ladles - 1 No.
- Blow lamp 1/2 litre capacity - 1 No.
- Tongs 300 mm - 1 No.
- Triangular file smooth 200 mm - 1 No.
- Hacksaw adjustable 300 mm with 32 TPI blade
- Hammer ball pein 250 g - 1 No.
- Plier round nose 150 mm - 1 No.
- Hand vice 50 mm - 1 No.

Materials

- UG cable multi-core copper/ aluminium - as required.
- Binding wire 16 SWG - 200 g
- Lead and tin alloy 60/40 - asrequired
- Kerosene oil - 2 litre.
- Cotton tape 25 mm10mm long - 1 roll
- Bitumen compound ('epoxy'compound) - as required
- Jute thread 3 mm - 100 g.
- Impregnated cotton tape - as required.
- Porcelain barrier - as required.
- Coupling sleeve of suitable size - as required.
- Metal connectors of suitable size - as required.
- Slit sleeve of suitable size - as required.
- Insulating paste board or yarn tape - as required.
- Match box - 1 No.
- Asbestos thread - 50 g.
- Alca 'P' solder - 1/2 kg.
- Soldering flux - 100 g.
- Bricks - as required.
- Cotton cloth - as required.
- Eyre flux - 100 g.

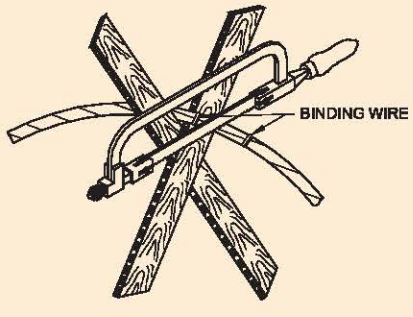
PROCEDURE

TASK 1 : **Make straight joint using sleeves in U.G cable**

1 Cut the given cable into two pieces as in Fig 1.

Fig 2 is given here for your guidance. Actual measurement for the cable insulation removal depends upon the type of cable joint box and cable sealing compound. Conventional method of cable jointing is done with bitumen compound for sealing the joint , brass glands at the ends of the joint box for sealing the joint entry and plumbing to finish the job. Modern joints with epoxy compounds are done by sealing the joint entry either with special tapes or with special compounds. According to the method chosen, the measurement has to be made and the insulation has to be removed at specified points. For procedural convenience in this sheet, L_1 is taken as 200 mm and so on.

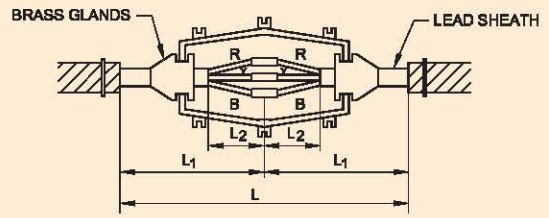
Fig 1



2 Bind 16 SWG GI binding wire on the serving (PILC cable) of the cables at a distance of 210 mm from one end as shown in Fig 3 to avoid loosening of the serving and damaging of the armour.

3 Remove the armour and serving of the cables to a length of 200 mm from the end of each cable as shown in Fig 4.

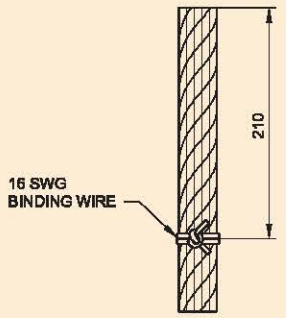
Fig 2



CONVENTIONAL JOINT USING FERRULE SLEEVE BRASS GLAND FOR SEALING

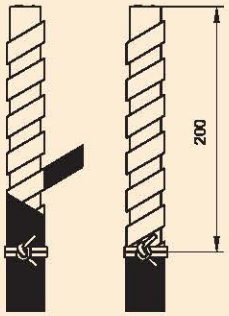
ELN1331J2

Fig 3



ELN1331J3

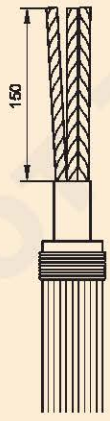
Fig 4



ELN1331J4

4 Remove the lead sheath to a length of 150 mm from the end of each cable as shown in Fig 5 and also remove the impregnated paper.

Fig 5



ELN1331J5

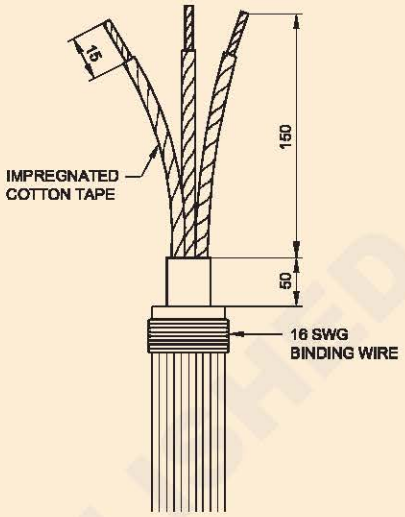
Avoid nicks or cuts on the core. Do not remove the paper insulation of individual cables.

5 Remove the paper insulation from both the cables to a length of 15 mm from the end.

Some prefer staggering of the joint position to have maximum efficiency of the joint. In such cases, the cable insulation should be removed accordingly. Fig 8 shows such a joint.

6 Twist the bare conductors tightly and tin the conductors. (Fig 6)

Fig 6



ELN1331J6

Wrap the end of the paper insulation near the bare conductor with lightly wetted cotton tape or asbestos tape to protect against excess heat.

7 Wrap the portion of the paper insulated cable with impregnated cotton tape to protect it from moisture and hot solder. (Fig 6)

Provide colour coding marks on cables at this stage.

8 Clean the split copper sleeves and the brass glands thoroughly and tin them.

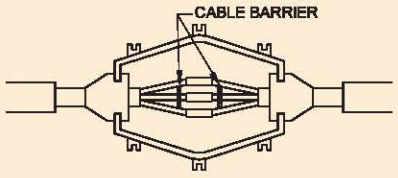
9 Clean the joint box and keep the bottom cover on the floor.

10 Insert the brass glands in the cables and position the bare end of the cable and gland inside the joint box as shown in Fig 2.

11 Insert the tinned portion of the cable ends into the split sleeve with the help of the colour code of the cables. (Fig 2)

12 Insert barriers (separators) between the three individual cables at both sides of the cable as shown in Fig 7.

Fig 7

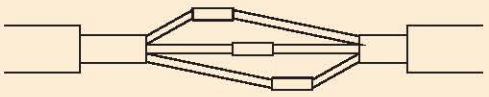


ELN1331J7

13 Turn the split portion of the sleevves in the upward position to facilitate pouring of the solder.

14 Remove the bottom cover of the joint box and push the brass glands apart and keep it in staggered position as in Fig 8.

Fig 8



STAGGERED POSITION OF JOINT

ELN1331J8

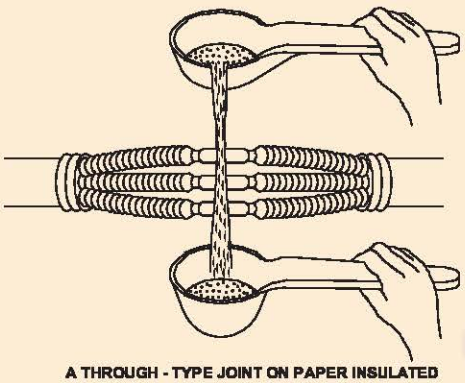
15 Apply soldering flux to the split sleeves and the bare portion of the conductor.

16 See that the ladles are dry and then start alternately scooping the molten solder with the ladles till the ladles are sufficiently hot.

17 Keep one of the empty ladles underneath the split sleeve that has to be soldered.

18 Pour the molten solder on the sleeve such that the solder enters the joint through the split as shown in Fig 9.

Fig 9



A THROUGH - TYPE JOINT ON PAPER INSULATED CABLES USING POT AND LADLE

ELN1331J9

After the joint is sufficiently heated, increase the time between the pourings to allow the solder to solidify inside the joint.

19 Stop pouring the solder when the sleeve is filled up, and the colour of the solder is bright.

20 Repeat this procedure to other joints one after another.

Do not shake or disturb the position of the cables during the soldering process as it will result in dry joints.

21 After the joint is cold, wrap with at least 2 layers of impregnated PVC tape over the joints.

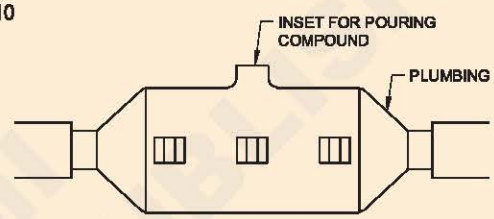
22 Preheat the joint box before filling the preheated sealing compound.

23 Close the top and bottom parts of the joint box together and, position the brass glands.

24 Use the solder lead to make proper plumbing joints between the lead sheath and the brass gland.

25 Pour molten sealing compound through the cover inlet as shown in Fig 10.

Fig 10



ELN1331JA

When the compound is filled up to the mouth of the inlet, stop pouring and allow it to cool.

After sufficient cooling, the compound will shrink, and now fill the available space with more molten compound.

26 Fix the cover inlet of the joint box after the joint is sufficiently cooled.

27 Cheek for cracks, melting due to heat or any other mechanical damage.

Test insulation resistance of underground cable using Megger

Objectives : At the end of this exercise, you shall be able to
- **measure the insulation resistance between conductors of an armoured cable using Megger**
- **measure the insulation resistance between earth and conductors of an armoured cable.**

Requirements

Tools/Instruments

- Insulation resistance tester (Megger) 500 V - 1 No.

Materials

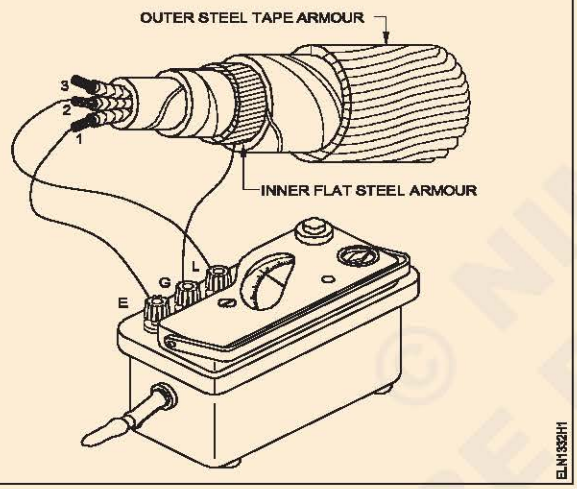
- Testing prods - 3 Nos.
- Armoured cables of different sizes and length - 2 Nos.

PROCEDURE

TASK 1: **Measure the insulation resistance between conductors of an armoured cable**

1 Connect the armoured cable as shown in Fig 1.

Fig 1



Connect the guard terminal of the meter with the armour (metal sheath) of the cable.

2 Measure the insulation resistance between the conductors and record the readings in Table 1.

Table 1

Measurement	Insulation resistance in megohms
Between conductors	
Conductor 1 and conductor 2	
Conductor 2 and conductor 3	
Conductor 1 and conductor 3	
Between earth and conductors	
Conductor 1 and earth	
Conductor 2 and earth	
Conductor 3 and earth	
Conductor 1, 2, 3 shorted and earth	

Steadily rotate the insulation tester's handle at a constant speed (160 r.p.m) at least for one minute duration before recording the meter reading.

TASK 2: **Measure the insulation resistance between earth and conductors of an armoured cable**

1 Connect the armoured cable as shown in Fig 2.

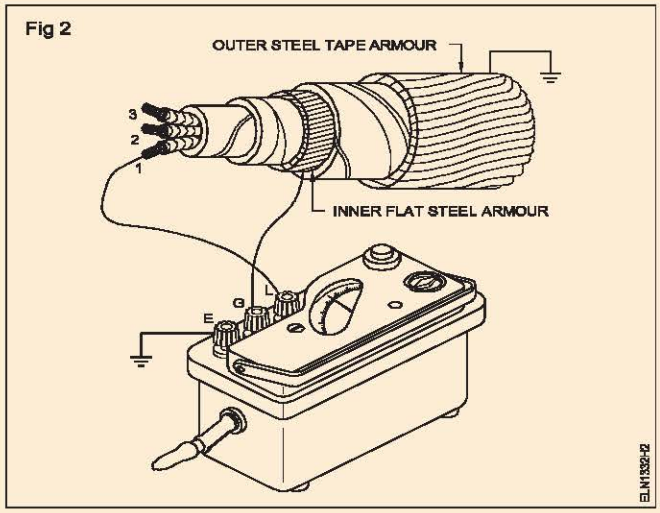
If the armoured cable is buried in the ground, connect the Megger as shown in Fig 2.

2 Measure the insulation resistance between earth and each conductor and record the readings in Table 1.

3 Measure the insulation resistance between earth and all the three conductors by shorting them together and record the reading in Table 1.

Discuss the required insulation resistance value of the cable with your instructor

Fig 2



Test underground cables for faults, and remove the fault

Objectives: At the end of this exercise you shall be able to
- **locate open circuit faults in the cable**
- **locate short circuit faults in the cable**
- **locate the ground fault in the cable and rectify the fault.**

Requirements

Tools/Instruments

- Combination plier 200 mm - 1 No.
- Connector Screw driver 100 mm - 1 No.
- Screw driver 200 mm with blade of 4 mm width - 1 No.
- D.E electrician's knife 100 mm - 1 No.
- Megger 500V - 1 No.

Equipments/Machine

- Wheatstone bridge - 1 No.

Materials

- Connecting Prod for Megger - 1 set
- Connecting Prod for Wheatstone bridge - 1 set
- Connecting Cables (flexible, uniform, cross sectional area) - as reqd.

PROCEDURE

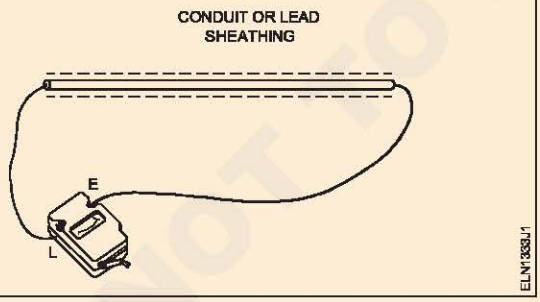
TASK 1: **Locate open circuit faults in underground cable**

This test is made to check whether the cable insulation is in open condition and to identify the exact location of the open circuit.

1 Switch 'OFF' the mains. Remove the fuse and the neutral links in the main switch and keep them in safe custody.

2 Select 500 V Megger and connect one terminal of the Megger, say L, to the one end of cable as shown in Fig 1.

Fig 1



3 Connect the other terminal of the Megger say 'E' to the other end of the cable.

4 Rotate the megger at 160 r.p.m.

5 Observe the megger reading. If the megger shows infinity, there is open circuit in the cable.

Open circuit may be due to open in the cable.

If the megger shows '0' reading, it indicates no open in the cable.

6 Connect the 'E' terminal near the middle of the cable and repeat the above procedure for open circuit.

If it shows '0' reading, there is no open in between 'L' and the middle of the cable.

7 Repeat the above procedure, connecting the 'E' terminal to beyond the middle point of the cable at varied distances.

When the megger shows infinity in a parhcilar place, that is the point of open.

8 Locate the faulty portion and make fresh straight joint to the UG cable.

— — — — — —

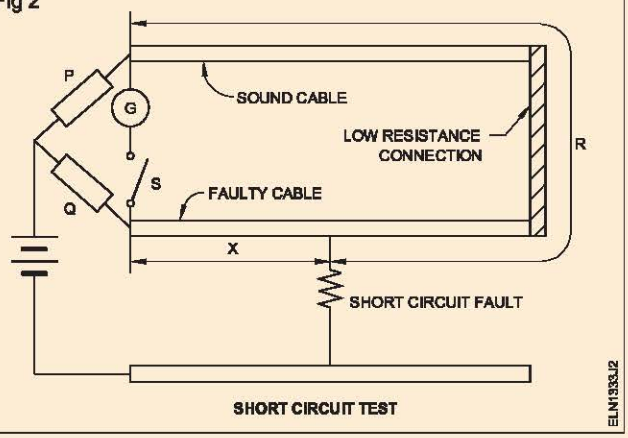
TASK 2: **Locate the short circuit fault in U.G cable**

This test is made to locate the short circuit in the cable by Murray loop test.

1 Switch 'OFF' the main switch. Remove the fuse of the main switch and keep it in safe custody.

2 Select a Wheatstone bridge and connect one end of the cable to the meeting point of P and Galvanometer and another cable end to the meeting point of Q and Galvanometer as shown in Fig 2.

Fig 2



3 Measure the length of each cable.

4 Connect the other two ends of both the cables by means of low resistance wire.

5 Take the battery terminal (negative) wire and place it at any point of the cable and observe the deflection in the Galvano meter.

The area of the cable where the Galvanometer shows '0' reading is the exact location of the short circuit. It can be calculated with the formula given below.

$$(i.e)\ \frac{x}{p}=\frac{Q}{P}\ \text{or}\ \frac{X}{R+X}=\frac{Q}{P+Q}$$

where X is the length of the fault from the test end.

L is length of each cable.

6 Locate the fault while measuring the length of the cable and clear the short circuit in the UG cable.

TASK 3: **Locate the ground fault in U.G cable**

This test is also done to locate ground fault in the cable by Murray Loop test.

1 Connect the cables as shown in the Fig 3 and repeat the steps explained in the short circuit test (TASK 2).

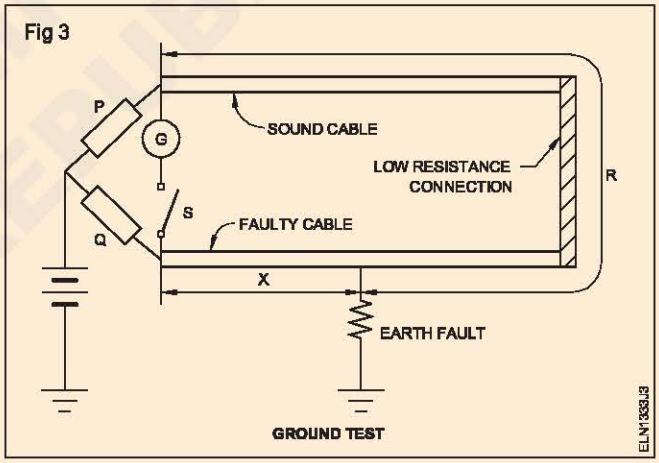
The area of the cable where the Galvanometer shows '0' reading is the exact location of the ground fault.

2 Calculate and locate the place of the ground fault as given below.

$$X=\frac{Q}{P+Q}\times 2L$$

Where 'X' is the length of the fault from the test end.

Fig 3



3 Locate the place where the ground fault is by measuring the length from the test end and repair the fault.
