TELECOM AUSTRALIA

LINEMEN'S HANDBOOK

CABLE JOINTING NO. 2

ISSUE NO. 2, 1976

Issued to

(Name) CHUNTER

(Station) WHYALLA

ISSUED BY
General Manager
Engineering Department

Issue 2, 1976.

INTRODUCTION

This handbook has been prepared to assist Lines and Technical Staff engaged on the jointing of voice and high frequency Communication Cables.

The handbook contains summarised information regarding the jointing of trunk and coaxial cables. For more detailed information the reference copy of Lines Engineering Instructions held at the Line Station should be consulted.

Your attention is directed to the information on safety precautions which is given throughout this handbook and, in particular, to the detailed instructions in Section C on power feed carrier systems and the detection of dangerous gases in underground plant. Follow these instructions and work in safety.

Issued By:
General Manager,
Engineering Department.

Issue 2, 1976.

CONVERSION TO METRIC SYSTEM OF WEIGHTS AND MEASURES

In accordance with the adoption of the Metric system of weights and measures by the Australian Telecommunications Commission all dimensions, etc., on drawings in this Handbook are shown in Metric units.

In some cases previous standard dimensions have been rationalised to round them off to the nearest five or ten millimetres.

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CABLE JOINTING 1

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R - Identifying Cable Pairs

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GOOD WORKMANSHIP

+

SAFETY

+

COURTESY

=

GOOD SERVICE

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SAFETY PRECAUTIONS

SECTION C - General Safety Practices
Power Feed Carrier Systems
Dangerous Gases
Heart Lung Resuscitation

Electrical Accidents
Lifting and Handling Material
First Aid - Treatment of Burns
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Issue 1, 1976.

REMEMBER!

NO JOB IS SO IMPORTANT

and

NO SERVICE IS SO URGENT

THAT WE CANNOT TAKE TIME

TO DO IT SAFELY

SAFETY PRECAUTIONS

Safety information is given throughout this book and as footnotes to many pages.

Further general safety precautions, rescue operations, first aid practices and accident reporting procedures are described in this Section.

WORK SAFELY AND MAKE SAFETY PRECAUTIONS A PART OF THE JOB.

Be constantly on guard against an accident and do not commence a job until you are sure that you can work in safety.

GUARDING MANHOLES, EXCAVATIONS, ROAD AND FOOTPATH OBSTRUCTIONS.

Prevent workmen or members of the public stepping into open manholes or jointing pits by placing manhole guards around them before removing the covers.

Where there is any danger to workmen or traffic, e.g. when working in a roadway manhole, erect road warning signs in prominent position so as to warn road users and give them sufficient time to avoid danger. In built up areas 70-100 m from the hazard is usually adequate, but on maximum speed roads the signs should be 100 to 200 m ahead.

Erect temporary barricades around open excavations, heaps of spoil, material stacks and other hazards to ensure the safety of vehicular and pedestrian traffic. Attach red warning lamps to outline the hazard at night.

Provide red lights on jointers trailers or other equipment left overnight in a position which could create a traffic hazard.

DO NOT EXPOSE YOURSELF TO THE RISK OF INJURY OR CREATE CIRCUMSTANCES WHICH WOULD CAUSE AN ACCIDENT TO OTHER PEOPLE.

PROTECT YOURSELF FROM INJURY BY WEARING CLOTHES AND FOOTWEAR SUITABLE FOR THE JOB AND BY USING THE SAFETY AIDS PROVIDED.

POWER FEED CARRIER SYSTEMS

Power is fed through some cables to repeaters, usually via the coaxial tubes. Sometimes core interstice and layer pairs carry power with a voltage in excess of 20V AC or 120V DC which can be dangerous to Lines Staff.

DISCONNECTING POWER BEFORE WORKING ON CABLE

Before starting work, disconnect all power in excess of 20V AC or 120V DC in the cable. Work may proceed however, on the cable sheath or layer pairs without removing the power from the tubes, core or interstice conductors providing:

(i) Approval has been obtained from the Supervising Engineer.

(ii) The paper core wrappings surrounding the assembly of the tubes core and interstice conductors are not disturbed.

(iii) The Jointer does not work alone.

In cases where mechanical damage occurs to the cable the power must be removed. Carrier systems with underground repeaters cannot be operated with the power disconnected and provision is seldom made to lock it in the off position. Such currents are usually limited to safe values. Where dangerous currents are used and operation must be maintained, the Supervising Engineer may authorise work with the power connected to the essential circuits provided:

(i) Dangerous power feeding currents are disconnected from all other pairs and tubes in the cable.

(ii) The work is adequately supervised.

POWER FEED CARRIER SYSTEMS

ACCESS TO EQUIPMENT

Do not start work requiring access to equipment components carrying dangerous voltages until these voltages have been disconnected from the panels concerned.

BASIC SAFETY PRECAUTIONS

Engineering Instruction Lines Cables SP5900 and any relevant State Engineering Instruction's must be read and understood before work is commenced on any cable which has power feed working through the cable.

One person only must be responsible:

(i) To ensure that all dangerous voltages are removed from the cable before work is started on that cable.

(ii) That all switches are locked in the off position and that he alone is responsible for the safe-keeping of the keys.

(iii) That these voltages are not re-applied until work has been completed.

DANGEROUS GASES

TYPES OF GAS ENCOUNTERED

The dangerous gases most commonly found in underground plant are those reticulated for industrial and domestic use for heating, cooking, etc. Soil, industrial gases and liquid fuels (oil, petrol, etc.) may also enter ducts and manholes and create a hazard.

TYPE	EFFECT	HOW DETECTED	POSSIBLE SOURCE
Natural Gas (Methane)	Suffocating and Explosive	Combustible Gas Detector	Areas of gas reticulation
Liquefied Petroleum Gas (L.P.G.)(Propane)	Suffocating and Explosive	Combustible Gas Detector	Areas of gas reticulation. Leaks in L.P. Gas plumbing equipment
Tempered Liquefied Petroleum Gas and Simulated Natural Gas	Suffocating and Explosive	Combustible Gas Detector	Areas of gas reticulation
Manufactured Gases (Contain Carbon Monoxide, Hydrogen or Methane)	Poisonous and Explosive	Combustible Gas Detector Carbon Monoxide Detector	Areas of gas reticulation

TYPES OF GAS RETICULATED FOR INDUSTRIAL AND DOMESTIC HEATING

NOTE: (i) A characteristic odour is provided in many cases, but under certain conditions the smell disappears and dangerous gas can be present but not smelt. Always use a combustible gas detector to be sure no gas is present.

(ii) The dangerous element in each gas is shown in brackets in the "Type" column.

DANGEROUS GASES

TYPE	EFFECT	HOW DETECTED	POSSIBLE SOURCE
Sewer Gas (Hydrogen Sulphide)	Poisonous and Explosive	Smell like rotton eggs. Combustible Gas Detector	In vicinity of sewer mains
Marsh Gas (Methane)	Suffocating and Explosive	Combustible Gas Detector (Gas is odourless)	Areas of coal deposits, decaying vegetation or made up ground.
Acetylene	Poisonous and Explosive	Combustible Gas Detector	Leaks from oxy-acetylene welding equipment.
Exhaust Gases (Carbon Monoxide)	Poisonous	Carbon Monoxide Detector (Gas is odourless)	Exhaust gases from petrol or oil driven internal combustion engines.
Refrigeration Gases (Ammonia and Sulphur Dioxide)	Irritating	Irritates respiratory track	In vicinity of industrial plants.
Petrol Vapour	Poisonous and Explosive	Oil film on moist surfaces. Combustible Gas Detector	Leaks or spillage from service stations, industrial premises or underground tanks. Road tanker accidents.
Fuel Oils	Irritating and Explosive	Oil Film. Combustible Gas Detector	As for petrol vapour above
Foul Air (Oxygen deficiency)	Suffocating	Headache, Nausea, Dizziness or Panting	Poor ventilation of deep manholes.

DETECTING DANGEROUS GASES

WHEN TO TEST FOR GAS

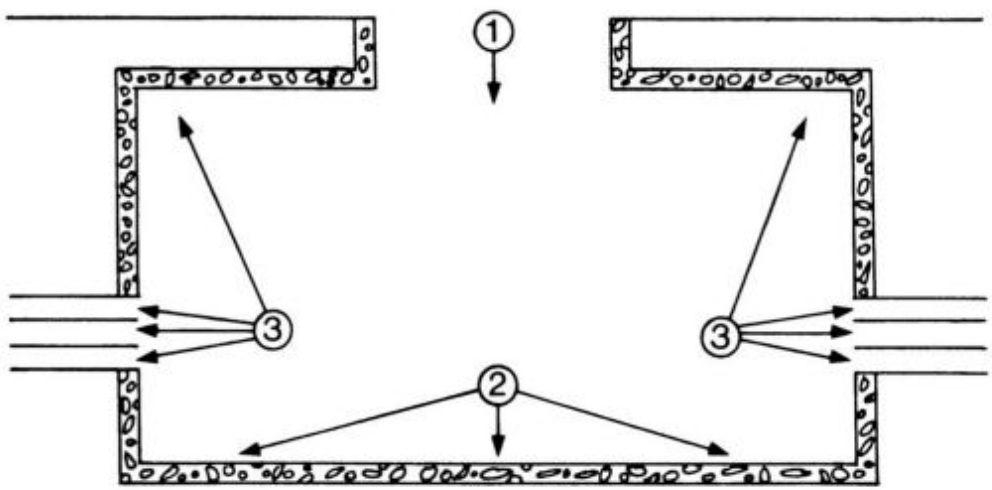
In areas where gas is reticulated, test for the presence of gas before entering any of the following:

1. All tunnels.
2. All manholes. (Forced draught ventilators must be used while working in shaft entry manholes or deep manholes with poor ventilation.)
3. All jointing pits.
4. Any excavation or other work area where gas is smelt or suspected.

In areas where gas is not reticulated test for gas in all tunnels, deep or shaft - entry manholes and other manholes or excavations where there is any possibility of marsh or sewer gas, industrial gases or petrol vapour being present.

DUCT PLUGS

Where duct plugs are installed, spot sampling tests must be carried out as described in "How To Test For Gas" on page C-9.



TESTING FOR GAS IN MANHOLES

HOW TO TEST FOR GAS

Before any work is commenced or any flame (or cigarette) is brought near an underground opening, make the following tests with a spot sampling portable Combustible Gas Detector:

Manholes. 1. Pass the probe 150 mm through the keyhole or test hole in the manhole cover. (If no hole move cover about 50 mm to make test).

2. Remove cover and test close to the floor.

3. Test each nest of ducts behind duct plugs and the upper level of the manhole. (Where there is water in the manhole, pump it out before making Test 2 & 3).

Manholes with Side Entrances and Tunnels. Make the same tests as above and also, while traversing the shaft or tunnel, make continuous tests at waist level.

Jointing Pits. Test as for manholes.

Where any positive reading is obtained on a Combustible Gas Detector, the manhole must not be entered or any work undertaken in the vicinity until action is taken to remove the gas and subsequent tests show that the gas has been cleared and conditions are safe.

NOTE: Several types of Combustible Gas Detectors have been provided and the manufacturer's instructions for correct use and servicing of the instrument must be followed. (See Section-W (CJ1).) In areas where manufactured gas containing carbon monoxide is reticulated, tests should also be made with a Carbon Monoxide Detector, Serial 420/2 (See page C-12), carbon monoxide although explosive in rich concentrations, is also extremely toxic in low concentrations.

REPEAT TESTS DURING WORKING HOURS

Before using any flame or spark producing device in a manhole, before resuming work after a temporary absence, e.g. meal break, make further tests for gas. If gas is suspected at any time while working, e.g. smell of gas, headache, nausea or dizziness, turn off all flame and retest for gas, if gas is detected leave manhole (see Section-C pages 10 & 11 on action to be taken). If no combustible gas is detected, arrange for continuous ventilation by forced draught or windsail. Where a continuous monitoring gas alarm is provided place the instrument close to the working position to monitor the atmosphere while work is in progress.

INTERPRETING COMBUSTIBLE GAS DETECTOR READINGS

POSITION OF NEEDLE ON METER SCALE	INTERPRETATION OF READING	ACTION TO BE TAKEN
1. From 1 to 10% (Dangerous)	Low concentration of gas in manhole is potentially dangerous because a higher concentration of gas could be in adjacent manholes or ducts. NOTE: The meter needle on hand aspirated Combustible Gas Detectors normally fluctuates slightly above or below zero when fresh air is being drawn into the instrument.	Suspend all work operations. Adequately guard the area to keep the public at a safe distance and to prevent any flame, burning material or spark being brought near the manhole. Do not remove any manhole covers or enter any manholes. Inform Lines Supervisor or Line Inspector of presence of gas. The Supervising Officer will: Test adjacent manholes and pits to determine area affected by gas. If possible ascertain origin of gas and advise relevant Authority. Advise Engineer of the presence of gas and supervise gas clearance operations.
2. From 10 to 100% (Dangerous to Explosive)	Needle rising to top of scale (100) and staying there indicates a concentration of gas near or above the Lower Explosive Limit (L.E.L.)	As for 1.

POSITION OF NEEDLE ON METER SCALE	INTERPRETATION OF READING	ACTION TO BE TAKEN
3. Meter needle rises rapidly to top of scale and returns to a lower point on the scale.	Indicates a very rich gas mixture which is over the Lower Explosive Limit.	As for 1 (Page C-10)
4. Meter needle rises rapidly to top of scale and returns to zero or below zero. NOTE: The action of the needle on hand aspirated instruments is very rapid while the action on instruments fitted with electric sampling pumps is somewhat slower.	Indicates a very rich gas mixture which is well above the Upper Explosive Limit. NOTE: (i) It is important to continuously watch the meter face while sampling for gas and to recognise the condition described in 4 because this very rich gas mixture may be come violently explosive when diluted with more air. (ii) Readings obtained in 3 or 4 may be verified after the sampling test by immediately sampling fresh air. The high concentration of gas in the instrument will cause the needle to react in the same manner as sampling the very rich gas mixtures.	As for 1 (Page C-10)

DETECTING CARBON MONOXIDE GAS

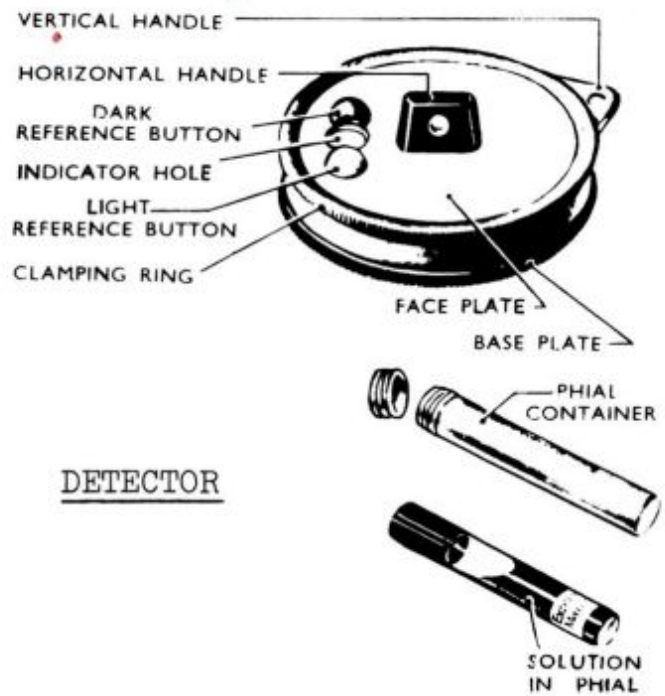
USE OF CARBON MONOXIDE DETECTOR

In areas where manufactured gas is reticulated or where carbon monoxide from any other source is suspected, a Carbon Monoxide Gas Detector (S.420/2) must be used to check for the presence of this gas before entering manholes or tunnels.

The Detector is supplied in a case together with a phial of sodium chlorpalladite solution.

Assemble the Detector in the order shown on page C-13 clamping the face plate to the base firmly with the clamping ring.

NOTE: The Carbon Monoxide Gas Detector will not detect natural gas, liquefied petroleum gases, petrol vapour and other combustible gases. Use a Combustible Gas Detector for this purpose.



DETECTOR

TESTING FOR CARBON MONOXIDE GAS

Apply just sufficient solution to saturate the small area of test paper seen through the hole in the face plate.

Immediately lower the detector into the manhole by a piece of string or wire attached to the support on the face plate and suspend it with the face plate perpendicular at or near the position the workman's head will occupy.

After 10 minutes, remove detector from the manhole and compare the colour of the test paper with the colour of the face plate and the reference buttons on either side of the indicator hole.

IF TEST PAPER HAS CHANGED TO A COLOUR DARKER THAN THE FACE PLATE, CARBON MONOXIDE GAS IS PRESENT. THE ATMOSPHERE IS DANGEROUS AND MAY BE EXPLOSIVE.

 Advise the Lines Supervisor and take other action as described on Page C-10.

TESTING FOR CARBON MONOXIDE GAS (Continued)

To detect the duct from which the gas is flowing into the manhole suspend the detector with its face plate perpendicular and place it so that the sensitised part of the paper is close to the duct mouth.

Do not enter the manhole.

After each test loosen clamping ring and rotate face plate so that a fresh section of test paper is exposed. Approximately 10 tests may be made with the one paper.

Use only perfectly clean test papers.

SUPPLY OF SODIUM CHLORPALLADITE SOLUTION

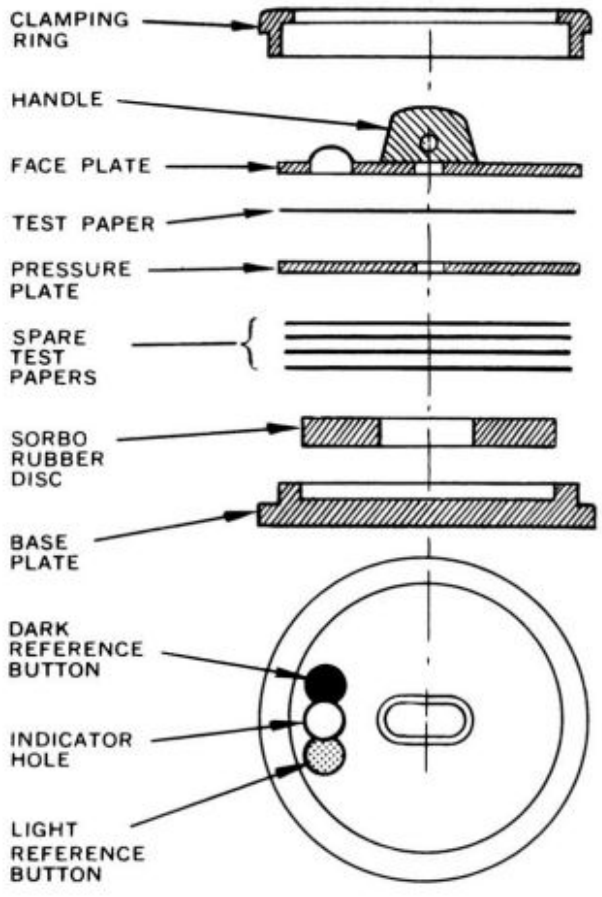
The solution is supplied in a phial labelled with an expiry date, as it deteriorates after about 12 months. The solution must not be used after this date.

MAINTENANCE OF DETECTOR

Do not expose phials of solution to strong daylight for long periods.

Keep indicator and associated equipment in its case when not in use.

Serial/Item	Equipment
420/2	Carbon Monoxide Detector (Complete).
420/3	Glass phial Sodium Chlorpalladite solution.
420/5	Test papers 70 mm diameter.



CARBON MONOXIDE DETECTOR
ORDER OF ASSEMBLING
COMPONENTS

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DETECTING CARBON MONOXIDE GAS

LOCALITIES WHERE MANUFACTURED GAS IS RETICULATED			
STATE	LOCALITY	RELATIVE DENSITY	% CARBON MONOXIDE
QUEENSLAND	Brisbane (Brisbane Gas Co)	0.60	15 - 19
"	Bundaberg	0.60	15 - 20
"	Cairns	0.60	15 - 20
"	Gympie	0.60	7 - 12 may change to 15 - 20
"	Mackay	0.60	15 - 20
"	Maryborough	0.52	up to 40
"	Rockhampton	0.65	15 - 20
SOUTH AUSTRALIA	Port Pirie (Possible conversion to natural gas 1976-77)	0.52	9 - 17
TASMANIA	Hobart	0.54	17 - 19
"	Launceston	0.52 + 0.60	12 - 16

LOCALITIES TO TEST FOR CARBON MONOXIDE

LOCALITIES WHERE MANUFACTURED GAS IS RETICULATED			
STATE	LOCALITY	RELATIVE DENSITY	% CARBON MONOXIDE
NEW SOUTH WALES	Albury	0.65	14 - 21
"	Bathurst	0.56	16.5 - 20.5
"	Cessnock	0.59	22.6 - 29.6
"	Dubbo	0.65	18 - 22
"	Goulburn	0.62	17 - 23
"	Maitland	0.59	22.6 - 29.6
"	Muswellbrook	0.60	17 - 22
"	Sydney (Australian gas light Co.)	0.61	12 - 14
"	Orange	0.54	16.5 - 20.5
"	Wagga Wagga	0.55	22.6 - 29.6
"	Wollongong	0.58	15 - 20

LOCALITIES TO TEST FOR CARBON MONOXIDE (Continued)

LIQUEFIED PETROLEUM GAS EQUIPMENT

LIQUEFIED PETROLEUM GAS (PROPANE) IS HIGHLY FLAMMABLE. TAKE THESE PRECAUTIONS TO PREVENT ACCIDENTS WHEN USING L.P.G. PLUMBING EQUIPMENT.

When using equipment in a manhole make sure the manhole is adequately ventilated.

Never use a leaky hose or equipment. Generally the L.P. Gas smell will indicate a leak, but if in doubt, check the whole of the assembled equipment for leaks by one of the following methods:

(i) portable combustible gas detector,
(ii) brush entire equipment with soap-suds,
(iii) immerse the equipment in water.

Never test for a leak with an open flame.

Keep torch flame well away from the hose and cylinder.

Keep the cylinder upright and out of direct sunlight when in use and stored.

Do not use excessive force when tightening fittings, valves or couplings as these are brass and easily damaged. Use only the spanner provided. Keep threads clean and undamaged so that gas tight connections can be made.

Never dismantle or tighten any connection without first closing the cylinder valve.

Don't lift or drag cylinders by the hose, as this could damage the hose.

In case of fire in the hose or other equipment turn off the cylinder valve if possible.

TO TURN OFF GAS, CLOSE CYLINDER VALVE FIRST, ALLOW HOSE TO EMPTY, THEN SHUT FINE ADJUSTMENT VALVE ON BURNER HANDLE. DO NOT ALLOW PRESSURE TO REMAIN IN THE HOSE.

The cylinder must be fitted with a Regulator (S.414/84) to maintain constant gas pressure (four settings) to suit the types of L.P.G. equipment. The regulator has a hose failure valve which automatically shuts off the gas in the event of a burst hose or similar gas leak. To reset the hose failure valve after operation, first turn off cylinder valve then depress reset button.

When attaching the regulator to portable cylinder:

(i) Hand tighten then seat the surfaces by turning the regulator half a turn to the right and half a turn to the left - repeat this operation at least twice.
(ii) Tighten the nut with the spanner provided.

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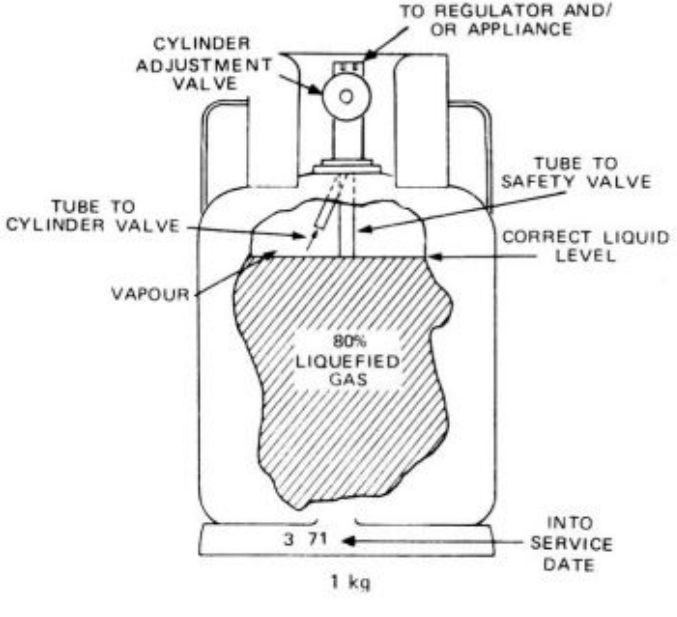
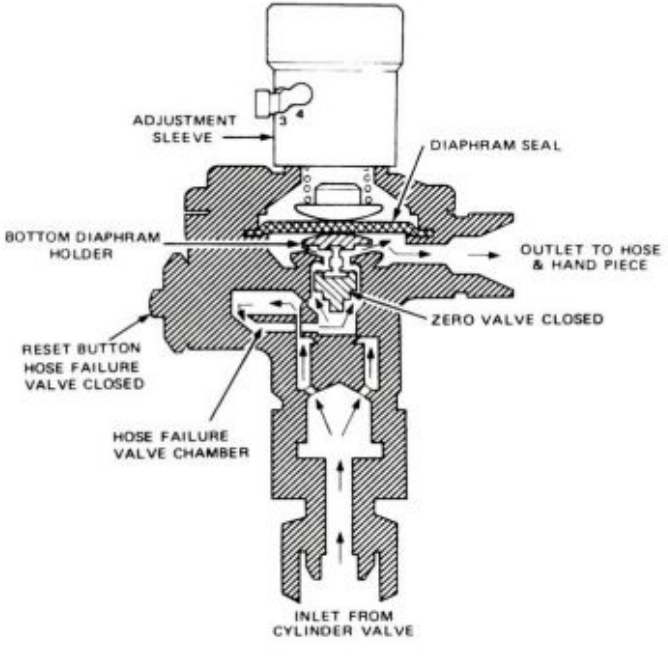
When refilling cylinders follow correct procedure and avoid overfilling. If a cylinder is overfilled liquefied gas can pass into the hose and block the fine hole in the burner nipple. After each filling test cylinder for leaks by immersing upright in water.
Always place cylinder so that its valve is readily accessible. Wherever possible secure cylinder outside manhole.
Never store cylinders in manholes or transport them in cabins of vehicles.



PORTABLE CYLINDER (S.414/50)



REGULATOR (S.414/84)

CLEARING DANGEROUS GAS FROM UNDERGROUND PLANT

1. Ascertain in conjunction with the Gas Authority the extent of gas throughout the conduit network or tunnel by making a series of tests with a combustible gas detector to define the area affected by gas.
2. Record the location and % lower explosive limit (L.E.L.) of gas shown by the detector where each test is made. The highest readings can help pinpoint the location of the gas leak.
3. After fault located use forced draught ventilators to purge the gas from ducts and manholes concerned. If ventilators are not available, use windsails. (See page C-19). Remove covers from adjacent manholes.
4. Ensure that the Gas Authority locates and repairs the source of the leak.
5. When the gas has been cleared, close all manhole covers for at least half an hour and then retest for gas throughout the affected area.
6. If these tests (5) are satisfactory, make sure that the work area is well ventilated, preferably with a forced draught ventilator, before entering the manhole and while working in the manhole. Remove covers from adjacent manholes.
7. Ensure that a continuous monitoring combustible gas detector is available. Retest for gas at least every hour and before using any flame in the manhole. This includes smoking.
8. Where mechanical ventilation is not available, provide a man to remain on duty above ground for the remainder of the day.
9. Place Safety Line (S.116/38) over the manhole guard with the snap hook end down the manhole in case rescue should become necessary. (See Manhole Rescue page C-27).

DO NOT WORK IN A MANHOLE WHERE GAS HAS BEEN DETECTED UNTIL TESTS SHOW THAT THE GAS HAS BEEN CLEARED AND WORKING CONDITIONS ARE SAFE.

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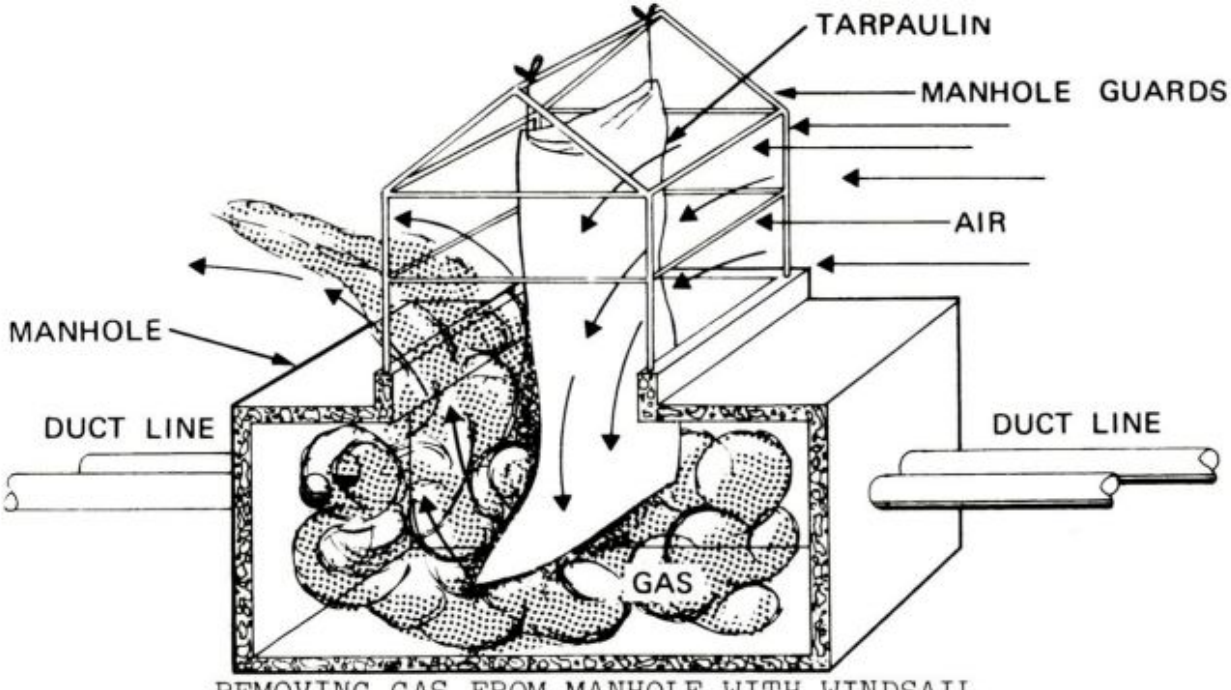
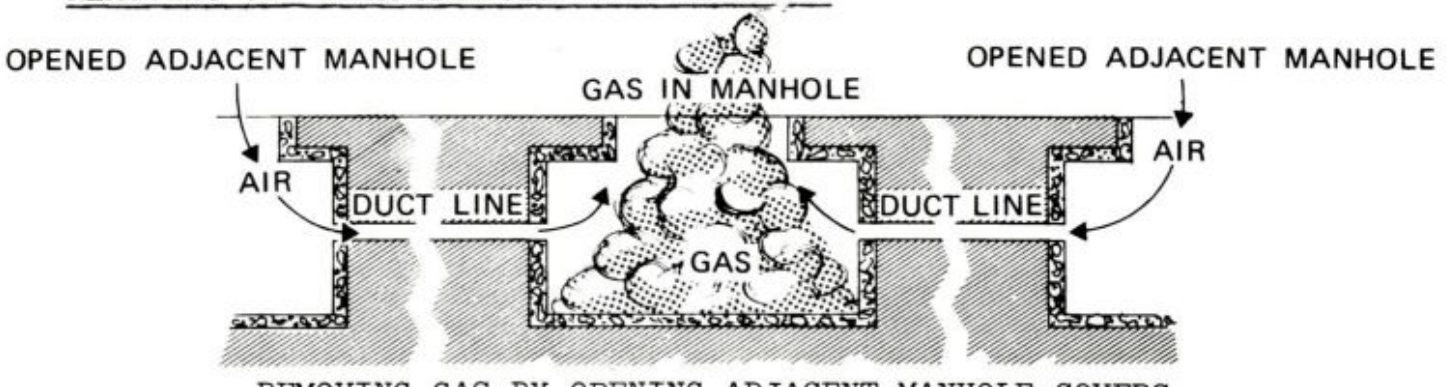
REMOVING DANGEROUS GAS FROM MANHOLES



REMOVING GAS FROM MANHOLE WITH WINDSAIL



REMOVING GAS BY OPENING ADJACENT MANHOLE COVERS.

HEART-LUNG RESUSCITATION

Electric shock, suffocation by smoke or gas, drowning or heart attack, can stop both breathing and heart action. Death may follow within a few minutes.

The rescuer must take over the role of lungs and heart in providing the two things necessary for life. AIR and BLOOD CIRCULATION. This is done by EXPIRED AIR RESUSCITATION and HEART RESUSCITATION without delay - EVERY SECOND COUNTS.

A good knowledge of heart-lung resuscitation may enable you to save the life of a workmate or even a member of your own family. Study the following pages so that you become familiar in every aspect of Heart-Lung Resuscitation.

TO INFLATE LUNGS

. CLEAR THE MOUTH AND THROAT. Lay victim on his back on a firm surface and quickly wipe any foreign matter from his mouth and throat.

. TILT HIS HEAD BACK. Lift his head and tilt it back as far as possible to open the airway to his lungs. If immediately available place a pad of clothing or similar material under the victim's shoulders to raise them approx. 50 mm. Do not waste time looking for something.

. INFLATE HIS LUNGS. Blow air into his lungs through his mouth or through his nose.

. MOUTH TO MOUTH METHOD. Pinch his nose between thumb and forefinger to seal it. Take a deep breath, open your mouth widely, place it over his mouth and blow steadily.

CHECK AT REGULAR INTERVALS THAT YOUR SAFETY LINE IS IN GOOD CONDITION (SEE PAGE C-27)

. MOUTH TO NOSE METHOD. Hold his mouth closed; take a deep breath, open your mouth widely, place it over his nostrils and well on to his nose and blow steadily.

. LET HIM BREATHE OUT. Watch his chest, when it rises remove your mouth, listen to the air being exhaled. When the flow of air stops blow in again.

. RATE OF INFLATING LUNGS. Give victim four deep breaths at a rapid rate then continue at about twelve breaths per minute until natural breathing is restored.

GAUGING AMOUNT OF BREATH REQUIRED.

Blow forcefully for adults, gently for children, use only cheek puffs for infants. Blow steadily until you see victim's chest expand. Don't blow too hard or force more air into him than is required to fully inflate his lungs, as it serves no useful purpose and may enter his stomach. Do not attempt to expel air from the stomach by pressing on the abdomen, as this may empty the stomach contents into his throat and block his air passage.

If chest does not rise when you blow.

If attempting mouth-to-nose resuscitation change to mouth-to-mouth, or vice versa. Increase backward head tilt. Place two fingers behind angle of lower jaw near lobe of the ear and push it forward so that lower jaw tends to overlap upper. If necessary hook a thumb over lower teeth or gum and lift jaw forward.

If still unsuccessful look for a foreign body in victim's throat. Attempt to dislodge it by shaking victim or slapping him firmly on the back.

If patient is breathing faintly.

Assist natural breathing by blowing in at the moment he inhales and then take your mouth away to permit him to exhale. Even if heartbeat returns it may be necessary to assist breathing.

When victim commences to breathe naturally.

Keep him warm and quiet and under constant observation in case heart or breathing should stop again (see Coma position page C-23).

TO CHECK VICTIMS HEARTBEAT

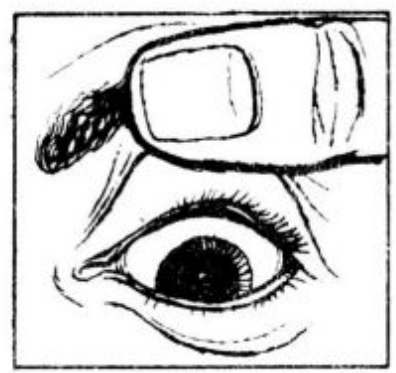
. FEEL FOR PULSE IN HIS THROAT. Press pads of fingers into groove between VOICE box and muscle of neck (either side) behind adams apple.

. EXAMINE PUPIL OF BOTH EYES. If pupil is enlarged and does not contract when eyelid is raised, this indicates that the heart has stopped.

. CHECK THE COLOUR OF HIS SKIN. Pink Skin indicates that blood is circulating, blue tinge indicates that blood circulation has stopped.

. WHEN HEARTBEAT DETECTED. Commence Lung Resuscitation immediately.
WHEN NO HEARTBEAT DETECTED. Commence Heart Lung Resuscitation immediately.

FEELING FOR PULSE



EXAMINING PUPIL

PREVENTION IS BETTER THAN CURE. BEFORE WORKING AT ANY PIT, MANHOLE OR JOINTING CHAMBER. CHECK FOR THE PRESENCE OF GAS USING A COMBUSTIBLE GAS DETECTOR (SEE SECTION W, CJ No. 1.)

APPLYING CHEST PRESSURE.

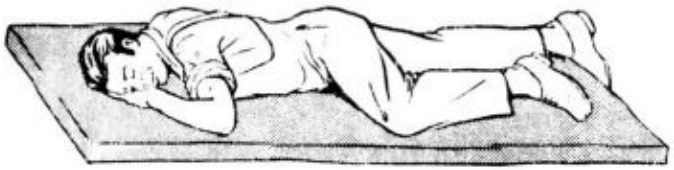
Use heel of hand only. Raise fingers so that no pressure is exerted on the ribs. Remember, insufficient pressure will not pump blood but too much pressure or incorrect positioning of hand may break ribs and damage internal organs. Pressure of one hand is sufficient for children and for babies use two fingers only.

RETURN OF HEARTBEAT

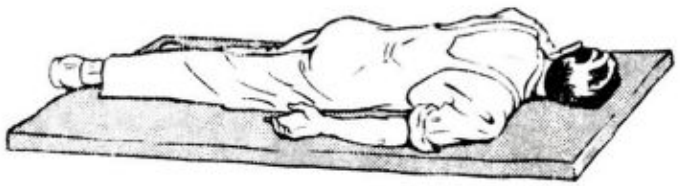
Check at intervals for return of heartbeat and other signs of revival such as spasmodic breathing or body movements. Even if heart beat returns it may be necessary to assist breathing. When the rhythm of heart-resuscitation is broken e.g. one operator alternatively applying heart and lung resuscitation, care must be taken not to re-apply heart resuscitation if the heart beat has returned.

COMA POSITION

If the victim has recovered sufficiently to breath unaided, lay him on his side in the coma position and encourage him to rest until placed in the care of a doctor, or suitably trained medical staff i.e. ambulance staff.



Coma position - front view



Coma position - back view

HEART–LUNG RESUSCITATION

CHECK is the victim clear of electric current or any dangerous situation? If not free him quickly without endangering yourself (see page No. C-26).

CHECK if the victim is breathing and is his heart beating? If not COMMENCE HEART-LUNG RESUSCITATION. If the victims heart is beating COMMENCE LUNG RESUSCITATION, SEND for medical assistance as soon as possible.

LUNG RESUSCITATION

1. CLEAR MOUTH AND THROAT.

LAY VICTIM ON HIS BACK ON A FIRM SURFACE QUICKLY WIPE ANY FOREIGN MATTER FROM HIS MOUTH AND THROAT.

2. TILT HIS HEAD BACK.

LIFT HIS HEAD AND TILT IT BACK AS FAR AS POSSIBLE TO OPEN THE AIRWAY TO HIS LUNGS.

RAISE SHOULDERS TO CLEAR AIRWAY.

3. INFLATE HIS LUNGS

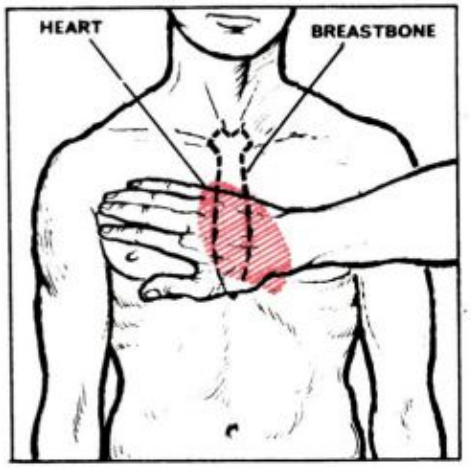
GIVE HIM FOUR DEEP BREATHS AT A RAPID RATE THEN CONTINUE AT ABOUT TWELVE BREATHS PER MINUTE UNTIL NATURAL BREATHING IS RESTORED.

4. APPLY HEART RESUS ITATION ONLY IF YOU ARE SURE THAT THE VICTIMS HEART HAS STOPPED BEATING.

HEART LUNG RESUSCITATION

1. LOCATE HIS BREASTBONE.

FEEL FOR THE TOP OF THE BREASTBONE AT HIS THROAT AND THE BOTTOM AT THE "V" OF HIS RIBS. PUT THE HEELS OF YOUR HANDS ON TOP OF EACH OTHER OVER THE THE LOWER HALF OF THE BREASTBONE KEEPING YOUR FINGERS OFF HIS CHEST.



2A. APPLY HEART RESUSCITATION (ONE OPERATOR)

LEAN OVER HIS CHEST KEEPING YOUR ARMS STRAIGHT. COMPRESS HIS CHEST FIFTEEN TIMES AT ONE SECOND INTERVALS. DEPRESS CHEST 35 TO 50 MM. RETURN TO HIS FACE AND GIVE TWO BREATHS AFTER EVERY FIFTEEN COMPRESSIONS.

2B. APPLY HEART RESUSCITATION (TWO OPERATORS)

AS ONE RESCUER COMMENCES ARTIFICIAL RESPIRATION THE OTHER CHECKS FOR HEART BEAT THEN APPLIES HEART RESUSCITATION IF NECESSARY. COMPRESS CHEST FIVE TIMES AFTER EACH INFLATION OF THE LUNGS WHILST THE VICTIM IS EXHALING.

3. CONTINUE HEART-LUNG RESUSCITATION UNTIL THE PATIENT REVIVES OR A DOCTOR PRONOUNCES LIFE EXTINCT.

C-26 ELECTRICAL ACCIDENTS - RESCUE PROCEDURE

RESCUE STEPS

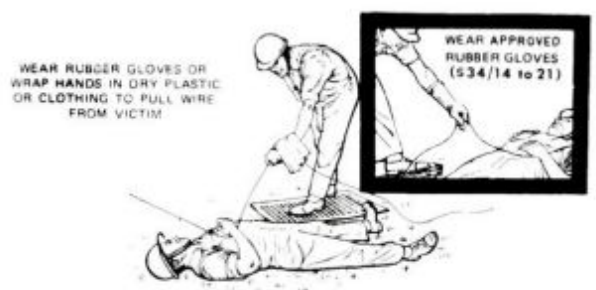
1. FREE VICTIM FROM CONTACT WITH LIVE WIRE OR EQUIPMENT IF HE IS STILL TOUCHING IT. Switch off power if possible. Call for assistance from fellow workmate or the public. Every second of delay in freeing him greatly reduces the victim's chance of recovery.
2. IF VICTIM IS NOT BREATHING·COMMENCE LUNG OR IF NECESSARY HEART-LUNG RESUSCITATION. Continue without interruption until he breathes naturally or a doctor pronounces, Life Extinct.
3. SEND FOR MEDICAL ASSISTANCE AS SOON AS POSSIBLE.

WHEN FREEING VICTIM FROM LIVE WIRE INSULATE YOURSELF AGAINST ELECTRIC SHOCK:

1. Wear rubber gloves or wrap your hands with several thicknesses of plastic or dry cloth, or
2. Wear rubber boots or stand on a rubber mat, dry timber, dry clothing or plastic.
3. Push or pull victim away from wire or wire away from victim with dry rope, safety belt, plastic cable, drop wire, dry timber or other insulating material.

For low voltage use a combination of two items wherever possible.

4. If the victim is in contact with a live high voltage conductor do not handle the body or the conductor. The measures explained in 1, 2 and 3 would not be effective against high voltage and the victim would, most likely, be beyond help.



FREE VICTIM BY THE QUICKEST MEANS USING AVAILABLE EQUIPMENT AND WITHOUT ENDANGERING THE RESCUER

Issue 1, 1976.

MANHOLE RESCUE

SAFETY LINE

Every Cable Jointer must be equipped with a Safety Line to assist in rescuing him if he should be injured or overcome by gas while working in a manhole.

The Safety Line (S.116/38) consists of a 12 metre length of 12 mm manilla rope with a snap hook spliced to one end.

When working in a manhole where a second man is necessary, e.g. roadway manhole, manhole over 2 m in depth or where gas has been detected, place the Safety Line over the manhole guard and hang the snap hook end down the manhole.

REMOVAL OF UNCONSCIOUS MAN FROM MANHOLE

If it is suspected that the workman has been overcome by gas he must be removed from the manhole as quickly as possible.

Call for assistance from other workmen or passers by.

Send for an ambulance or doctor.

Look for cause of the accident (gas, electrical, fallen material, etc.) and take precautions accordingly.

Enter manhole with safety line.

Turn victim on his back. Move his head and shoulders under the manhole opening if possible.

Pass Safety Line under his armpits and clip snap hook around the rope.

Leave manhole and haul victim to the surface.

If breathing has stopped apply artificial respiration.

When victim regains consciousness keep him quiet and warm until assistance arrives.

SAFETY LINE

DANGER TO RESCUER FROM GAS

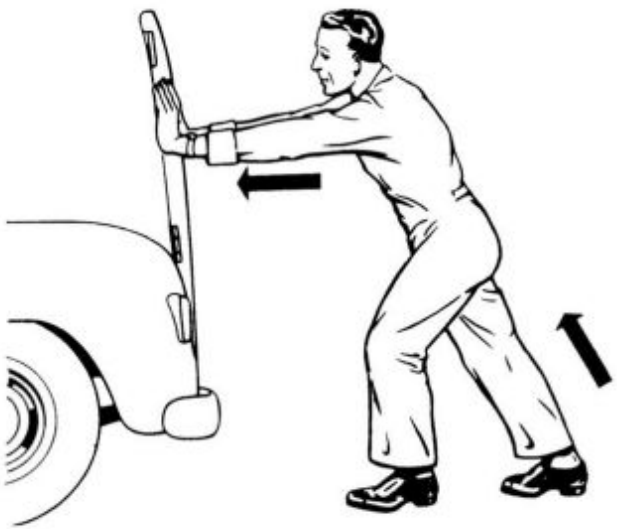
As rescuer will be in the manhole for only a short time he is unlikely to be overcome by gas but he must be alert for indications of the effects (headache, dizziness or nausea) and leave the manhole immediately if affected. Spend short periods in manhole intersperced with short rests in the open air to avoid being overcome.

LIFTING AND HANDLING MATERIAL AND EQUIPMENT

DEVELOP CORRECT LIFTING TECHNIQUES TO AVOID INJURY. Strained back muscles, slipped or ruptured spinal discs, hernia and other painful injuries result from incorrect methods.

SEVEN STEPS FOR SAFE LIFTING, PUSHING OR PULLING

1. Position your feet correctly for balance.
2. Maintain a straight back.
3. Keep your head erect and your chin in.
4. Make the maximum use of your powerful leg muscles.
5. Obtain a proper hold on the object.
6. Keep your arms close to your body when lifting.
7. Use your body weight.

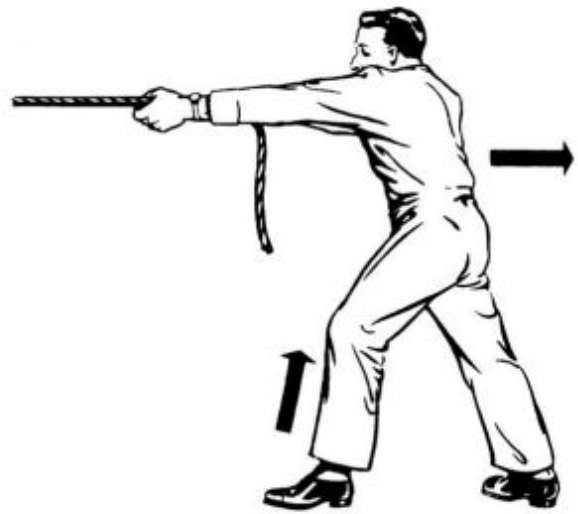


PUSHING

One foot forward to provide balance, rear foot gives thrust, back kept straight.

LIFTING

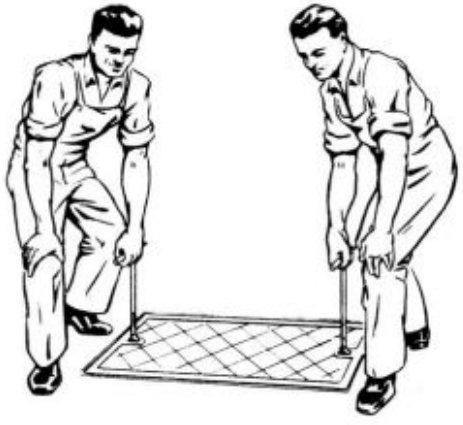
Back kept straight, lifting done with powerful leg muscles.



PULLING

Advanced leg with knee bent gives thrust, rear foot safeguards balance, back kept straight.

LIFTING MANHOLE AND JOINTING PIT COVERS



LIFTING MANHOLE COVER

Point your advanced foot in the direction of travel.

Place your unoccupied hand on your knee.

Keep your head up and your chin in.

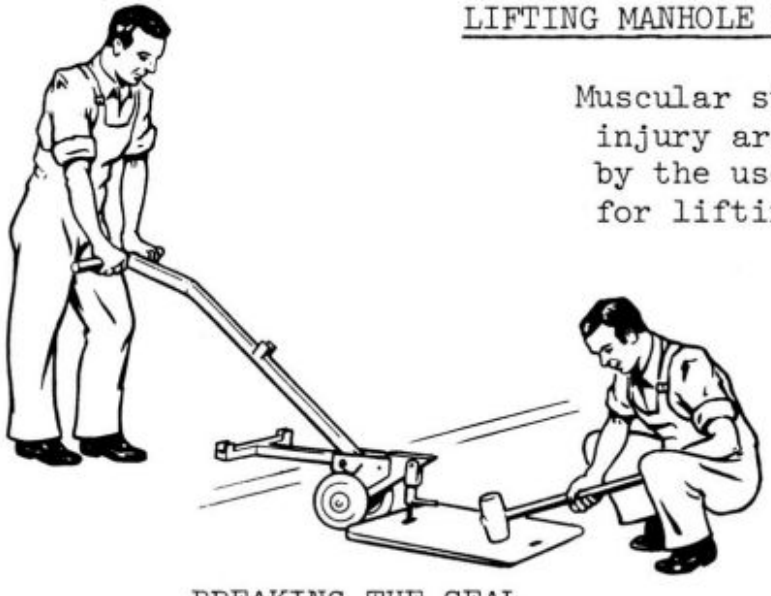
Keep your back straight, and lift with your legs.

Always get assistance to lift heavy manhole covers.

LIFTING PIT COVER

LIFTING MANHOLE COVER WITH SPECIAL LEVER

Muscular strain and the risk of injury are considerably reduced by the use of mechanical devices for lifting heavy manhole covers.



BREAKING THE SEAL

LIFTING THE COVER

Shovelling: Many strains occur while using a shovel so select the right type of shovel for the job. Where material is being transferred to other than a specific area the long-handled shovel may be ideal.

Where material is being handled by a shovel in a confined space or where granular material is being handled, a short-handled shovel may be preferred.

STEP	KEY POINTS
Shovelling - (Long Handle)	Place feet apart one behind the other. Bend the forward knee. Grasp shovel handle as follows : Near the top of the handle with the hand on same side as back foot. Slightly over half way down the handle with the hand on the same side as the front foot. Use body weight and thrust of rear leg to drive shovel blade under the material. (Where necessary use front foot to drive shovel.) Withdraw load. Press down with rear hand and straighten front knee to raise load. Deliver load pivotting on feet using front hand as fulcrum.

STEP	KEY POINTS
Shovelling - (Short Handle)	Place feet apart. Bend knees keeping back "straight" and inclined forward. Drive shovel under material by thrusting with rear leg and leaning body downwards and forwards. (If necessary use front foot to drive shovel.) Withdraw load. Place back of rear hand on rear thigh, then raise load by straightening forward leg and bringing the back to a vertical position. Pivot on feet to delivery load.

METHODS OF SHOVELLING

CHECK THE LOCATION OF ELECTRICAL POWER CABLES AND GAS AND WATER MAINS BEFORE COMMENCING TO EXCAVATE.
IF AN OBSTRUCTION IS ENCOUNTERED WHEN EXCAVATING UNCOVER IT CAREFULLY - IT MAY BE A DANGEROUS POWER CABLE, GAS OR WATER MAIN.

HAZARDS WITH HAND TOOLS

HOT SOLDERING TOOLS CAN CAUSE SEVERE BURNS

Test whether the tool is hot enough with a piece of solder held against the tip.

DON'T HOLD THE TOOL NEAR YOUR FACE OR HAND TO FEEL ITS HEAT.

Always solder with your face above the job. Falling molten solder can cause a severe burn. Don't flick solder off the tip of the tool.

Watch where you place a hot tool - it can set fire to combustible material.

SCREWDRIVERS CAN GIVE SERIOUS PUNCTURED WOUNDS.

Always use the correct size screwdriver for the job.

Make sure the blade is shaped correctly and the end blunt and square.

Don't use a screwdriver as a chisel or carry it in your pocket.

Keep your free hand away from the end of the blade so that there is no chance of injury if the screwdriver slips.

COLD CHISELS OR GADS WITH MUSHROOMED HEADS ARE SAFETY HAZARDS

Injuries are caused by hammers glancing off the head and by flying metal splinters.

Grind the head to a slight taper for safe work.

A FILE OR RASP WITHOUT A HANDLE IS DANGEROUS

The handle makes it much easier to use and prevents painful injuries.

AVOID INJURY WHEN USING CUTTING TOOLS

Store sharp edged tools such as knives, chisels and saws with a guard over the cutting edge. This protects you from cuts and also protects the cutting edge from damage.

Never cut towards your hand or body with a knife or chisel.

Issue 1, 1976.

DANGERS IN HANDLING LEAD

When handling lead (including lead covered cables) it is essential to prevent any trace of lead entering the body as it may cause lead poisoning.

DO NOT EAT, DRINK OR SMOKE WHILE HANDLING LEAD.

Wash your hands and face with soap and running water and clean your finger nails with a nail brush before eating a meal or rolling or smoking a cigarette. After washing do not get lead dust from your clothes on your hands, and be careful that lead dust does not get in your food.

Never use a knife that has been used to cut lead to cut food as any trace of lead entering your body by the mouth or nose may cause lead poisoning.

Clean your mouth and teeth regularly, watch for digestive upsets and avoid constipation.

SAFETY WHEN WORKING ON POLES

Provide a secure footing for the ladder. Tie the bottom rung to the pole if there is any danger of it slipping.

Place head of the ladder so that the chain straddles the pole.

Tie the head of the ladder to the pole immediately you climb it.

WEAR A SAFETY BELT AND HELMET WHENEVER YOU CLIMB A POLE. FASTEN IT AS SOON AS YOU REACH THE WORKING POSITION.

Don't stand on top of the ladder stiles. Get a longer ladder.

WORKING IN MANHOLES AND TUNNELS

Refer page L-7 (C.J.I.) for safety precautions to be observed when working in manholes and tunnels.

FIRST AID - TREATMENT OF BURNS

BE VERY CAREFUL TO AVOID BURNS WHEN OPERATING L.P.G. PLUMBING EQUIPMENT AND SOLDERING IRONS AND WHEN WORKING CLOSE TO OTHER HOT MATERIAL OR EQUIPMENT.

TREATMENT FOR BURNS

Superficial Burns :

Where there is reddening of the skin and minor blister formation :

(i) Wash with cold running water.
(ii) Apply cold compresses. This greatly reduces the pain and swelling.
(iii) Cover with a clean dressing (preferably sterile) to prevent infection, and bandage firmly.

Deep Burns

(i) Remove or cut away clothing over the burned area but leave any clothing that is stuck.
(ii) Wash liberally with cold water.
(iii) Cover the burned area with a sterile or clean dressing and bandage securely.
Cover large burns with a clean sheet or towel.
For burns of the face leave an adequate airway.

NOTE: Do not apply lotions, ointments or oily dressings.
Do not prick blisters.

(iv) If the casualty is thirsty or if there is a long delay before the arrival of medical aid, give small amount of water or tea unless he is unconscious.

(v) Transport the casualty to medical aid without delay..

ACCIDENTS

REPORT ALL ACCIDENTS INVOLVING PERSONAL INJURY TO YOUR LINES SUPERVISOR OR LINE INSPECTOR AS SOON AS POSSIBLE AFTER THE OCCURRENCE.

An Accident Report, Form P.400, must be prepared for all accidents involving personal injury, damage to plant or equipment which could have caused injury or the contracting of a disease due to employment.

An injury which may appear only slight when it is sustained may develop into something more serious later. It is essential, therefore, that all injuries, however minor, be reported and placed on record. If there is no official record you may find it difficult to substantiate a claim for compensation if this becomes necessary.

The onus is on you to prove that the injury was sustained on duty or when travelling to or from work by the usual route.

Treat minor cuts and abrasions immediately. What is a minor scratch today may become a major injury next week if it becomes infected.

Keep a portable First Aid Kit in your cable jointers trailer and see that items used are replaced promptly.

Read your First Aid booklet and learn how to treat injuries correctly.

IT IS YOUR RESPONSIBILITY TO :

1. Work safely and follow the safety rules made for your protection.
2. Use the safety equipment provided by the Commission.
3. Dress in a manner which will assist in protecting you from injury.
4. REPORT ANY ACCIDENTS PROMPTLY.

PROTECTIVE CLOTHING

OVERALLS AND APRONS: Overalls, bib and brace or combination are supplied in addition aprons should be worn when the load is wet, dirty or greasy. There is a tendency for loads to be held away from the body to protect the clothing. This posture results in increased loading of the back, arms and shoulder muscles causing strains.

PROTECTIVE GLOVES: Should be worn when the materials being handled may cause injury to the hands. The gloves should be of a type suitable for the purpose.
Gloves should not be used where a critical sense of touch is required; they should not have protruding tips which may catch on projections. GLOVES SHOULD NOT BE USED NEAR MOVING PARTS OF MACHINERY.

PROTECTIVE PADS: To protect the palms of the hands protective pads should be used when handling heavy loads with narrow bearing surfaces which cause localised pressure on the hand.

PROTECTIVE FOOTWEAR: Safety boots and shoes fitted with protective steel toe caps, should be worn in situations where there is a danger of foot injuries.

PROTECTIVE GOGGLES: Use when working close to pneumatic tools especially where pavements or manhole holes are being cut or broken, or other similar operations where eye injuries can occur from flying particles.

SAFETY HELMETS: Should be worn on all Lines work operations with the exception of Cable Jointing. However, where jointers are working adjacent to other operations such as a drop-wire party, the jointer should also wear a safety helmet.

EAR MUFFS.

Ear muffs must be worn in the following situations :

(i) When operating breakers, drifters, spaders and other pneumatic impact tools.

(ii) When operating gasoline engine driven chain saws.

(iii) When working in close proximity to tools mentioned in (i) and (ii) above, particularly in the case of pneumatic tools if they are being operated in confined spaces such as deep trenches, chambers and tunnels.

(iv) When operating or working in close proximity to machines which produce high noise levels. Such machines have been identified and are appropriately marked.

(v) When using or working close to explosive powered tools in a confined space.

(vi) Other situations considered necessary by the Supervisor, Line Inspector or Engineer in charge of the work.

A.T.C. ENGINEERING INSTRUCTION REFERENCES

Lines General	SP 1000
Lines General	SP 4000
Lines General	SP 9000
Lines General	SP 9010
Lines General	SP 9012
Lines Aerial	SP 9111
Lines Cable	SP 9001
Lines Cable	SP 9101
Lines Cable	TE 1405
Lines Conduit	SP 9301

PROTECTION OF CABLES

(This section to be issued at later stage)

12N AND 120 CIRCUIT SYSTEMS

(This section to be issued at later stage)

JOINTING CARRIER CABLES

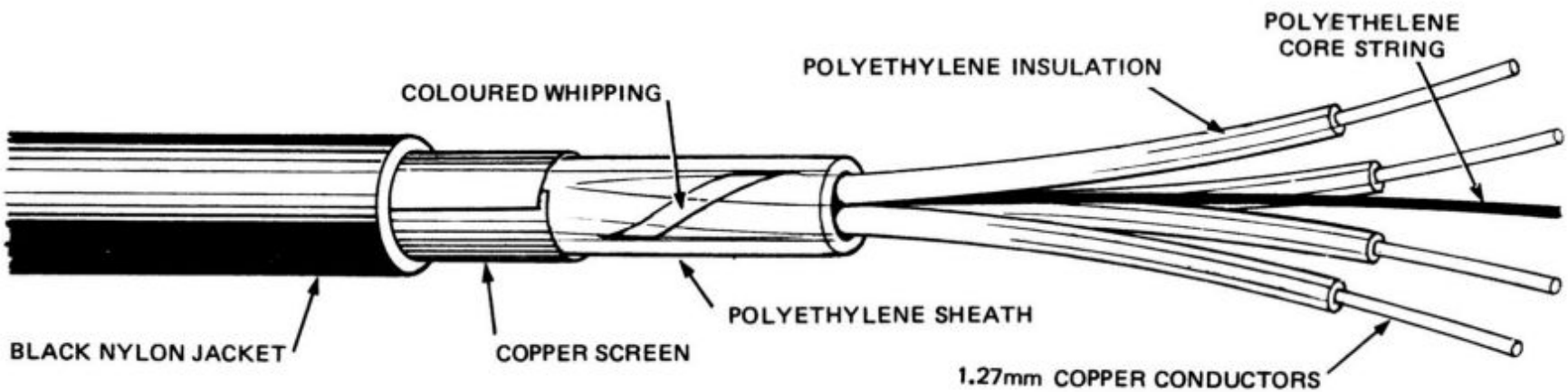
SECTION: I – 2/1.27 mm PEIQC CABLE

Issue 1, 1975.

2/1.27 mm PEIQC CABLE JOINT
(Single Quad Carrier Cable)

CONSTRUCTION DETAILS

Polyethylene insulated single quad Carrier Cable Copper Screened Hard Plastic Jacketed 2/1.27 mm (S480/5580) Type A, (5581) for Type B. This cable consists of four 1.27 mm copper conductors insulated with polyethylene and formed into a quad over a centre core of solid polyethylene. The Quad is whipped with a coloured identifying tape. Blue whipping is used to identify the Type A cable and orange whipping to identify the Type B cable. The cable has a polyethylene sheath covered with a copper tape screen with the whole cable enclosed in a black nylon jacket.



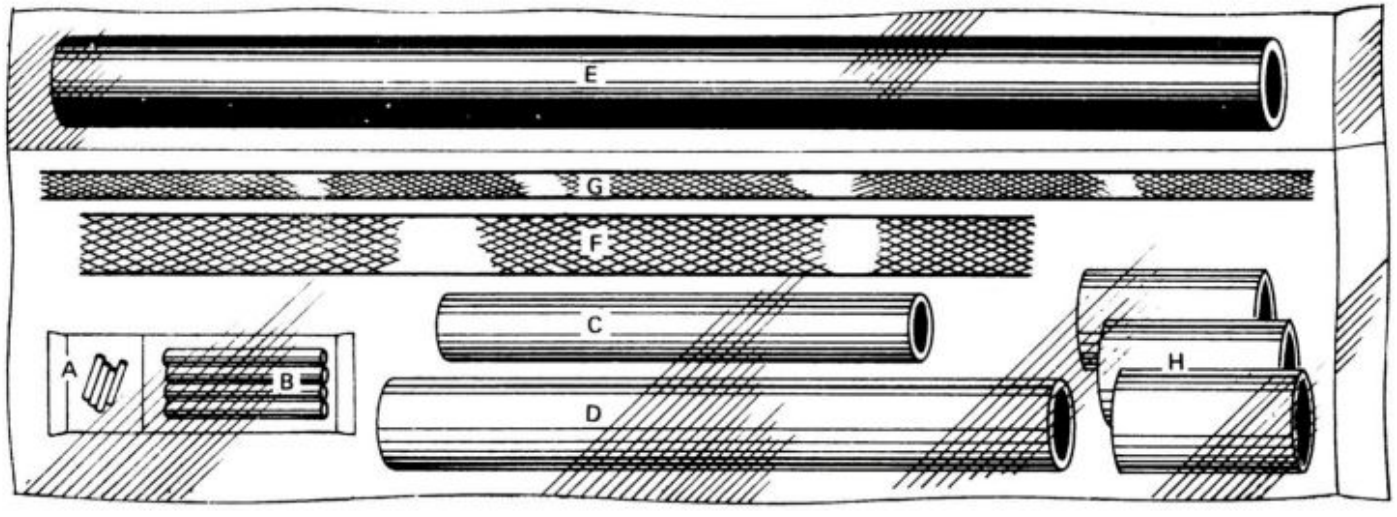
CABLE CONSTRUCTION

Issue 1, 1975.

2/1.27 mm PEIQC CABLE JOINT

JOINTING KIT (S.433/202,203) - Each jointing kit contains material for one joint.

Item	Quantity	Description
A	4	10 mm Split sleeves, tinned copper, for jointing 1.27 mm conductors.
B	4	45 x 3 mm dia. Brown S.C.L. (Selectively Cross-linked thermo-shrinkable sleeves.)
C	1	120 x 13 mm dia. Blue S.C.L. thermo-shrinkable sleeve.
D	1	185 x 19 mm dia. Yellow S.C.L. thermo-shrinkable sleeve.
E	1	305 x 19 mm dia. Black thermofit cable sleeve adhesively lined.
F	1	Braid, tin-plated copper - 13 mm wide x 255 mm long.
G	1	Braid, tin-plated copper - 6 mm wide x 305 mm long.
H	3	50 x 19 mm dia. Blue or Orange thermo-shrinkable cable identification sleeves.



JOINTING KIT - S.433/202,203 - 2/1.27 mm PEIQC CABLE

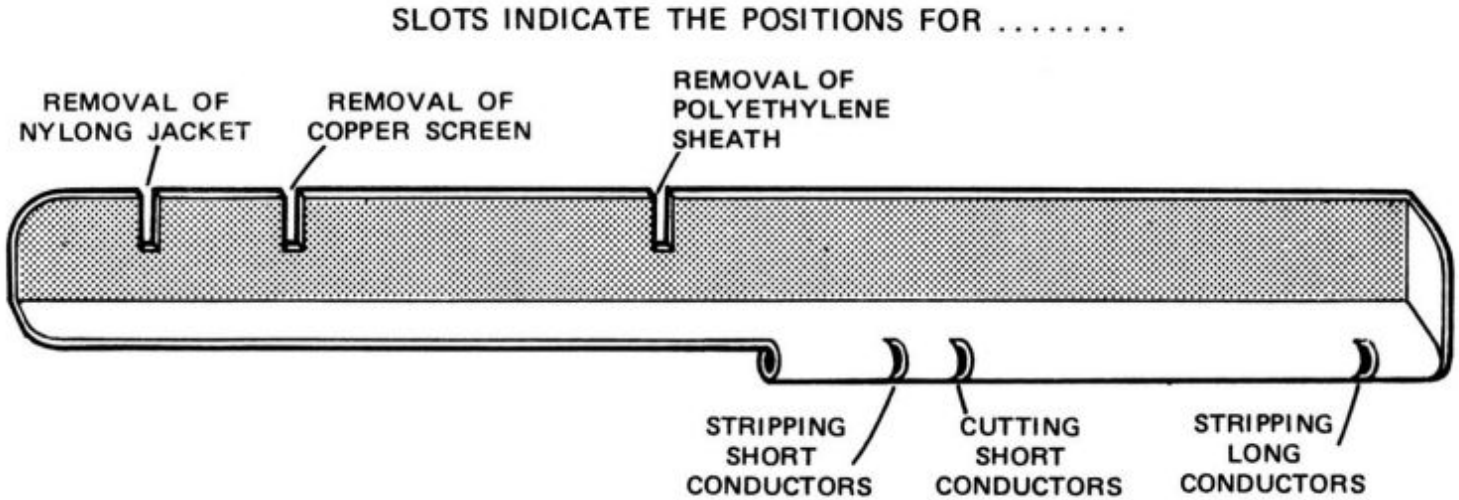
2/1.27 mm PEIQC CABLE JOINT

JOINTING KITS

Two kits are available with different identification sleeves. The kits are S.433/202 (Raychem No. TJK-1), with blue sleeves, for jointing type A cables and S.433/203 (Raychem No. TJK-2), with orange sleeves, for jointing type B cables.
Avoid storing kits in direct sunlight. In hot weather the adhesive in the black cable sleeve may "run".

STRIPPING GUIDE

The cable stripping guide is used to obtain indentical dimensions for each cable thus simplifying the preparations for jointing.

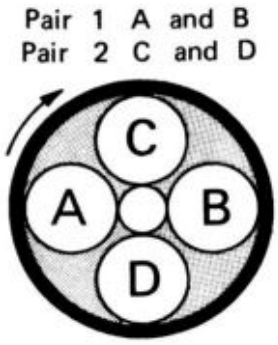


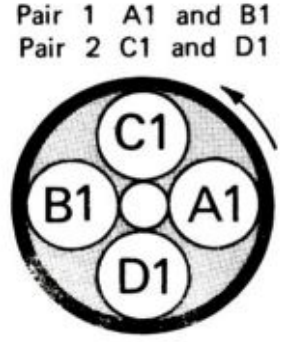
CABLE STRIPPING GUIDE, 2/1.27 mm PEIQC CABLE

Issue 1, 1975.

2/1.27 mm PEIQC CABLE JOINT

TYPES OF JOINTS





2/1.27 mm (2/40) PEIQC CABLE - PAIR ARRANGEMENTS WITH CABLE ENDS VIEWED FROM CENTRE OF JOINT OPENING

The jointing methods may be one of the following:

(i) The four wires of the cable jointed straight through, A to A1, B to B1, C to C1 and D to D1.

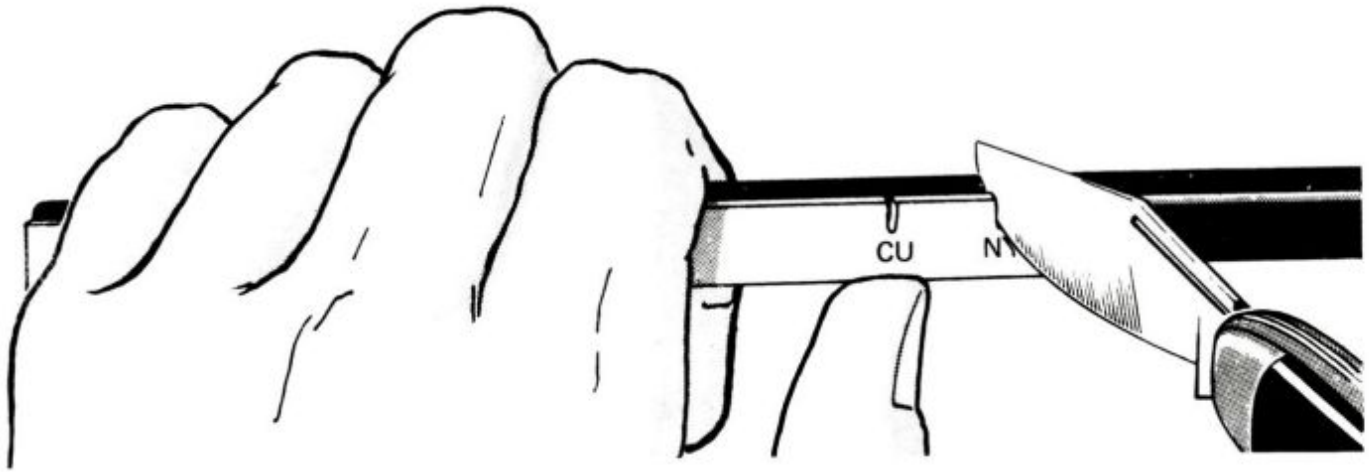
(ii) PAIR 1 jointed straight through, and PAIR 2 transposed, A to A1, B to B1, C to D1 and D to C1.

(iii) PAIR 1 transposed and PAIR 2 jointed straight through, A to B1, B to A1, C to C1 and D to D1.

CABLE PREPARATION

Thoroughly wipe with a clean cloth one cable end of the nylon jacket for about 1 metre, then rewipe with clean cotton waste moistened with methylated spirit. Remove and recover the cable and seal by cutting the last 75 mm from the cable end. Insert cable into the right angular section of the cable stripping guide ensuring that the cable end abuts the closed end of guide. Hold cable firmly in position and using a pocket knife mark cable at the nylon jacket removal mark (slot marked "Ny").

2/1.27 mm PEIQC CABLE JOINT



MARKING THE CABLE

CUTTING CABLE SHEATH

Avoid scoring or damaging the underlying screen during the following steps:

Remove cable from the guide and make a circumferential cut around the nylon jacket at the marked position.

Flex cable about this cut to break the nylon jacket and then re-insert cable end into the guide and mark the surface of the copper screen at both the copper screen removal position ("Cu"), and the sheath removal position ("Pe"). Withdraw the cable from the guide, and extend the marks around the circumference of the screen. Tear away and remove the copper screen using the score mark at the "Pe" position as a guide.

CARE IN HANDLING POLYETHYLENE SURFACES

Do not remove the section of copper screen between the "Pe" and "Cu" marks as its retention serves to keep the polyethylene underneath from being handled during jointing operations.

CARE IN HANDLING POLYETHYLENE SURFACES

If at any stage the polyethylene surfaces are fingered, wipe them with a lint free cloth, well moistened with methylated spirit to clean them and to improve the bonding when the tubes are subsequently shrunk.

REMOVING IDENTIFICATION TAPE

Cut away the manufacturer's identifiction tape at the "Pe" position. Make a light circumferential cut on the polyethylene sheath. Flex the cable about this cut to break the sheath.

REMOVING POLYETHYLENE SHEATH

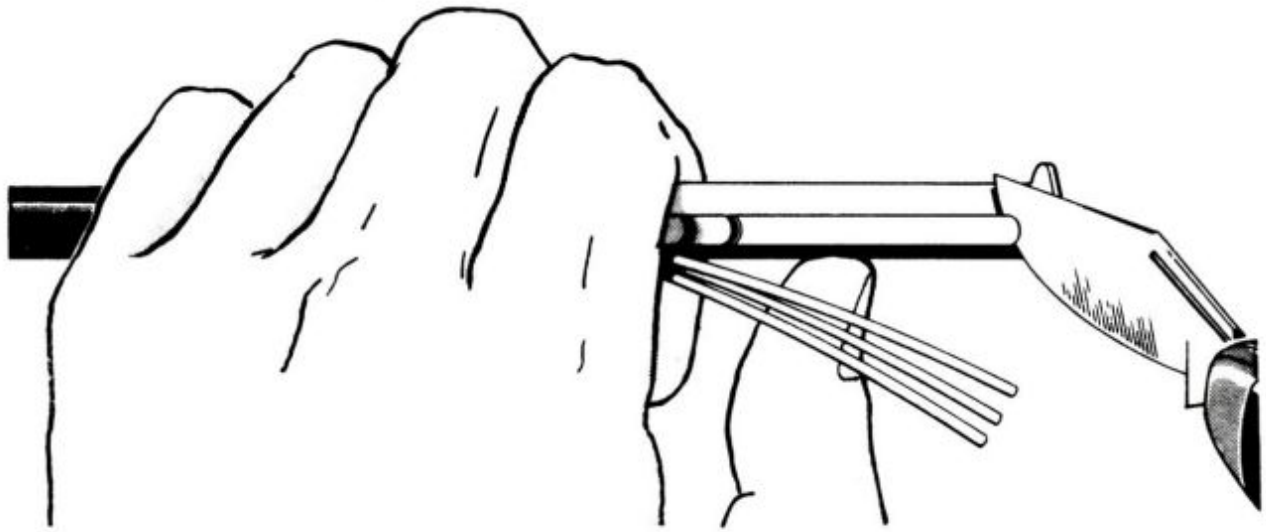
Remove the unwanted section of polyethylene sheath with the MHJ sheath stripper. Set the stripper so that the shortest cutting blade is used. Loosen and remove the polyethylene wrapping from around the conductors. Cut and remove the coloured whipping tape close to the polyethylene sheath end. Separate the conductors and cut and remove the centre polyethylene core string. Check the conductor insulation for damage or nicks resulting from the sheath removal. If the conductor is exposed, cut away the damaged conductors and recommence the cable preparation.

MARKING THE CONDUCTOR

Select a conductor from PAIR 1 and insert it into the tubular section of the guide, check that its end firmly abuts the closed end of the tube. Using a pocket knife make a score in the insulation at position 1 on the guide. Withdraw conductor from the guide. Remove the insulation from the conductor by applying the "V"-jaw strippers (S457/41) at the score mark.

Repeat for the second conductor of PAIR 1.

2/1.27 mm PEIQC CABLE JOINT



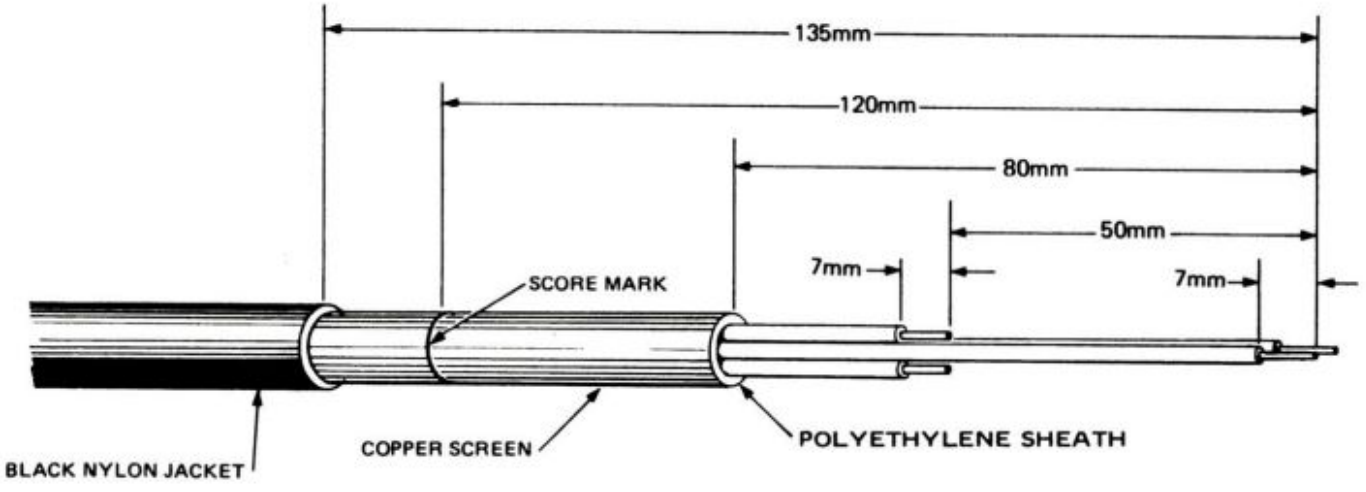
MARKING THE CONDUCTOR

MARKING SECOND PAIR

Select a conductor from PAIR 2, and insert it into the small tubular section of the guide. Score the insulation at position 2 and position 3. Withdraw the conductor. Cut the conductor at the position 2 mark. Strip the insulation from the position 3 mart.

Repeat for the second conductor of PAIR 2.

Prepare the second cable end the same way interchanging the conductors of PAIR 1 with those of PAIR 2.



PREPARED CABLE END

MARKING THE JOINT

Place in sequence the following items over one cable end:
2 off 19 x 50 mm blue (type A) or orange (type B) Cable Identification sleeves (3 sleeves if an external earth is required).
1 off 19 x 305 mm black thermofit cable sleeve adhesively lined.

FITTING BRAID SLEEVE

One Braid, tin plated copper sleeve 13 x 255 mm. To fit the braid sleeve over the cable, first expand it by sliding it over a suitable tubular object (e.g. piece of cable or dowel and push the sleeve ends together).
One 19 x 185 mm Yellow S.C.L. thermo-shrinkable sleeve.
One 13 x 120 mm blue S.C.L. thermo-shrinkable sleeve.

2/1.27 mm PEIQC CABLE JOINT

FITTING BRAID SLEEVE (CONT'D)

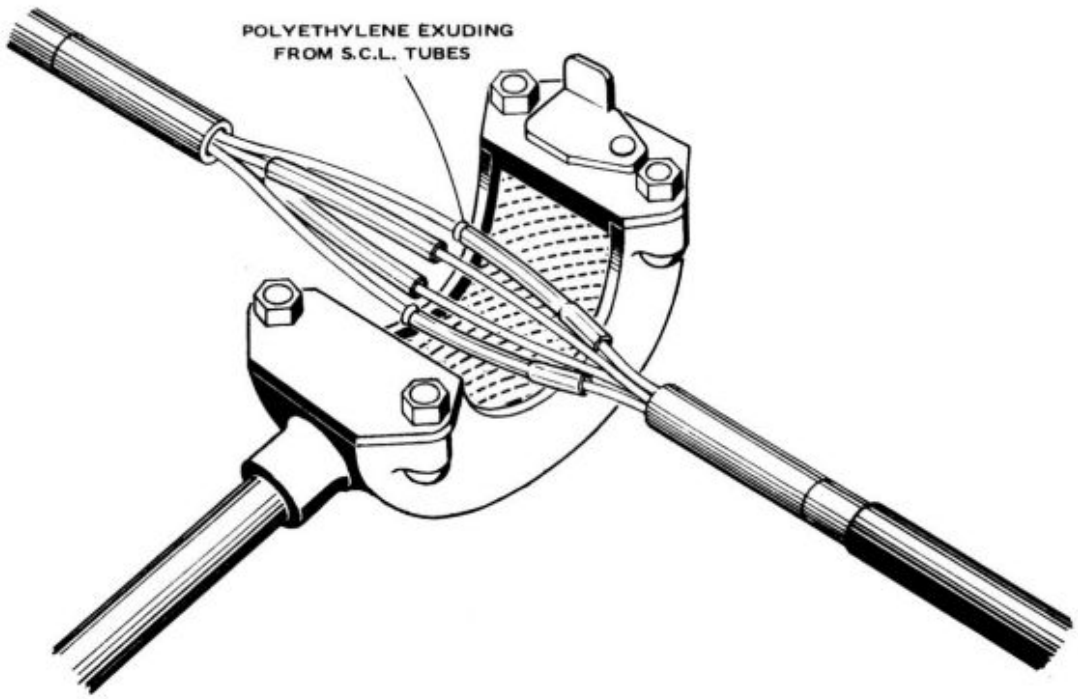
Prevent the sleeves from passing beyond the cleaned section of the nylon sheath by tying a cloth around the cable. Place cable in one end of jointing jig. Tighten the jig clamps and secure cable. Tin the four conductor ends and fit a 10 mm split sleeve with its slot facing upwards, to each conductor. Lay the second cable into the other jig clamp, align the conductors to be jointed together in each cable, tighten the clamp then tin the conductor ends.

JOINTING CONDUCTORS

Over each of the four long conductor ends, place a 3 mm diameter brown S.C.L. sleeve. Place the four conductors of the second cable into their appropriate split sleeves, transposing the wires if required. Push the cables together so that the conductors to be jointed abut in each sleeve. Centre the 10 mm split sleeves in the space between the conductor insulation. Solder each in turn. Do not use excessive heat, but ensure that solder flows around the bare 2 mm of conductor protruding from each end of the sleeve. Centre the brown S.C.L. sleeves over the four conductor joints. Separate the conductors from each other.

HEATING BROWN S.C.L. SLEEVES

Using the LP Gas torch fitted with the Semi-circular Radiant Heat Burner (Companion Part No.781) apply heat uniformly to the brown S.C.L. sleeves, working from the centre of the joint towards each end. Separate the four jointed conductors to enable the heat to circulate between the conductors and allow complete circumferential shrinkage of the S.C.L. sleeves. Continue heating, moving the torch constantly until a small ring of polyethylene exudes from each end of the sleeves.



SHRINKING THE 3 mm BROWN S.C.L. SLEEVES

USING A.C. POWER

Where 240 V A.C. power is available, a hot air blower, Raychem 1502/A-9 with reflector type PR12, or similar may be used as a heat source for shrinkable sleeves.

Allow sleeves to cool, and compact conductors neatly in the joint opening. Remove from each cable end the 40 mm copper screen which has previously been scored to facilitate tearing. Avoid touching the polyethylene sheath during this operation.

2/1.27 mm PEIQC CABLE JOINT

POSITIONING BLUE S.C.L. SLEEVE

Loosen the jig cable clamp and position the Blue S.C.L. sleeve centrally over the sheath opening. Retighten the cable clamp.

HEATING BLUE S.C.L. SLEEVE

Shrink the blue S.C.L. sleeve using the same method as for the brown S.C.L. sleeve until a ring of blue polyethylene exudes from each end.

BLUE S.C.L. SLEEVE APPLIED

Allow the sleeve to cool without disturbing

SOLDERING SCREEN

To simplify the subsequent reinstatement of screen continuity, tin with resin cored solder the two 15 mm sections of screen at each end of the joint. Use minimum heat on the copper screen to avoid melting the polyethylene sheath.

SEALING THE SHEATH

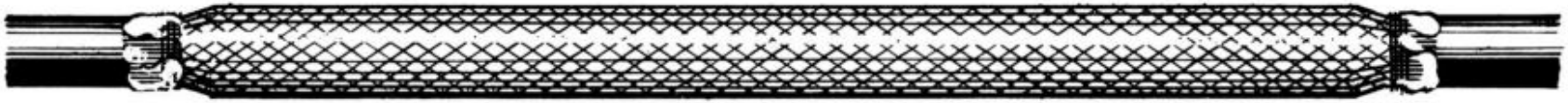
Loosen cable clamps and position the Yellow S.C.L. sleeve centrally between the copper screens. Retighten the cable clamp. Shrink the yellow S.C.L. sleeve using the same method as for the brown S.C.L. sleeve until a yellow ring of polyethylene exudes from each end.

POLYETHYLENE SHEATH SEALED (Allow to cool without disturbing.)

2/1.27 mm PEIQC CABLE JOINT

PROVIDING CONTINUITY OF COPPER SCREEN

Position the 255 mm length of tinned copper braid centrally over the joint and smooth it out so that each end covers the exposed tinned copper screen. Secure each end of the braid to the screen with two or three turns of 0.40 mm scrap copper wire. Solder each end of the braid to the screen.



CONTINUITY OF COPPER SCREEN RESTORED

PROVISION FOR EARTHING OF COPPER SCREEN

At the most convenient end of the joint, attach (with a few turns of 0.40 mm copper wire) the 6 mm wide x 305 mm length of braid to the continuity braid sleeve and lay it neatly along the cable so that it leads away from the joint. Solder the length of braid to the continuity braid sleeve. The outer end is ready for connection to an earth stake.

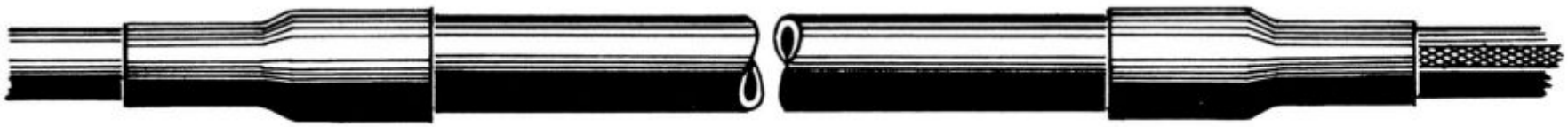
FITTING THE OUTER CABLE SLEEVE

Loosen the cable clamp and position the **black thermofit** cable sleeve centrally over the joint. Retighten the clamps. Apply heat uniformly to the sleeve starting at the centre and working out towards each end, until a uniform ring of bitumastic adhesive exudes from each end.

FITTING IDENTIFICATION SLEEVE

Finally, place on the 19 mm dia. x 50 mm **blue or orange** thermo-shrinkable sleeves centrally over each of the ends of the **black cable** sleeve, and shrink into position. This serves to identify the type A and type B cable and also to retain the adhesive which has exuded from beneath the **black cable sleeve.**

2/1.27 mm PEIQC CABLE JOINT



COMPLETED JOINT

FITTING SLEEVE ON EARTH BRAID

Where the tinned copper earth braid has been provided, place the third blue or orange sleeve over the braid, positioning it as far from the joint as is convenient, and shrink into place. This serves to relieve stress being applied to the joint via the earth lead.

HOUSING THE CABLE

Remove completed joint from the jig and house the cable in the pit or manhole.

ENGINEERING INSTRUCTION REFERENCES

E.I. LINES Cables J3800

Issue 1, 1975.

MX170 REPEATER AND EQUALISER

JOINTED TO SINGLE QUAD CARRIER CABLE

Issue 1, 1976

MX170 REPEATER JOINTED TO SINGLE QUAD CARRIER CABLE

GENERAL

The MX170 Repeater is fitted with a four pair 0.64 mm plastic jacketed paper insulated tail cable, about 3 m long. The 4/0.64 Repeater cable tail is jointed to two 2/1.27 mm Single Quad carrier cable tails 6 m long.

PROTECTING S.Q.C. CABLES

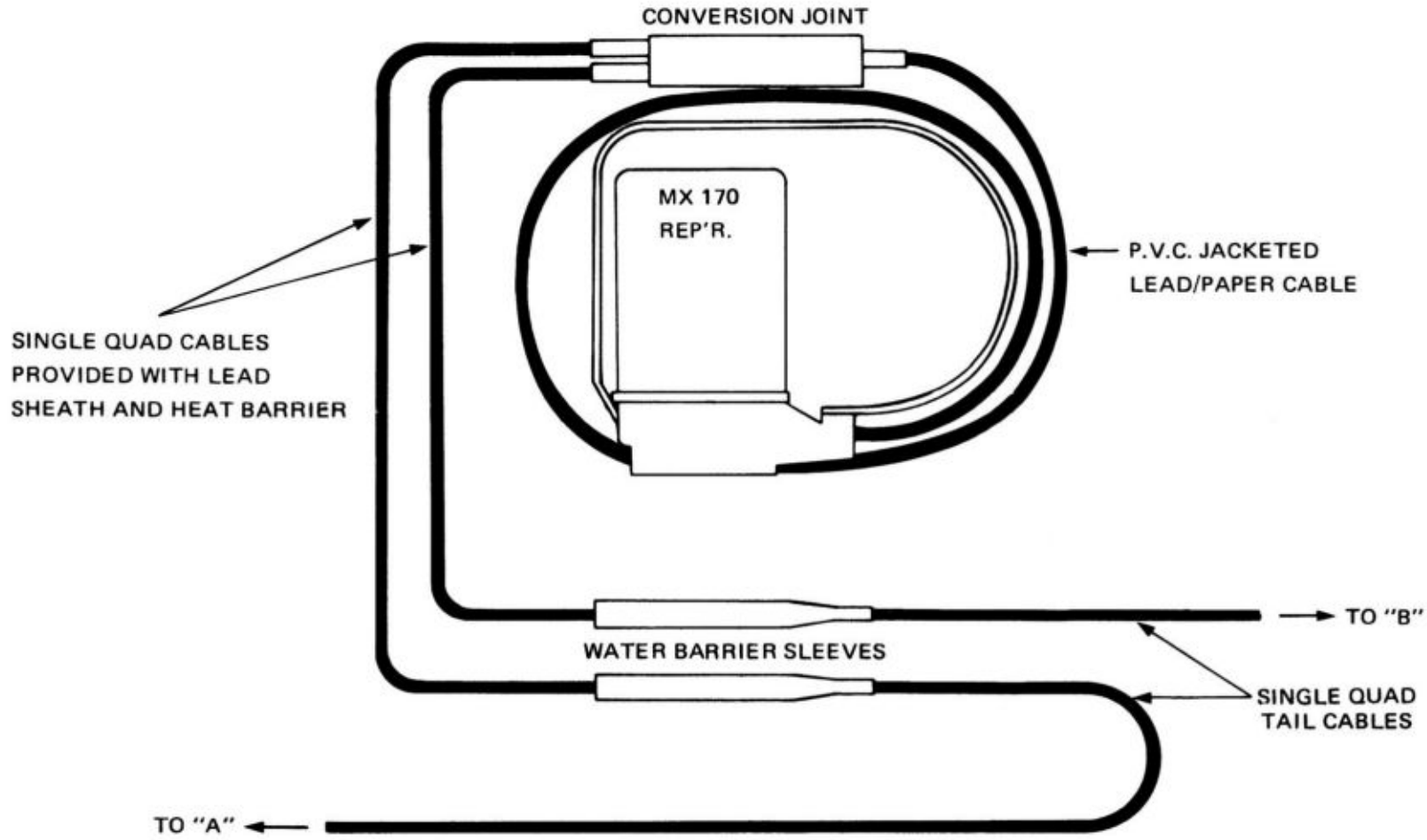
Before jointing, the Single Quad carrier cables are placed inside a 9.5 mm diameter asbestos tube (heat barrier) which are in turn placed in a 19 mm diameter lead sheath. The asbestos and lead sheath covers the single quad carrier cable between the conversion joint and the two water barrier sleeves. The tails are jointed to the S.Q.C. cable bearers by using the same method described in Section I-1 to I-14 (Jointing 2/1.27 mm P.E.I.Q.C. cable).

MX170 REPEATER

WARNING :

DANGEROUS GASES CAN ACCUMULATE IN MANHOLES AND TUNNELS. BEFORE ENTERING EITHER TEST FOR THE PRESENCE OF GAS.

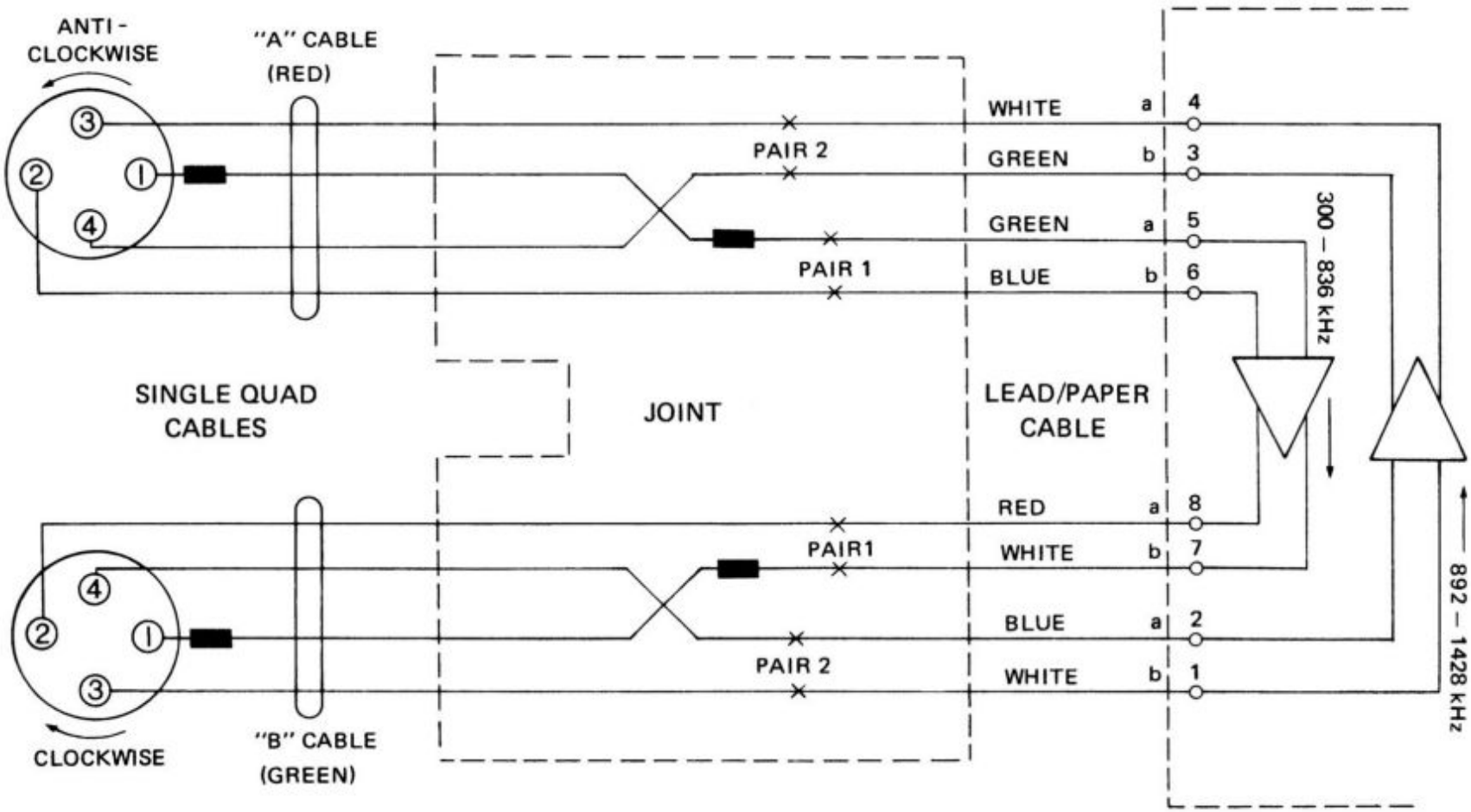
MX170 REPEATER JOINTED TO SINGLE QUAD CARRIER CABLE



MX170 REPEATER CONVERSION DETAILS

Issue 1, 1976

MX170 REPEATER JOINTED TO SINGLE QUAD CARRIER CABLE



JOINTING MX170 REPEATER TO S.Q.C. CABLE

SPACING REPEATERS

Repeaters are spaced at 3.66 km but after 8-10 dependent repeater sections the transmission performance is maintained by the installation of an equaliser, as directed by the Engineer or Technical Officer.

SUBSEQUENT ACCESS

Should entry to the conversion joints be necessary the slip sleeve can be removed by careful application of heat to the seals.

NOTE : Avoid overheating when removing the sleeve and re-sealing it because overheating may damage the polyethylene insulated cables.

THOROUGHLY DRY OUT MANHOLE NEAR JOINT BEFORE OPENING CABLES.
RETURN ALL SCRAP CABLE, LEAD SHEATH AND WIRE TO STORE ON COMPLETION OF THE JOB.
SAFE WORK DEPENDS UPON WELL KEPT TOOLS, USING THE RIGHT TOOL FOR THE JOB AND USING IT CORRECTLY.

MX172 REPEATER AND MX174 EQUALISER UNIT JOINTED TO SINGLE QUAD CARRIER CABLE

Issue 1, 1976

MX172 REPEATER JOINTED TO SINGLE QUAD CARRIER CABLE

GENERAL

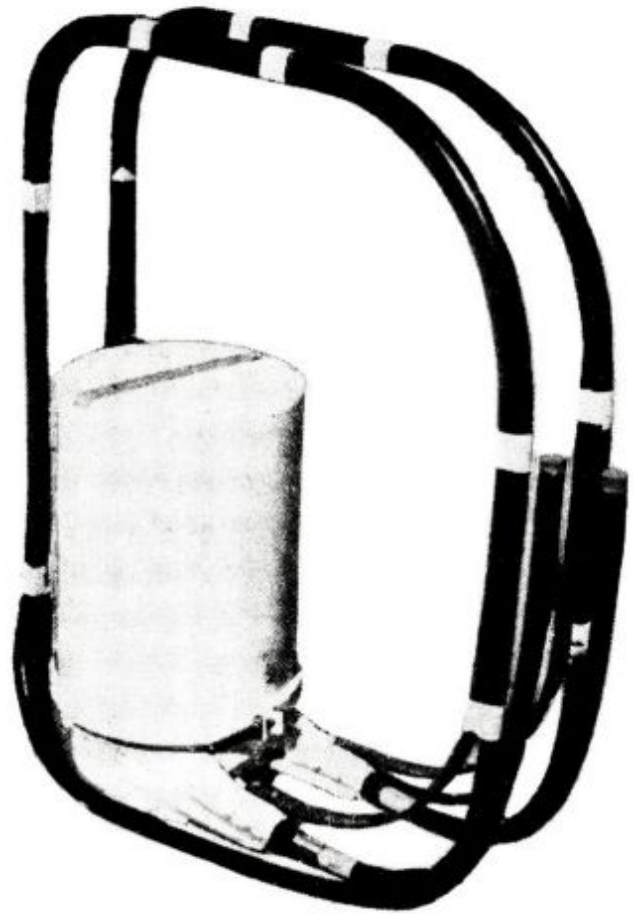
The MX172 Repeater is fitted with two 2/1.27 mm lead sheathed P.J. S.Q.C. cable tails. The tails are jointed to the S.Q.C. bearer cable by using the same method described in section I-1 to I-14 (Jointing 2/1.27 mm PEIQC cable).

SUPPORT BEARERS

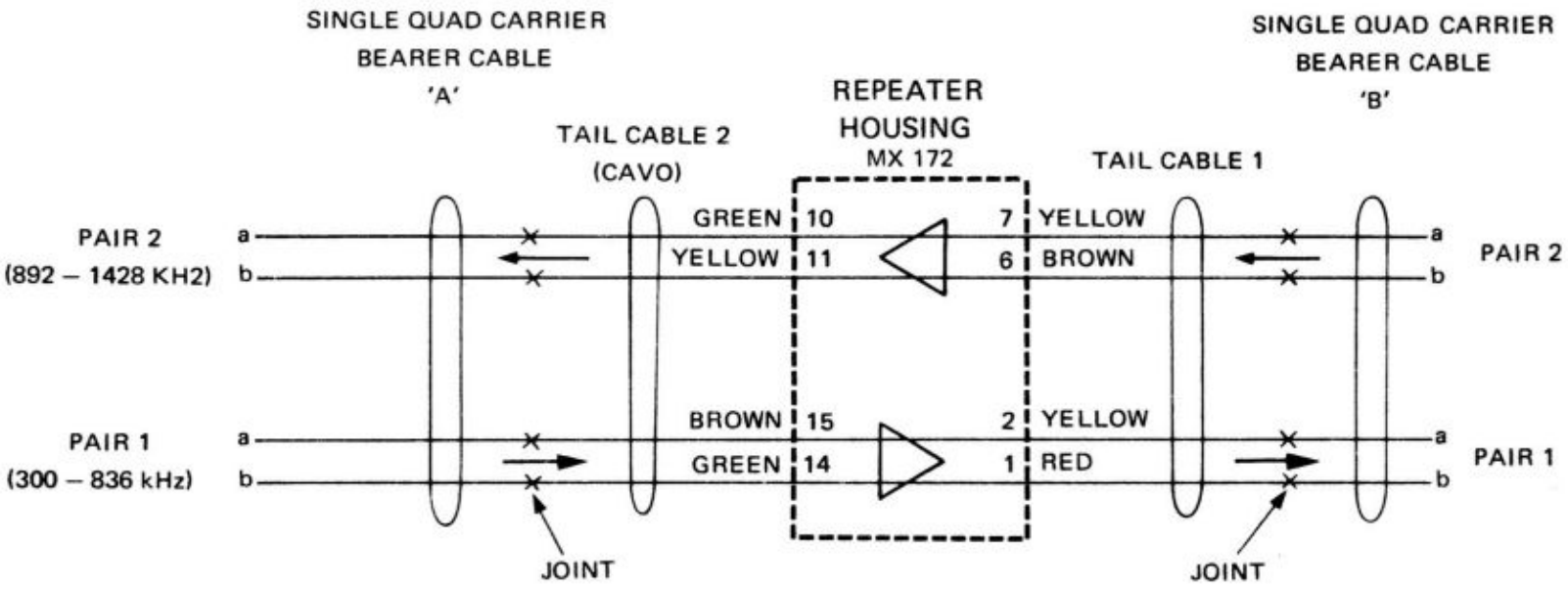
The Repeater is fitted with two support bearers and the cable tail attached. Both bearers are removed on installation of the repeater in manholes.

CARE IN HANDLING POLYETHYLENE SURFACES

When jointing the cable tails to S.Q.C. cable care must be taken not to handle the polyethylene surfaces more than necessary. If at any stage the polyethylene surfaces are fingered, wipe them with a lint free cloth, well moistened with methylated spirit to clean them and to improve the bonding when the tubes are subsequently shrunk.



MX172 REPEATER



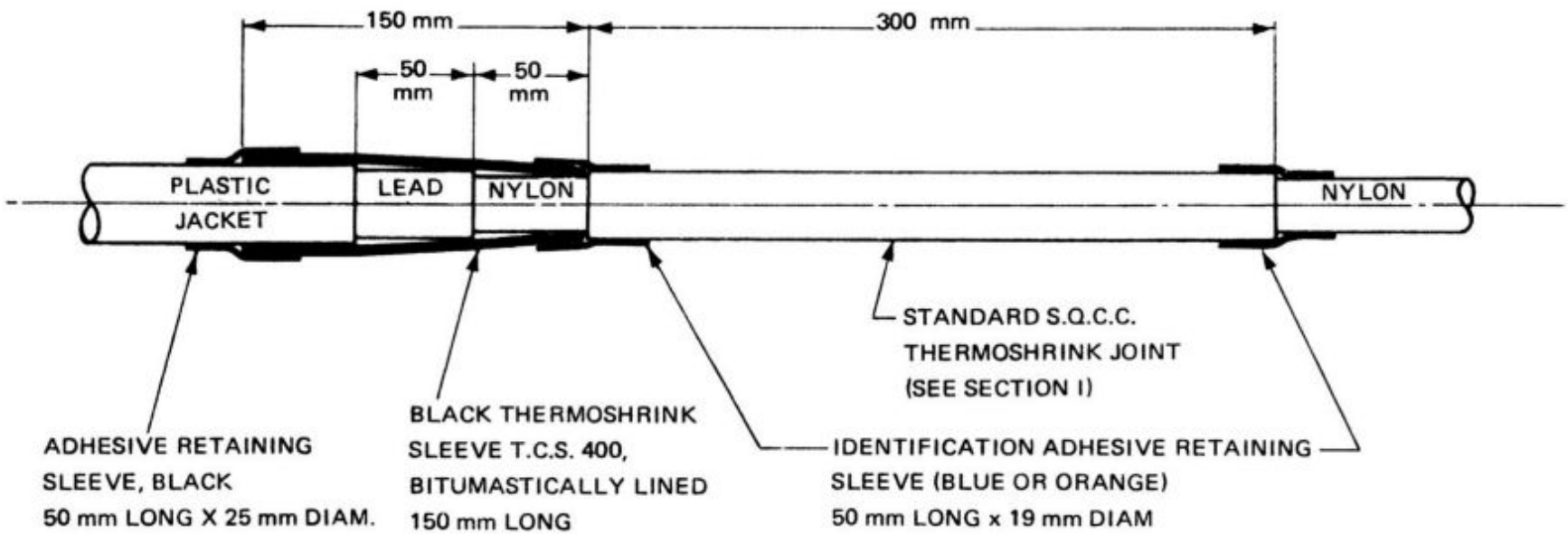
JOINTING DETAILS FOR CONNECTING AN MX172
REPEATER ONLY TO SINGLE QUAD CARRIER CABLE

Issue 1, 1976

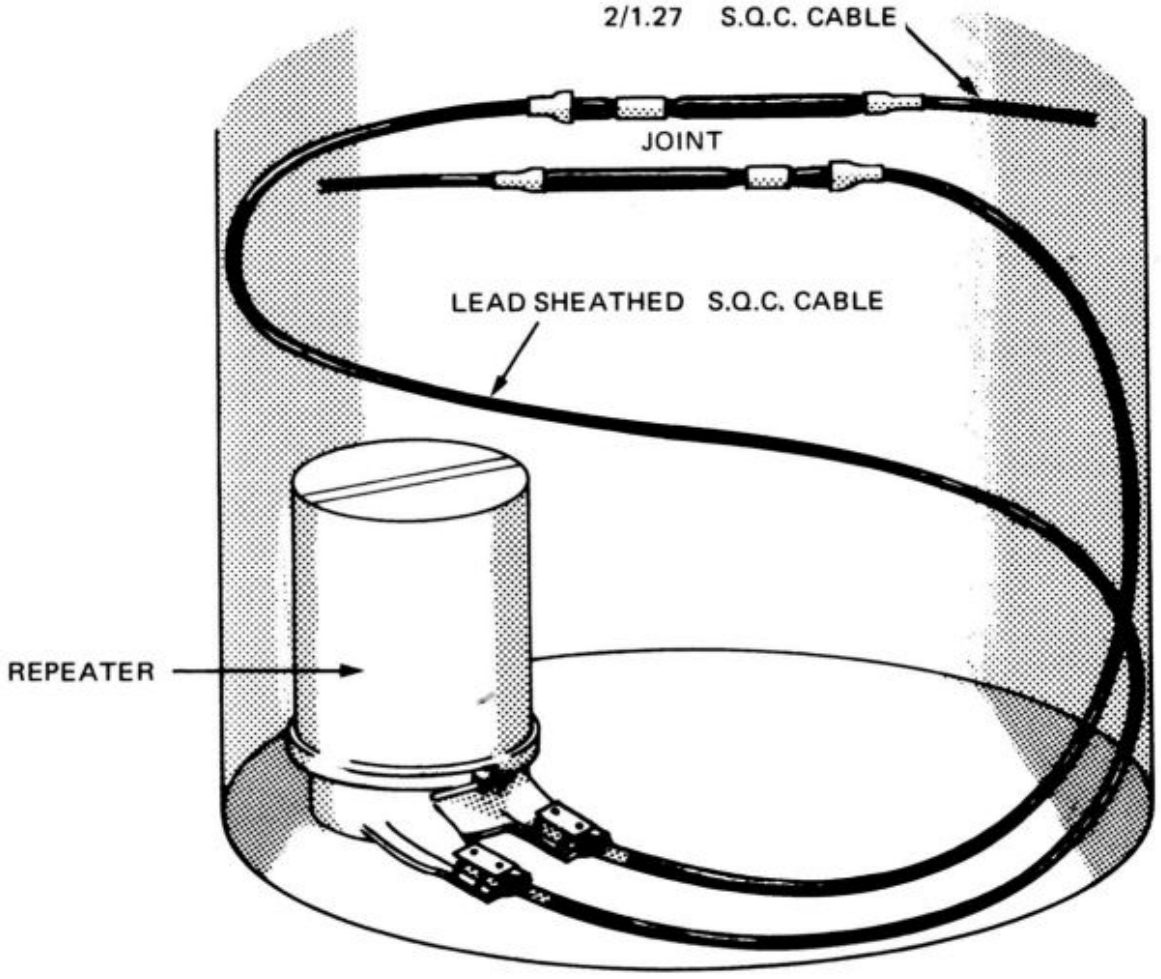
MX172 REPEATER JOINTED TO SINGLE QUAD CARRIER CABLE

SEALING PLASTIC JACKET

It is also necessary to seal the P.J. Lead Sheath of the tail cable against the entry of moisture. This is done by a 150 mm length of 33 mm diameter thermo-shrink cable sleeve lined with bitumen adhesive and 50 mm long adhesive retaining sleeves fitted to each tail cable. These seals may be located near to the joints or at any convenient place on the tail cable.



COMPLETED JOINT (MX172 TAIL CABLE TO S.Q.C. CABLE)

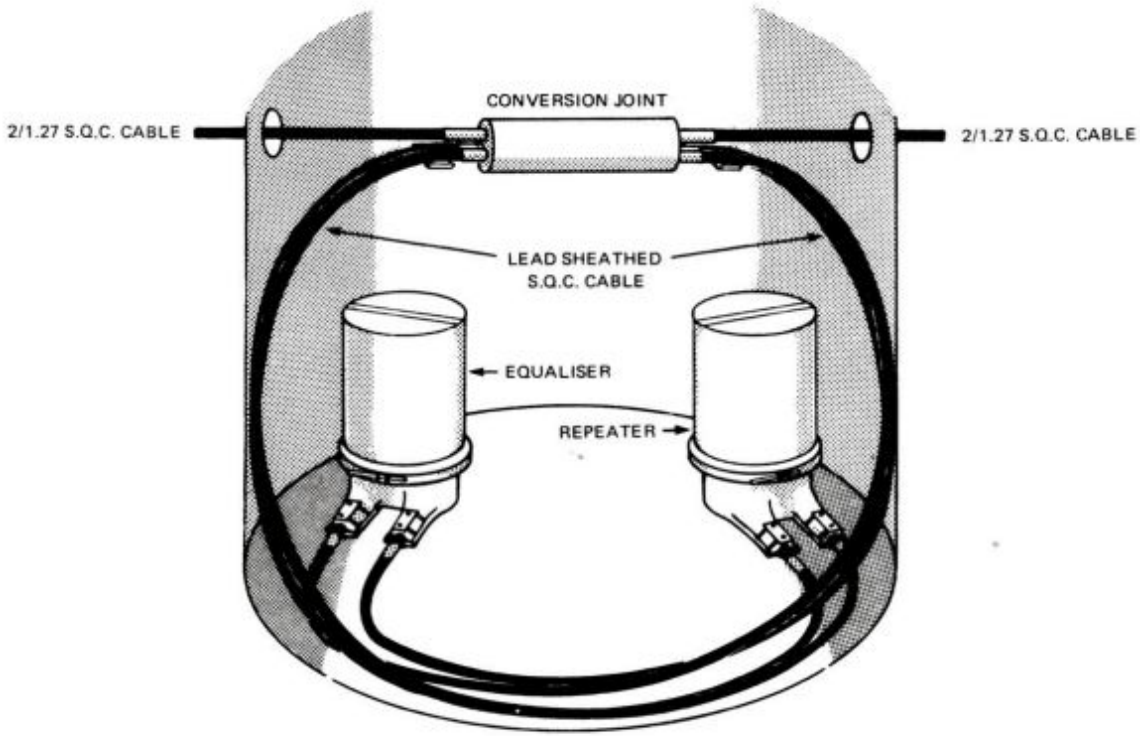


MX172 JOINT ARRANGEMENT

MX174 EQUALISER UNIT JOINTED TO SINGLE QUAD CARRIER CABLE

SPACING OF REPEATERS

Repeaters are spaced at 3.66 Km but after 8-10 dependent repeater sections the transmission performance is maintained by the installation of an equaliser, as directed by the Engineer or Technical Officer.

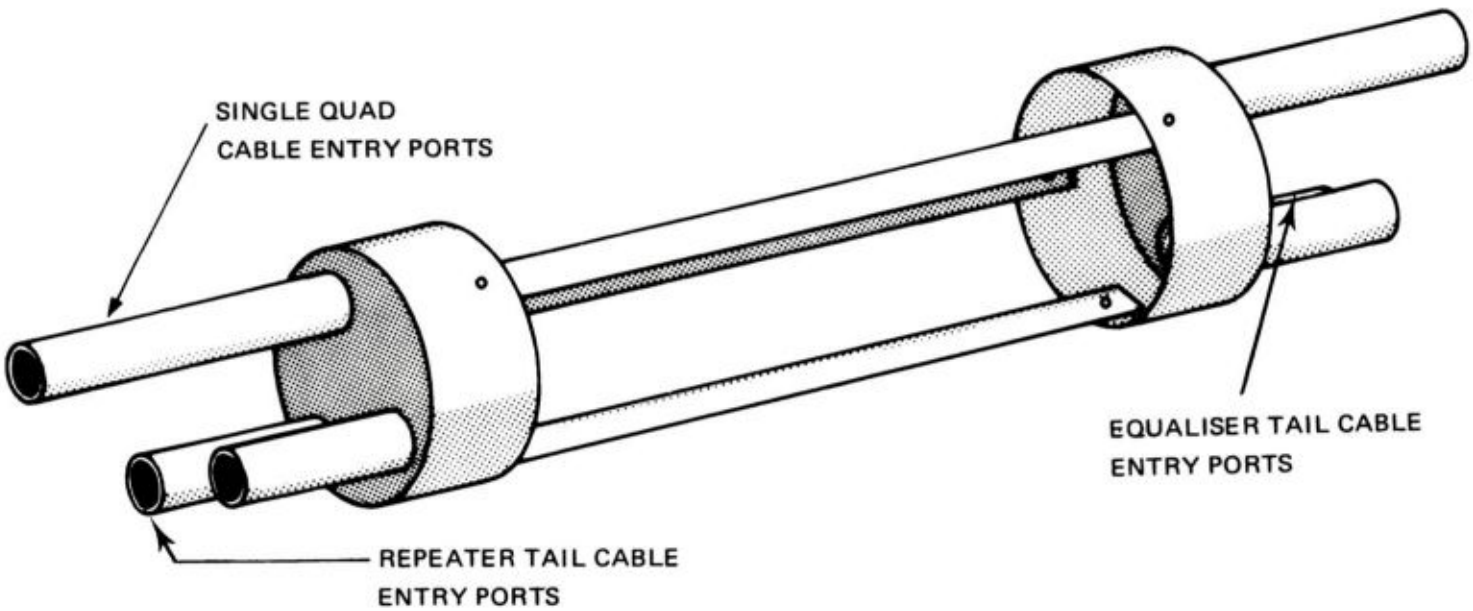


MX172 REPEATER AND MX174 EQUALISER JOINTED TO S.Q.C. CABLE

MX174 EQUALISER UNIT JOINTED TO SINGLE QUAD CARRIER CABLE

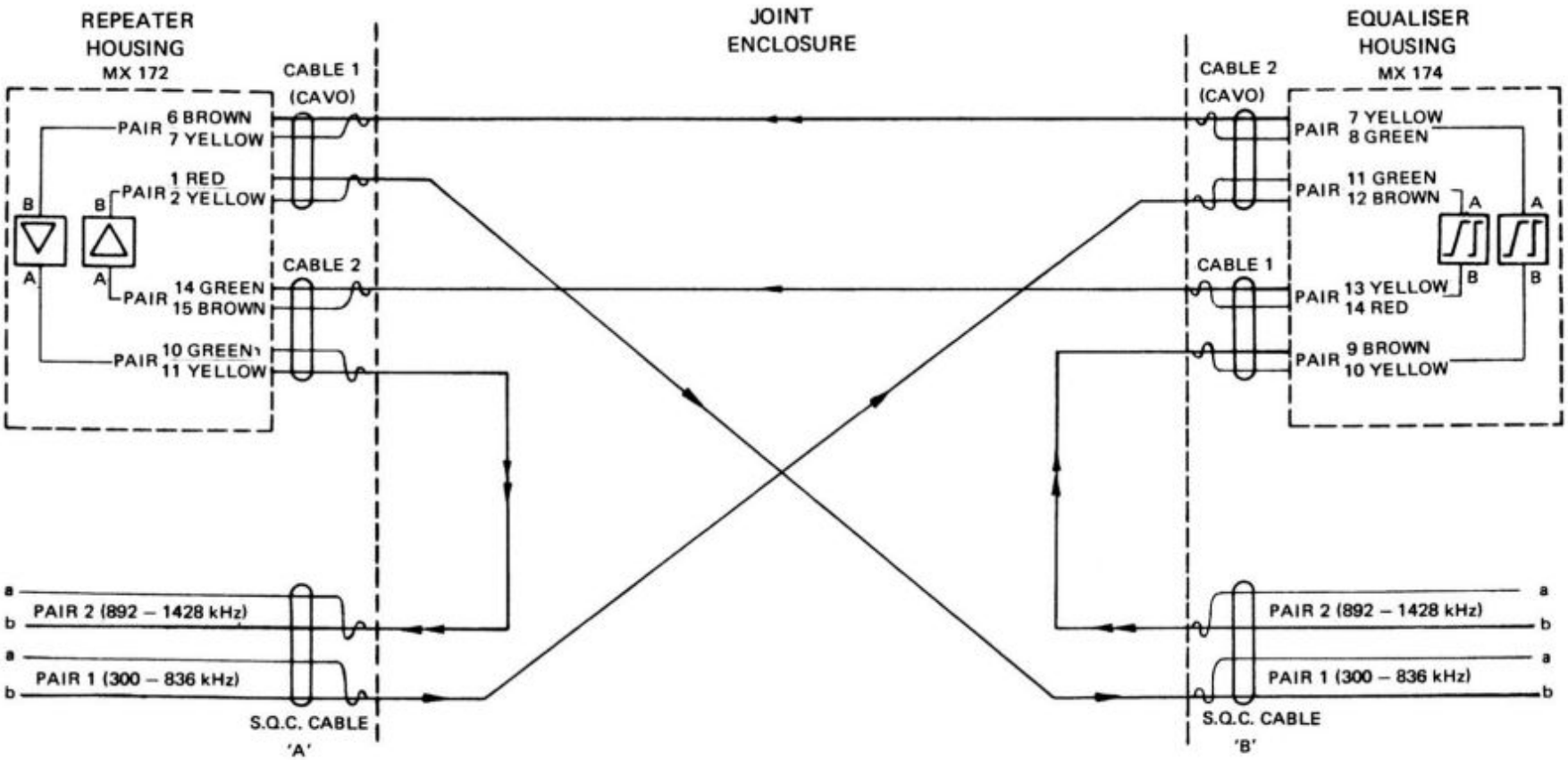
EQUALISER AND REPEATER HOUSING

The MX174 Equaliser and MX172 repeater are supplied in separate housings and each is fitted with two 2/1.27 mm Lead Sheathed P.J./S.Q.C. cable tails. The conversion joint is made up of two end caps, each end cap has three entry ports.



JOINT ENCLOSURE

MX174 EQUALISER UNIT JOINTED TO SINGLE QUAD CARRIER CABLE



JOINTING DETAILS

ELECTROLYTIC CORROSION PROTECTION

INSTALLATION OF EARTH ELECTRODES

Issue 1, 1976

ELECTROLYTIC CORROSION PROTECTION

PURPOSE OF ELECTRICAL DRAINAGE BONDS

Electrolytic corrosion occurs as a result of stray electric currents from D.C. traction systems, galvanic currents etc. which flow along the cable sheath and pass to earth at various points. Damage to lead sheath occurs where current leaves the cable. Where electric trams or trains operate, electrical drainage bonds specially designed by the Cable Protection Section are connected between the cable system and the rails to remove stray currents without damage to the sheath. Drainage bonds connected to rectifiers and special earth systems are also necessary in some other areas.

BONDING LEAD SHEATHED CABLES

To assist drainage bonds and to prevent interchange of current between adjacent cables bond all cables together at the following places:-

(i) All manholes where an electrical drainage bond is connected.
(ii) At nearest manhole to a point 50 to 100 metres from drainage bond on all routes leading from bond connection manhole.
(iii) At all manholes where a cable branches away from a conduit run.
(iv) On long cable runs at intervale not greater than 500 metres.

BONDING PLASTIC JACKETED LEAD COVERED CABLES

To protect workmen from dangerous induced voltages caused by power line faults, bond the lead sheath to other cables at the points shown above for P.I.L.C. cables. Specially installed earth electrodes may be necessary where there are no other cables on the route.

BONDING MOISTURE BARRIER SHEATHED CABLES

At joints between moisture barrier sheathed cables and lead cables bond the aluminium screen of the moisture barrier cable to the lead
to earth at the exchange and
bond it to other ead cables along the route.

BONDING OF CABLE SHEATHS

BONDING ALUMINIUM AND STEEL SHEATHED CABLES

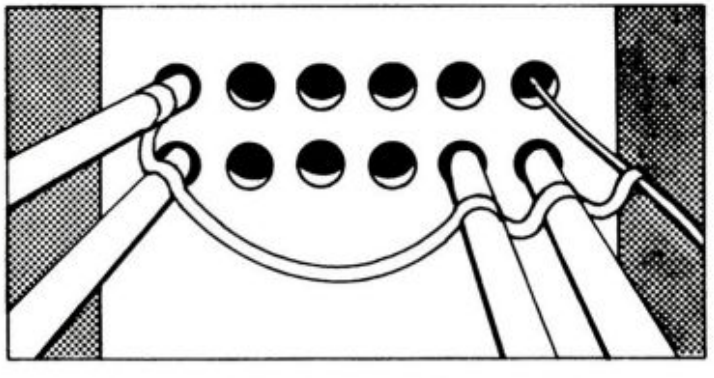
Do not bond aluminium moisture barrier or steel sheathed cables to lead covered cables.

Special bonding of long distance aluminium and steel sheathed cables may be necessary at exchanges and repeater stations as directed by the Engineer or Technical Officer.

FITTING BONDS TO LEAD CABLES

Use 25 mm strips of 3 mm sheet lead or scrap lead sheath wound around the cable and wiped to the sheath at the edges.

Connect the strip to cables at one end of the manhole close to the conduit entrance in the form of loops to allow for movement of cables.



CABLES BONDED IN MANHOLE

DISCONNECTION OF BONDS

DO NOT INTERFERE WITH ELECTRICAL DRAINAGE BONDS OR EQUIPMENT IN ANY WAY.

Where cable or manhole alterations are likely to affect drainage bonds advise the Cable Protection Section.

If a bond has to be disconnected to permit cable jointing or cable hauling operations or for rebuilding a manhole, make a temporary connection and replace the permanent bond when the work has been completed.

The disconnection of bonds for even short periods can result in the cable being under a severe hazard from the effects of electrical currents.

TREAT MINOR CUTS AND ABRASIONS IMMEDIATELY. A MINOR SCRATCH TODAY CAN BECOME A MAJOR INJURY NEXT WEEK IF IT BECOMES INFECTED.

BONDING ARMOURED CABLES

PURPOSE OF BONDING

Steel tape or wire armouring is bonded to the sheath of lead cables to protect the cable from:-

(i) High voltages from lightning discharges or earth faults on high voltage power lines which can cause flashovers between armouring and sheath.

(ii) Electrolytic corrosion.

CABLES TO BE BONDED

Bond steel armouring to lead cable sheath on both sides of all joints in the following cables:-

(i) All Trunk, Minor Trunk and Junction cables.

(ii) The following subscribers cables:-

(a) All cables on the exchange side of pillar terminals. If there is no pillar, all cables 50 pairs and larger. Cables on the distribution side of pillars in urban areas are only bonded when specified by the Engineer or Technical Officer.

(b) Cables 10 pair and larger in rural areas.

(c) Where the ultimate continuous run of armoured cable exceeds 800 metres.

Do not bond cables less than 10 pair because it is likely to damage the sheath.

Install bond about 150 mm inside the jointing pit.

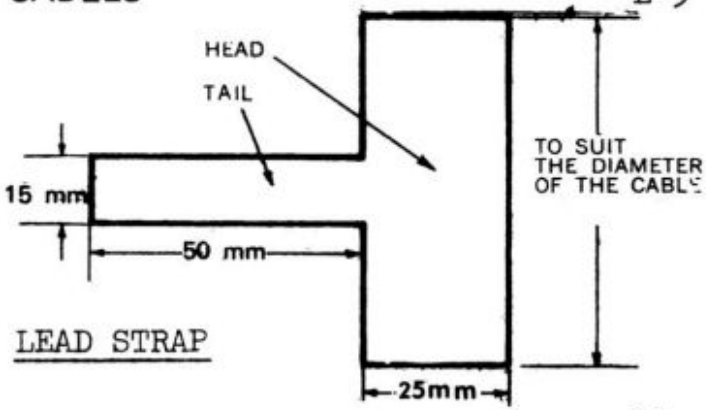
When removing armouring to fit bond take care not to damage the cable sheath. Partly cut through wire armouring and break wires by bending them back and forth. Cut sufficiently through steel tape armouring to allow for its removal.

Issue 1, 1976

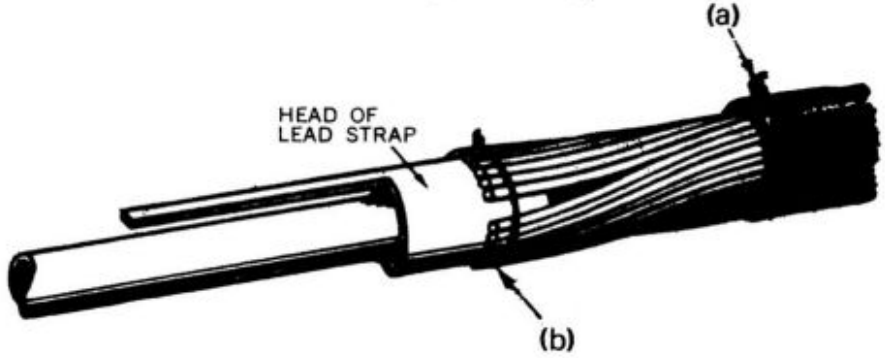
BONDING ARMOURED CABLES

BONDING STEEL TAPE AND WIRE ARMOURED CABLE

1. Place a twist of 1.60 mm (S62/24) GI wire (a) around the cable at point where bond is to be fitted and remove outer jute wrapping.
2. Make another twist of 1.60 mm GI wire (b) armouring about 50 mm from the end of the outer wrapping. Cut away armouring on the joint side of the tie.
3. Remove inner jute wrapping and cut it close to the armouring. Clean bare cable sheath with kerosene.
4. Remove twist of wire (b) lift armouring and clean it as thoroughly as possible with kerosene and then with emery cloth.
5. Cut a "T" shaped lead strap to suit diameter of cable and clean it on all surfaces.
6. Place head of lead strap half over and around inner jute covering and half over and around the cleaned cable sheath.
7. Place armouring back and tie in position with 1.60 mm GI wire.
8. Plumb armourning to head of strap and tail of strap to cable sheath with wiping solder (S.4/1)



LEAD STRAP



LEAD STRAP PLACED IN POSITION FOR WIPING

COMPLETED BOND

INSTALLATION OF EARTH ELECTRODES

GENERAL

The installation of earth electrodes for each district will be determined by the Senior Engineer or Technical Officer, who will advise the Line Supervisor of the equipment to be installed.

Earth electrodes can be installed by:-

(i) Wire buried directly in ground.
(ii) Earth rods.

BURIED WIRE

Stainless steel wire 2.5 mm (S62/25) is used where the earth wire can be buried in conjunction with cable laying or where rocky conditions make deep driven rods impracticable. The length of the wire (under normal conditions not less than 30 m with a maximum of 100 m) depends upon the soil conditions and the earth resistance required. The stainless steel earth wire is placed in the trench as far as possible from any other plant to avoid further disturbance or damage. Ram the soil around the earth wire making sure it is well compacted. Soil dampened when backfilling will improve compaction.

WIRE PLOUGHED IN GROUND

Where earthing is required on carrier cables at repeater locations, a single earth wire ploughed in away from the cable alighnment generally provides a low resistance earth. If the desired earth resistance is not achieved, additional lengths of stainless steel wire (not longer than 100 m) radiating away from the point of connection must be ploughed in.

Note: The resistance of a buried wire earth system during the first few months is likely to decrease slightly as the soil consolidates. If the required resistance is not achieved it may be necessary to install deep driven earth rods to obtain the resistance desired.

INSTALLING EARTH ROD SYSTEM

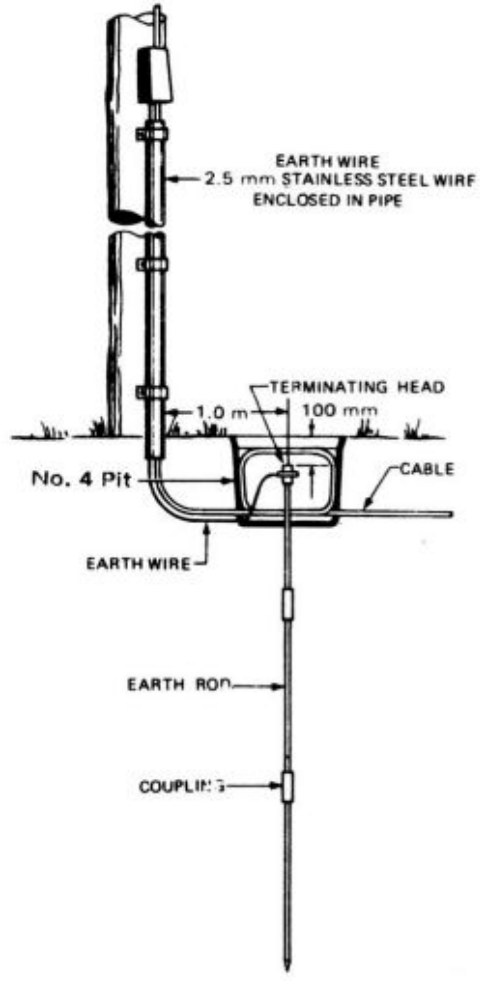
A single electrode system comprises of one or more rods coupled together and driven into the ground to a depth necessary to achieve the desired resistance. The rod is stainless steel (S446/16) 1.25 m long with a diameter of 14 mm. The steel driving point is a separate item and connects to the first rod driven into the ground. Subsequent rods are joined with a stainless steel coupling (S446/17). The coupling comprises an outer stainless steel sleeve with an inner locking pin.

FITTING TERMINATING HEAD

The stainless steel terminating head (S446/18) fits on the last rod and has provision for the attachment of the earth wire by means of a compression sleeve. A polyethylene cap is fitted to the open end of the terminating head after installation.

DO NOT EXPOSE YOURSELF TO THE RISK OF INJURY OR CREATE CIRCUMSTANCES WHICH PRESENT A HAZARD TO OTHER PEOPLE.

IF YOU OBSERVE ANY FAULTY OR DANGEROUS PLANT, FOR EXAMPLE BROKEN OR MISSING JOINTING PIT COVER MAKE IT SAFE IF POSSIBLE THEN INFORM YOUR SUPERVISOR IMMEDIATELY. CHECK FOR POWER CABLES AND GAS PIPES BEFORE DRIVING EARTH RODS.



SINGLE ROD ELECTRODE

Issue 1, 1976

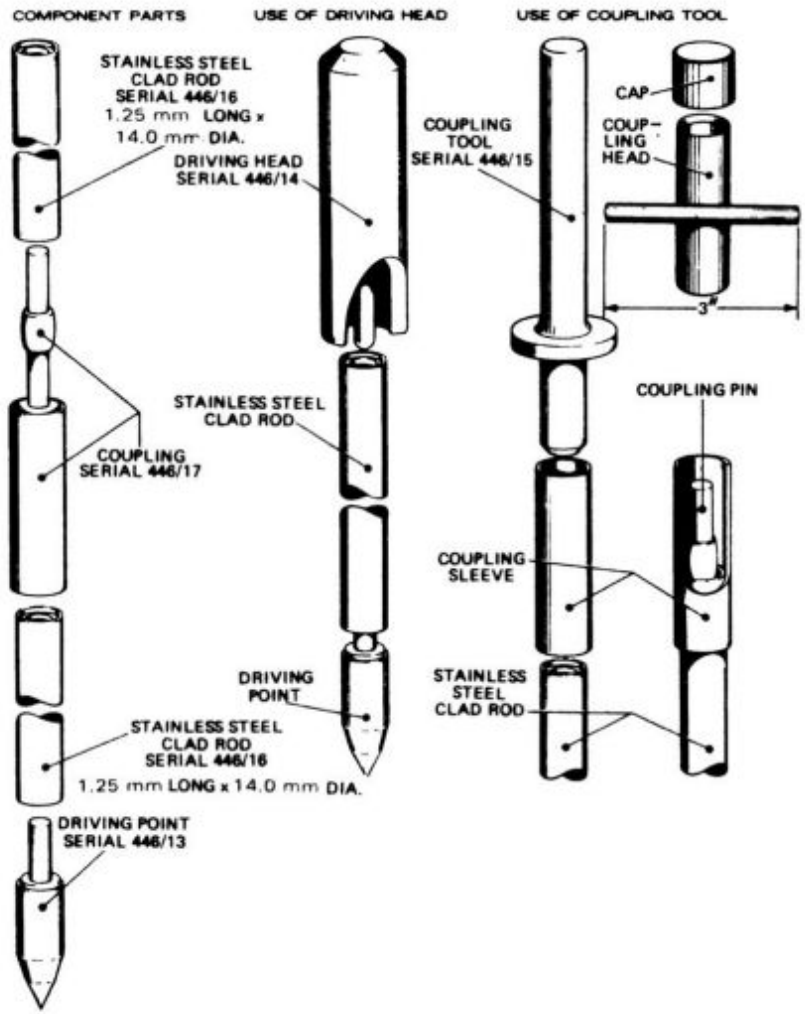
INSTALLATION OF EARTH ELECTRODES

EARTH ROD COMPONENTS

S.446/16 - Rod, Stainless Steel Clad Steel.
S.446/13 - Driving Point.
S.446/14 - Driving Head.
S.446/15 - Coupling Too.
S.446/17 - Coupling.
S.446/18 - Terminating Head.
S.446/19 - Cap, Polyethylene.

INSTALLING EARTH RODS

1. Fit driving point and driving head to rod.
2. Drive first rod and remove driving head.
3. Using the coupling tool, drive coupling sleeve on to the head of the driven rod.
4. Remove tool and insert coupling pin.
5. Insert next rod into coupling sleeve.
6. Fit driving head and continue driving.
7. Measure earth resistance after each rod.
8. When required resistance is obtained or rod cannot be driven further, cut rod to 100 mm below surface of ground.
9. Fit terminating head on end of rod using coupling tool and connect earth wire. Fit polyethylene cap over the head.
10. Install a No. 1 Jointing Pit over end of rod.



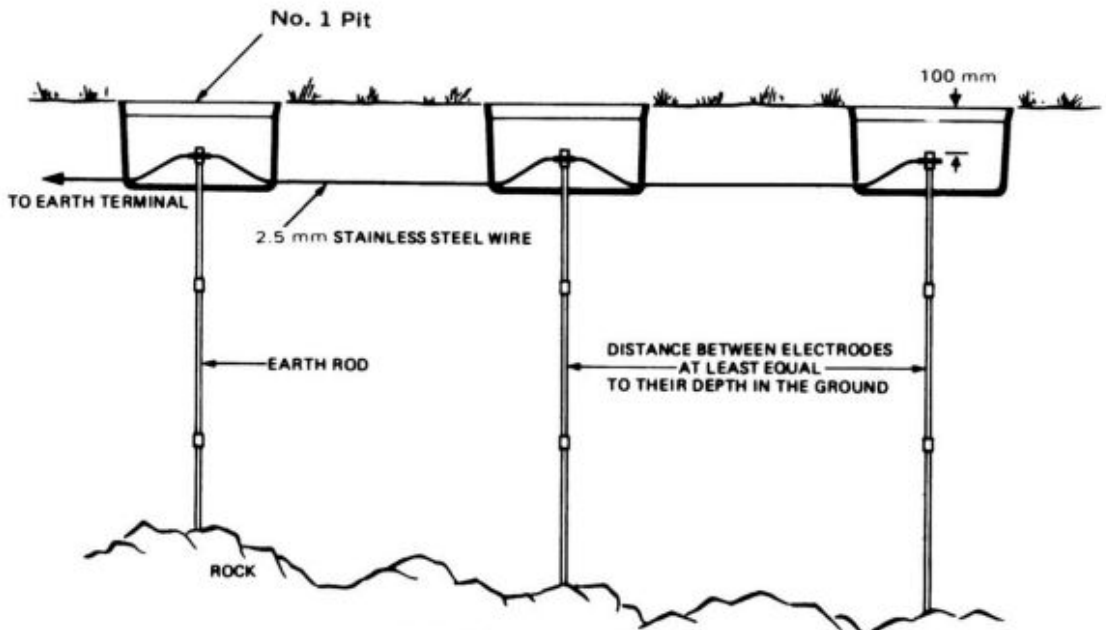
ROD COMPONENTS AND ACCESSORIES

Note: Vibration of the rod when being driven into the ground will often cause the hole to be enlarged and can result in a poor electrical contact with earth. Resistance measurements taken under these conditions may give false readings.

Muddy water poured into the hole during driving of the rod will help to maintain electrical contact and give a resistance reading which closely approaches the rod resistance after the soil has consolidated.

MULTIPLE ELECTRODE SYSTEMS

Where the required resistance cannot be obtained by a single electrode, for example where soil conditions prevent further driving or where resistance measurements show no progressive improvement in resistance with depth, it may be necessary to install additional electrodes and connect them to the initial electrode.



MULTIPLE ROD ELECTRODE SYSTEM

INSTALLATION OF EARTH ELECTRODES

ROD SEPARATION

To obtain the best results, multiple earth rods must be separated by a distance at least equal to their depth in the ground. Rods should be driven to 100 mm below ground level and connected by a 2.5 mm stainless steel wire (S.62/30) buried at least 300 mm below ground level in a straight trench between the earthing rods.

TESTING EARTH RESISTANCE

After each rod is installed the earth resistance must be measured on a Geohm Earth Tester (S.138/24). Instructions for use of the Geohm Earth Tester are provided with each instrument.

Further rods are installed until the required earth resistance for the multiple system is obtained. See Page L-15 for the method of connecting earth wires to earth rods.

LOCATION OF ELECTRODES

Security against subsequent disturbance, which could lead to damage to the earth system, is essential. Where it is necessary to indicate the position of the electrodes No. 1 jointing pits, (S.99/16) should be installed over the heads of the rods to act as markers.

Locate earth electrodes for pole mounted equipment about 1.0 m from the foot of the pole to avoid disturbance if the pole is replaced.

Avoid locations which may cause interference or damage to the plant of other authorities.

DRIVING EARTH RODS

Earth rods may be installed by hand or by power driving, or by insertion into a hole prepared by drilling. Hand methods are generally only suitable for light soils and where it is not necessary to install the rods beyond a depth of about 4.5 m. For harder driving conditions and greater depths a pneumatic or petrol driven hammer provides a quicker, more effective means of installing the rods. Drilling of rock for installation of earth rods is generally not economical and is only resorted to when other methods of obtaining an effective earth are inadequate.

HAMMERS

The use of a hammer is suitable only for the easiest of driving conditions and for shallow depths. A large number of blows from a light hammer (1.4 Kg) is more effective for driving earth rods than heavy blows from a large sledge hammer. The 1.4 Kg "high impact" hammer for use with masonry anchors is suitable. The heavy impact of a large sledge hammer causes the rod to flex or bend thus wasting a considerable portion of the driving force.

Take care to ensure that the hammer blows are applied squarely to the top of the driving head to avoid bending the rod or deforming the coupling section. Damage to the top of the rod will prevent the fitting of a coupling for adding more rods and make further driving impossible.

POWER DRIVING

Power driving is generally more efficient than manual driving and usually enables the required depths to be obtained for a satisfactory earth.

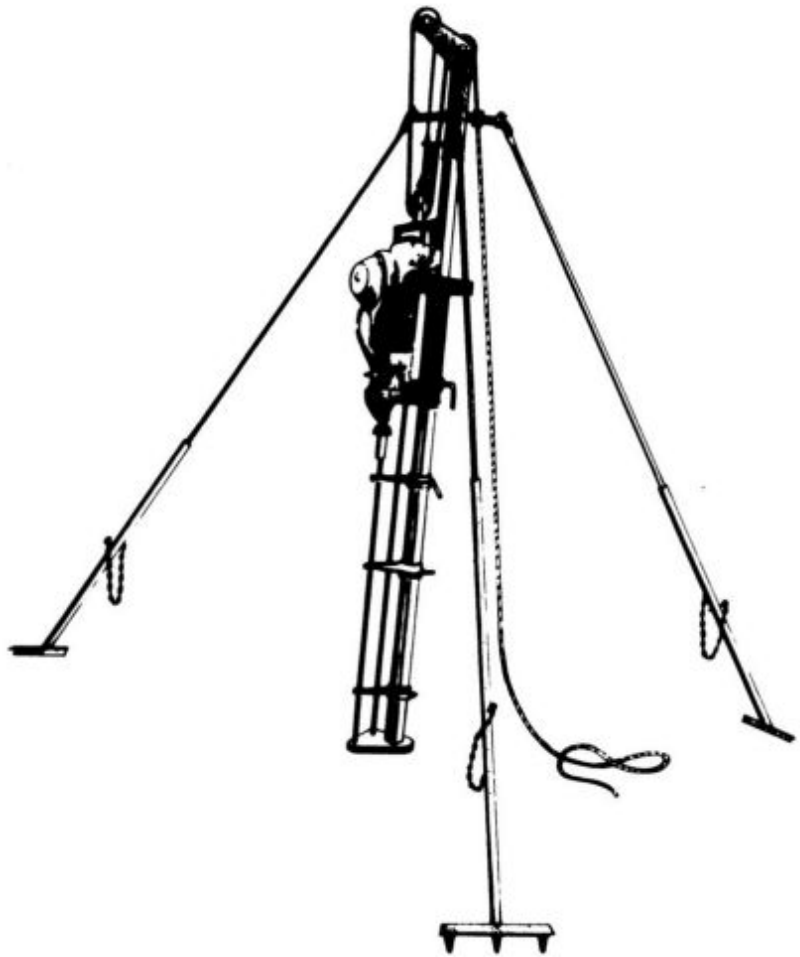
Power operated hammers used for excavation work may be readily adapted for the driving of earthrods by fitting a specially shaped driving head.

Self-contained petrol driven hammers have the advantage of portability but are slightly less effective than pneumatic operated tools which require compressors. Use the currently abailable engine driven breaker or for pneumatic operation a pavement breaker (S.429/11).

ALIGNING RODS

To ensure that the power hammer and the rods are correctly aligned it is essential that a suitable jig is used as a rigid support for the hammer and rod. The Jig (S.446/8) is designed for use with the above machines, though it can be readily adapted for use with other types of power hammer by modifying the hammer support brackets. The hammer is secured to a sleeve which slides over the centre column of the jig so that the hammer and the rod being driven are held in the same vertical plane.

The hammer may be clamped in position while rods are fitted. The earth rod being driven is firmly supported by guides to prevent it flexing. The guides are released one by one as the rod is driven into the ground.



DRIVING JIG (S.446/8)

ROCK DRILLING

While one metre of soft rock such as mudstone or shale may sometimes be penetrated by power driving equipment, it is not possible to install earth rods in solid rock other than by drilling.

Rock drilling for installation of earth rods can be extremely costly and is regarded as a last resort when other methods have failed and depth resistivity measurements, geological surveys or past experience in the particular locality indicate that it offers the best method of obtaining a low resistance earth. Rock drilling may be justified for important installations where provision of a low resistance earth is essential.

The equipment normally used for drilling rock for blasting pole holes, trenches, etc. is usually satisfactory for drilling rock to depths of about 7 m. Where greater depths are required specialised deep drilling equipment may be necessary.

For maximum contact between the rod and the surrounding earth, always fill the prepared hole with a slurry of clay or fine earth before inserting the rods.

Where soil is encountered beneath the rock strata, drive the earth rods as far as possible into the soil, until the required resistance to earth is obtained.

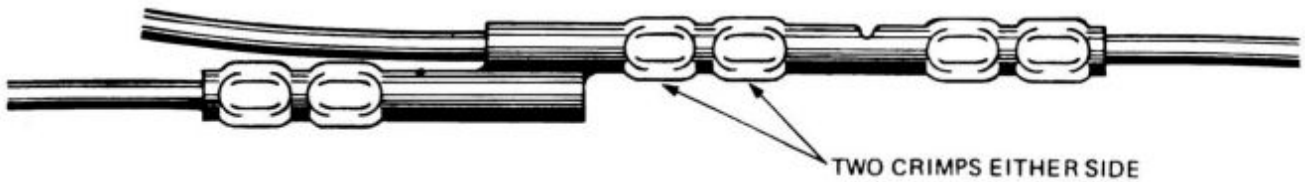
EARTH WIRES

Stainless steel wire (2.5 mm) is used to connect buried earth electrodes to lines equipment which must be earthed.

RUNNING EARTH WIRES

The earth wire should be run without joints between electrodes. However it is permissable to join the wire at the sleeve on the terminating head. On installations where two or more groups of electrodes form an earthing system, the earth wire from each group of electrodes can be joined to a single wire to the equipment to be earthed. A connecting sleeve (S.64/81) crimped to the wire is used for this purpose. Avoid sharp bends in the earth wire.

INSTALLATION OF EARTH ELECTRODES



CONNECTOR SLEEVE

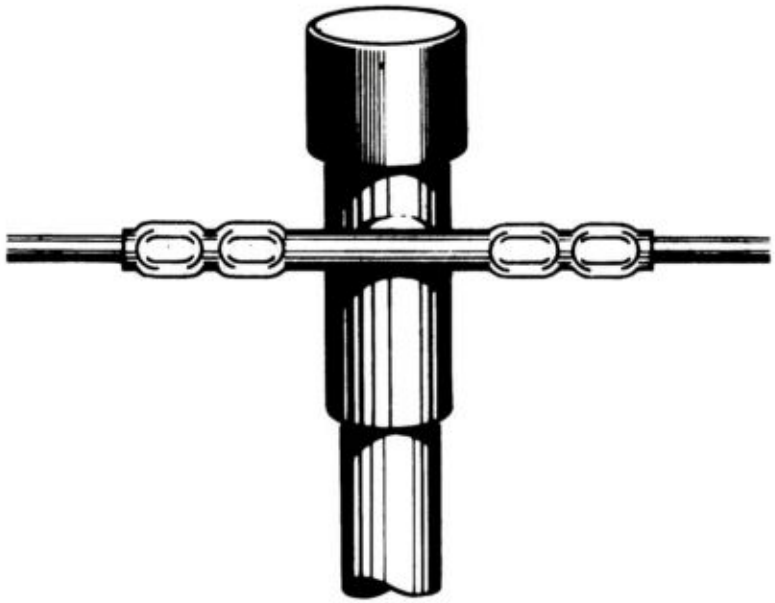
PROTECTING WIRE

Cleat the wires neatly to poles or structures. Where protection against mechanical damage is required or to meet the requirements for insulation on Joint Use Poles, install the wire in a small diameter P.V.C. pipe.

CONNECTING TO EARTH ELECTRODES

To connect the earth wire to the rod electrodes, thread sufficient terminating heads along the earth wire until there is one opposite each electrode. Using the coupling tool, locate the terminating heads on the electrodes then insert two crimps on each side of the sleeve using the Clamp Wire Jointing (S.93/52). Fit the polyethylene

DO NOT DISCONNECT OR INTERFERE IN ANY WAY WITH ELECTROLYTIC BONDS IN MANHOLE.



EARTH WIRE CONNECTION TO ROD ELECTRODE

After the earth wire terminations are completed fit a No. 1 jointing pit over each electrode. The pits will provide for future inspections and also serve as markers for location of the electrode.

CONNECTING EARTH WIRES TO EARTH TERMINALS

Terminals are normally provided for connection of earth wires to protection equipment such as substation protectors, cable terminal boxes, pole mounted line protection equipment etc.

INSTALLATION OF EARTH ELECTRODES

Where earth terminals are provided on cable terminal boxes or underground equipment such as housings of buried repeaters, a terminating sleeve type "A" (S.64/82) or type "C" (S.64/84) is used to connect the earth wire to the earth terminal. The terminating sleeves are crimped on to the earth wire with a Clamp Wire Jointing (S.93/53).

MAINTENANCE OF EARTH SYSTEMS

The importance of maintaining satisfactory earths for protection against lightning cannot be overstressed. Deterioration of earth resistance may endanger life and can give rise to serious damage to equipment or cables.

Earths on protected cable terminal boxes and other important earths above ground and in the marker pits should be checked periodically by measuring the earth resistance.

Subscribers' substation earths should be checked as opportunity arises, e.g. fault clearances etc.

Unsatisfactory earth connections must be removed and where earth resistances have deteriorated below acceptable limits, supplementary earths must be installed.

ENGINEERING INSTRUCTION REFERENCES

LINES Cables C3202
LINES General P3001

COAXIAL CABLE

BRIEF SYSTEM DESCRIPTION

AND LAYOUT

Issue 1, 1976

SYSTEM DESIGN AND LAYOUT

GENERAL

All new coaxial routes are to be laid out for ultimate 60 MHz operation. In this way every third 60 MHz repeater location coincides with a 12 MHz repeater location. It is not expected that any further 4 MHz systems will be purchaced in the future. However, where a new or recovered 4 MHz system is to be initially installed every 4 MHz repeater location will coincide with every second 12 MHz repeater location.

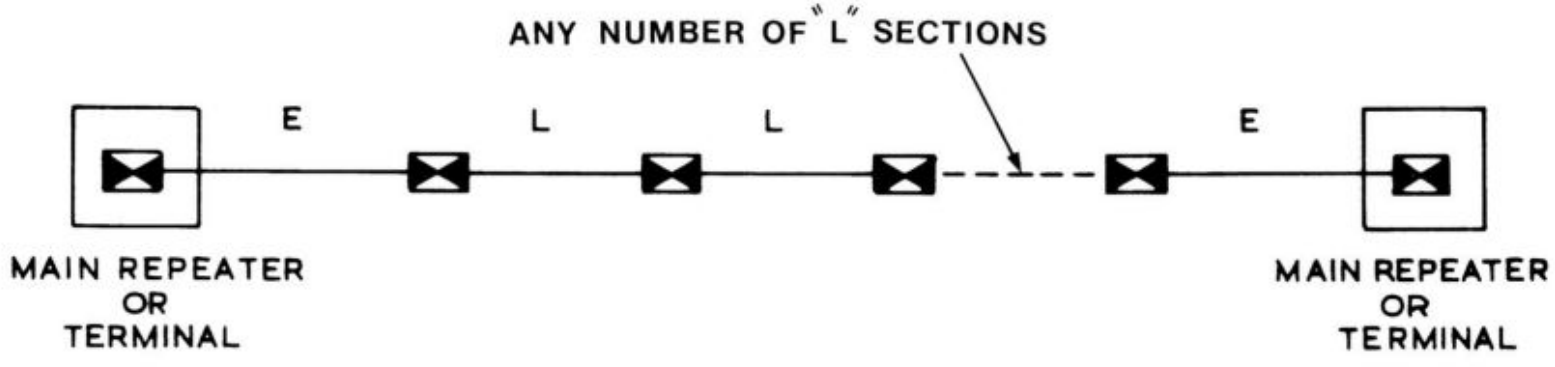
REPEATERS

To compensate for the attenuation of the cable, repeaters are placed at intervals along the route. Most of the repeaters are installed underground in housings located in manholes and fed with direct-current power from either terminal or main repeater stations. The power-fed repeaters are called dependent repeaters. Main repeaters are usually installed in surface buildings together with power-feeding equipment. With some systems, main repeaters may be installed underground in special containers and are then power-fed either from a coaxial power feed circuit or by special polyethylene-insulated interstice Quads in the cable.

SPACING OF REPEATERS

With 4 MHz operation the repeaters are spaced about 9.15 Km apart. All new routes shall be laid out for 12 MHz operation. With 12 MHz operation, dependent repeater sections (L) shall be 4500 ± 65 metres. Sections adjacent to main repeaters or terminals (E) shall be 4565 m or less. Also 60 MHz operation dependent repeater sections (L) shall be 1500 ± 25 m with a standard deviation of 10 m. Sections adjacent to main repeaters or terminals (E) shall be 1525 m or less.

THE E.I. LINES CABLES SP5900 AND ANY STATE E.I. MUST BE READ AND UNDERSTOOD BEFORE WORKING ON ANY CABLE WHICH HAS POWER FEED WORKING THROUGH THE CABLE.



SPACING OF REPEATERS

COAXIAL TAIL EQUIPMENT

Coaxial tail equipment used for extending broad-band radio systems to long line terminals are essentially simplified coaxial systems. Route distances are often short and may not need dependent repeaters between terminals.

ALARMS

Alarm circuits and control circuits on some systems are on core or layer pairs depending on the system used (see Section T).

POWER FEED CARRIER SYSTEMS

Power is fed through some cables to repeaters, usually via the coaxial tubes. Sometimes core interstice and layer pairs carry power with a voltage in excess of 20V AC or 120V DC which can be dangerous to Line Staff (See Section C Page No. C-24).

LOADING LAYOUT

The trunk, junction, or unit twin interstice or core pairs for the local and long haul order wires, are loaded with 88 mH loading coils at 1500 m spacing, with end sections of 750 m. If building - out is required, capacitors are used to bring the value of the pairs to a total of :-

QJ Pairs - 44.7 nF/Km
QT Pairs - 41.0 nF/Km
Twin Pairs - 44.7 nF/Km

The loading points should be placed at repeater positions for 60 MHz working.

EARTHING AT REPEATER POINTS

An earth of not more than 5 ohms should be provided at each coaxial and balanced pair repeater position, (for installation see section L).

IDENTIFICATION OF REPEATER SITES

Coaxial repeater sites are identified by the initial letters of the names of the main repeater, or the terminal station on either side of the repeater side followed by a numeral in consecutive order from one of the terminals. Repeater sites are numbered to cater for 60 MHz operation.

DIVIDING POINT BETWEEN LINES EQUIPMENT AND TRANSMISSION EQUIPMENT

In underground repeater housings the lines equipment includes the repeater housing and tail cables complete with all seals and securing means.
The lines equipment ends at the male coaxial connector. In surface buildings, the lines equipment includes all air-spaced single tube cable from the pothead up to and including the gas seal. Place gas seals close to the top of the pothead rack or close to the power-feed bay depending on which is the better location.

SHEATH TYPES AND WHERE USED

Normally alloy lead sheath cables are supplied but plain lead sheathing is permitted for coaxial cables (with the exception of 2 tube cable) for use within 350 Km of the factory of manufacture and where the sheath will not be subject to vibration after installation. Hard metal sheath cables can be supplied for special installations.

ARMOURED CABLE

The traditional construction of tape or wire armoured cable is unsuitable for coaxial cable. This is due to the adverse effects on the cable should the bituminous compound vaporise. However, where cable is to be protected (e.g. against low frequency induction and armoured cable is the most suitable) wire armouring over a plastic jacket is preferred to tape armouring. A further polyethylene outer jacket may enclose the wire armouring.

SHEATH TYPE	ABBREVIATION	EXTERNAL DIAMETER IN mm				
		2 TUBE	4 TUBE	6 TUBE	8 TUBE	12 TUBE
Alloy Lead Sheathed Polythene Jacketed	APJ	33	37	46	54	70
Lead Sheathed Polythene Jacketed Light Wire Armoured	PJLW	37	43	51	59	76
Lead Sheathed Double Light Wire Armoured	DW	55	61	68	76	92
Lead Sheathed Single Heavy Wire Armoured	HW	54	61	68	77	92
Add for each layer of 0.64 mm paper insulated conductors		6	6	6	6	6
Add for each layer of 0.90 mm paper insulated conductors		8	8	8	8	8

WARNING

DANGEROUS GASES CAN ACCUMULATE IN MANHOLES, TUNNELS AND PITS. CHECK FOR GAS BEFORE ENTERING AND WHILE WORKING IN ANY U.G. STRUCTURE WHERE THERE MAY BE DANGER FROM GAS.

SHEATH TYPE	SHEATH CODE	WHERE USED
Lead Sheathed (PJ) Polyethylene Jacketed (APJ)	13** 14**	All conduit runs which are not exposed to serious power induction hazards. Installation in tunnels. Buried cable sections which are generally free from stone rock and serious power induction hazards and where installation is by trenching or ploughing.
Alloy lead sheathed Nylon Jacketed (AHJ)	36**	Cable sections where ant or termite attack is expected.
Alloy lead sheathed polyethylene jacketed, steel tape armoured, polyethylene jacketed (PJSTPJ) or Alloy lead sheathed polyethylene jacketed light wire armoured, polyethylene jacketed (PJLWPJ)	31** 32**	The application of galvanised steel tape or light wire armouring reduces the longitudinal current induced by neighbouring power transmission lines especially during earth fault conditions.
Double light wire armoured (DW) or Single heavy wire armoured (HV)	27** 25**	Cable sections where tidal estuaries and harbour crossings are unavoidable and cable cannot be buried in an underwater trench.
Hard metal sheathed polyethylene jacketed (Special requirement).		Where unusually hazardous conditions exist :- long bridge crossings where severe vibration exists. Long runs of cable where very severe power induction cannot be avoided.

COAXIAL CABLE - SHEATH TYPES AND WHERE USED

ENGINEERING INSTRUCTION REFERENCES

E.I. LINES Cables	SY 3900
	SY 3903
	SY 3906

HOUSING COAXIAL CABLES

Issue 1, 1976

HOUSING COAXIAL CABLES

SIZE OF MANHOLES

The size of manholes containing coaxial cable joints should be no less than 2.8 x 1.2 m with a 1.2 x 1.2 m cover and frame. Placing coaxial cables in smaller manholes increases the possibility of damage to the cable during hauling and when other cables are being installed. When new manholes are required for other cables and the coaxial cable must pass through them, the offset manhole is preferred. This has one wall in line with the edge of the ducts and minimises the possibility of damage due to housing the cable on the manhole wall.

DRAINING MANHOLES

All manholes with coaxial cable should be drained wherever feasible. Where extensive re-arrangements and rebuilding of manholes are necessary within a few years, the work should be carried out prior to coaxial cable installation. Each coaxial cable must be installed in an empty duct and no other cable of any type drawn into the same duct.

POSITION OF CABLE IN DUCT ROUTE

Coaxial cables should occupy the lowest position of any duct route for added protection to the cable. Old iron ducts should be avoided if possible and G.I. pipes should only be used for special purposes.

ON COMPLETION OF JOINTING FOR THE DAY CLEAR THE MANHOLE OF SCRAP PAPER, WIRE ENDS AND OTHER MATERIAL WHICH COULD CLOG THE DRAIN AND CAUSE FLOODING.

Issue 1, 1976

MECHANICAL PROTECTION IN MANHOLES

Coaxial cables in manholes should be protected against mechanical damage and careless use of heat. In through manholes the cable can be protected by a firm but flexible covering such as polyethylene pipe or Kopex metal tubing. Where additional mechanical protection is required angle iron, double polyethylene pipe or armoured flexible galvanised mild steel covers should be installed.

MARKING CABLE IN MANHOLES AND TUNNELS (S.443/16)

When working in the vicinity of coaxial cables, care must be taken to avoid even minor mechanical damage to the cable. A band of special blue adhesive tape must be placed around the cable (or polyethylene tube cover) at through manholes and at jointing manholes on the joint and both sides of the joint. The tape has white lettering on the blue background. In cable tunnels the tape should be placed on the cable jacket at intervals of 6 m. Each coaxial cable joint should be labelled with a tag showing date of installation and cable identity.

CABLE MARKING TAPE

THOROUGHLY DRY OUT JOINTING MATERIAL BEFORE USING.
TEST FOR GAS BEFORE ENTERING ANY MANHOLE.
DO NOT WORK ALONE IN MANHOLES WHERE GAS HAS BEEN DETECTED.

MANHOLES FOR TEMPERATURE REGULATED REPEATERS

A circular concrete manhole has been designed to provide a suitable thermal environment for temperature dependent underground repeaters, and is suitable for general application on cross country routes. It is designed to carry a load of five tons located centrally on the roof. By assembling variants of the component parts, the manhole can be used for new cable projects or new repeaters on existing buried cables.

Repeater housings which can be accommodated are :-

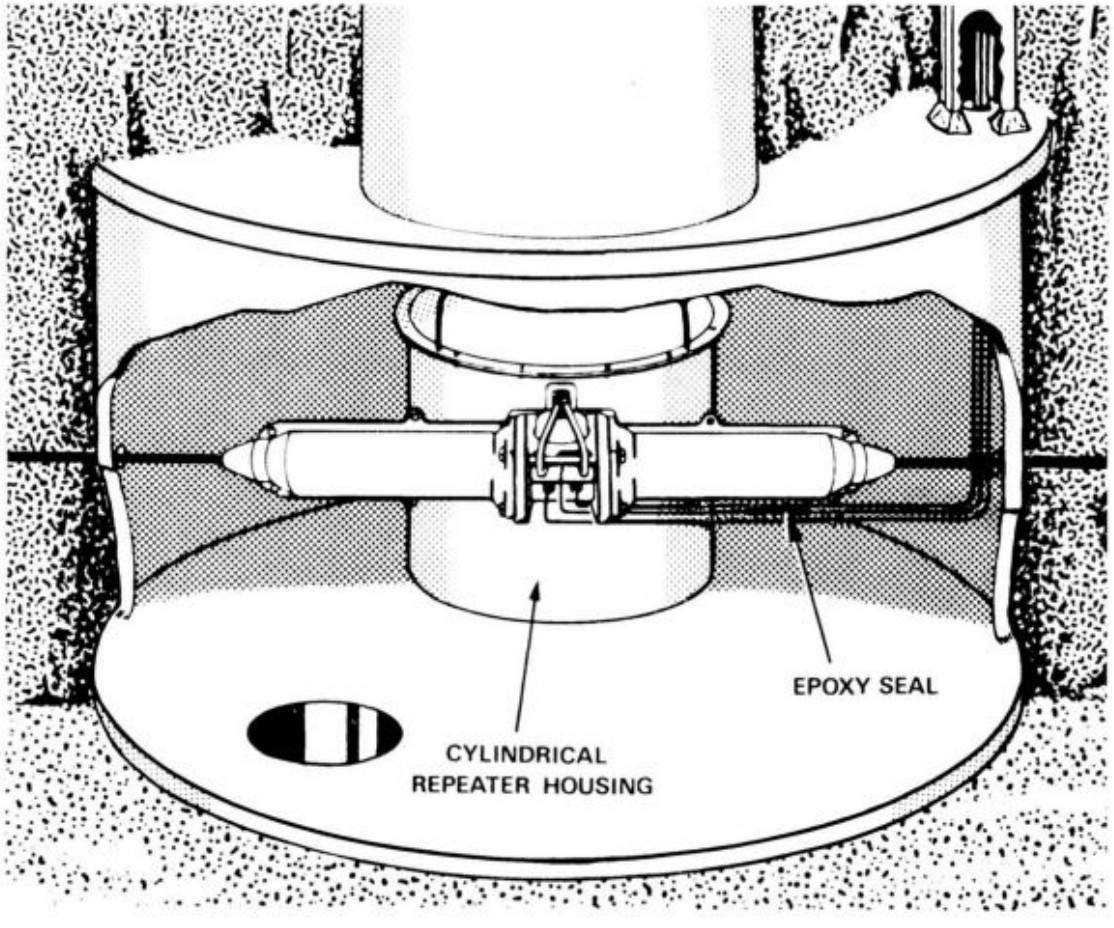
(i) Four tube rectangular repeater housing (S.443/17).

(ii) Six tube rectangular repeater housings (S.443/50).

(iii) Cylindrical repeater housings (S.443/71).

The jointing chamber body is circular and four types are available. All chambers are the same excepting the entry hole or slot which is in a different position for rectangular or cylindrical repeater housings.

PREVENT MEMBERS OF THE PUBLIC FROM STEPPING INTO OPEN MANHOLES OR JOINTING PITS BY ERECTING GUARDS BEFORE REMOVING THE COVERS.

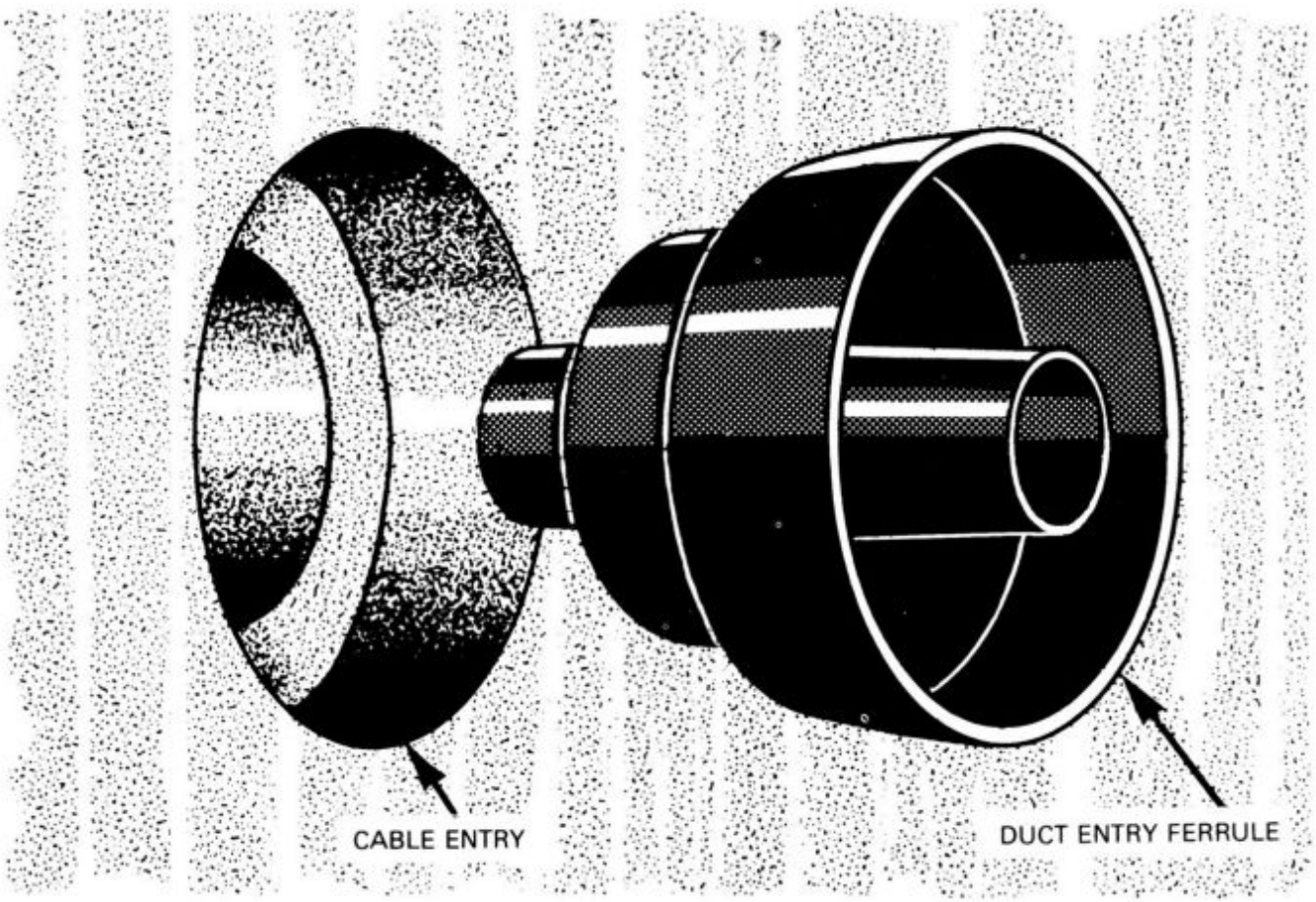


CYLINDRICAL REPEATER HOUSING IN CIRCULAR CONCRETE MANHOLE

HOUSING COAXIAL CABLE

CABLE ENTRY FERRULE

A polyethylene cable entry ferrule is necessary to support and prevent damage to coaxial cables entering circular concrete manholes. The hole in the ferrule through which the cable enters the manhole is available in various sizes to suit the cable in use.



FITTING CABLE ENTRY FERRULE

TYPE	DIAMETER OF ENTRY CABLE
1.	48 mm + .5 mm - .000 mm
2.	55 mm
3.	63 mm "
4.	34 mm "
5.	40 mm "

FERRULE SIZES

INSTALLATION

On new cable installations fit the ferrule externally into the entry hole in the manhole then carefully feed the cable through the ferrule, into the manhole. Bind the ferrule to the cable with black P.V.C. tape (S.443/11) both inside and outside the manhole.

To fit the ferrule over an existing cable, cut it longitudinally through one side with a hacksaw, so that the ferrule can be snap fitted over the cable, then position it in the cable slot and bind it to the cable with P.V.C. tape.

ENGINEERING INSTRUCTION REFERENCES

E.I. LINES Cables	C 3900 SY 3905
E.I. LINES Conduit	M 3012

JOINTING COAXIAL CABLES

OPENING COMPLETED TUBE JOINT

Issue 1, 1976

JOINTING COAXIAL CABLE

GENERAL

Coaxial cable being currently purchased is usually a lead sheathed PJ cable containing up to 12 coaxial tubes together with paper insulated layer and interstice quads. Some cables contain special polyethylene insulated interstice conductors for feeding power to main repeaters. Polyethylene discs are spaced along the centre conductor to maintain uniform spacing between the inner and outer conductors. Two steel tapes and two paper tapes are wrapped around the copper tube for protection. The tubes are usually separated by core and interstice paper insulated quads. Some coaxial cables may contain layer quads for intermediate trunks and other circuits.

TUBE IDENTIFICATION

Tube one is identified by the cotton whipping on the two interstice quads on each side of the tube. One quad has a green coloured whipping and the other quad has a red coloured whipping, all other interstice quads have a white coloured whipping. The quad with the red whipping separates tube one and tube two which the quad with the green shipping separates the last tube and tube one. Two tube coaxial cable has more than one interstice quad separating the tubes but the red and green whipped quads are placed adjacent to tube one.

CLEANLINESS AT ALL TIMES IS ESSENTIAL

Except in case of prepacked jointing materials, all component parts should be washed in methylated spirit and brushed inside with the coaxial brush (S.445/11) before use. Lead sheathed plastic jacketed 4 tube coaxial cable with interstice and outer layer quads is used to show the jointing procedure, because it is a common type.

*NOTE: When jointing 12 tube coaxial cable it is necessary to joint the first 6 tubes then the inner conductors followed by the remaining 6 tubes.

SERIAL/ITEM	TITLE	USE
443/1	Sleeve, Inner Conductor.	Press type sleeve for jointing inner conductors, 19 mm long without centre crimp.
443/2	Sleeve, Outer Conductor.	Tubular copper sleeve for jointing outer conductors.
443/3	Sleeve, Securing.	Copper tubes for securing steel tapes.
443/4	Ring, Crimping.	Copper ring for securing paper insulation and for jointing.
443/5	Bushing, Steel.	Steel Tube placed inside for reinforcing coaxial tube before outer conductor sleeve is rolled.
443/6	Disc, Polyethylene.	Polyethylene spacing disc used in jointing.
443/7	Spacer, Joint.	Resin-bonded-paper tube used to space tube joints.
443/8	Disc PTFE.	Heat resistant disc used in terminations. Coloured yellow for identification purposes.

MATERIAL FOR JOINTING COAXIAL CABLE

SERIAL/ITEM	TITLE	USE
443/10	Kit, Jointing	Each Kit contains 12 bags. Each bag contains: 1 Jointing sleeve 443/1 1 Outer conductor sleeve 443/2 2 Securing sleeves 443/3 4 Crimping rings 443/4 2 Steel bushings 443/5
443/11	Tape, Marking, Coaxial Cable.	Yellow adhesive P.V.C. tape printed with numerals 1 to 4. Supplied in 2 m rolls.
443/12	Tape, Marking, Coaxial Cable.	" 5 to 8. " " " "
443/13	Tape, Marking, Coaxial Cable.	" 9 to 12. " " " "
443/14	Tape P.V.C. Non Adhesive 16 mm.	For insulating tubes. Supplied in 25 m rolls.
443/16	Tape warning coaxial cable.	Blue adhesive P.V.C. tape 38 mm wide printed repeatedly throughout length "Coaxial Cable do not disturb".
440/4	Silica Gel.	Tin of 20 x 100 g bags.

MATERIAL FOR JOINTING COAXIAL CABLE

DO NOT WORK IN A MANHOLE WHERE GAS HAS BEEN DETECTED UNTIL TESTS SHOW THAT THE GAS HAS BEEN CLEARED AND WORKING CONDITIONS ARE SAFE.

S.443/1
SLEEVE,
INNER
CONDUCTOR

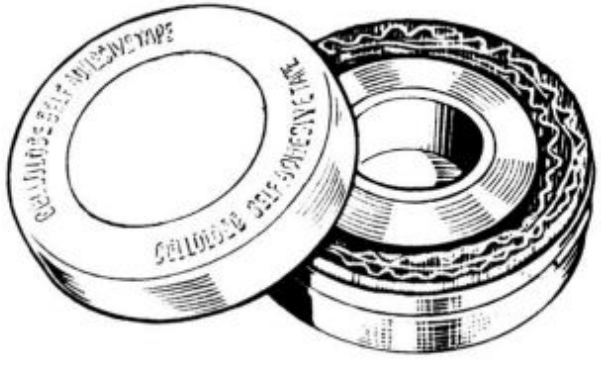
S.443/2
SLEEVE,
OUTER
CONDUCTOR

S.443/3
SLEEVE
SECURING

S.443/4
RING,
CRIMPING

S.443/5
BUSHING STEEL

S.443/6
DISC POLYETHYLENE



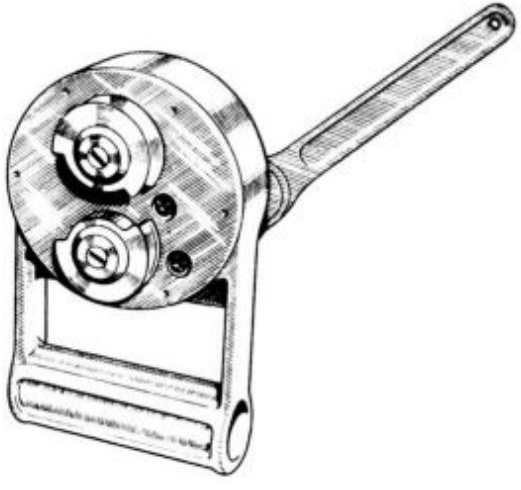
S.443/11
TAPE MARKING

SERIAL/ITEM	TITLE	USE
445/1	Roller, Coaxial Sleeve.	Roll outer conductor ends.
445/2	Cutter, Coaxial Sleeve.	Cut outer conductor sleeve when opening a joint.
445/3	Pliers, Coaxial (Ring Grip).	Crimp and tube forming operations.
445/15	Cutters, Coaxial Tube.	Cut coaxial tubes and inner conductors.
445/16	Spare Blades and Fixing Screws.	Replacements for Item 15.
445/6	Gauge, Coaxial Jointing No. 1.	Set out measurement for tube Joint.
445/18	Nippers, End Cutting.	Cut inner conductor sleeve when opening a joint.
445/8	Pliers, Inner Conductor crimping.	Crimp inner conductor sleeve.
445/9	Jig, Terminating.	Align components when terminating single tube cable on Siemens and Halske type terminations.
445/10	Former, Tube.	Form tubes before jointing.
445/11	Brush Coaxial 13 mm.	Clean jointing components.

TOOLS FOR JOINTING COAXIAL CABLE

SERIAL/ITEM	TITLE	USE
445/13	Extractor, Disc.	Extract polyethylene discs from coaxial tubes.
445/14	Inserter, Disc.	Insert discs. into coaxial tubes.
N.S.	Knife.	Mark coaxial tubes.

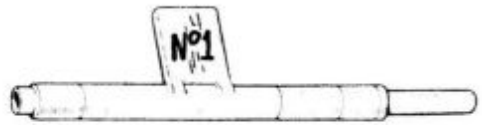
TOOLS FOR JOINTING COAXIAL CABLE



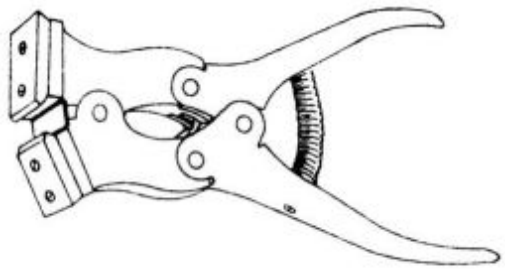
S.445/1 ROLLER, COAXIAL SLEEVE

S.445/2 CUTTER, COAXIAL SLEEVE

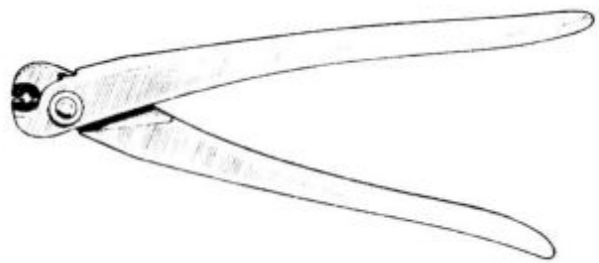
S.445/3 PLIERS, COAXIAL (RING GRIP)



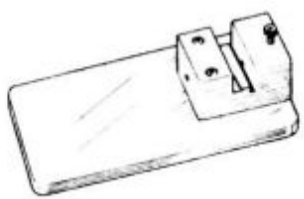
S.445/6 GAUGE, COAXIAL JOINTING NO. 1



S.445/18 NIPPERS, END CUTTING



S.445/8 PLIERS, INNER CONDUCTOR CRIMPING

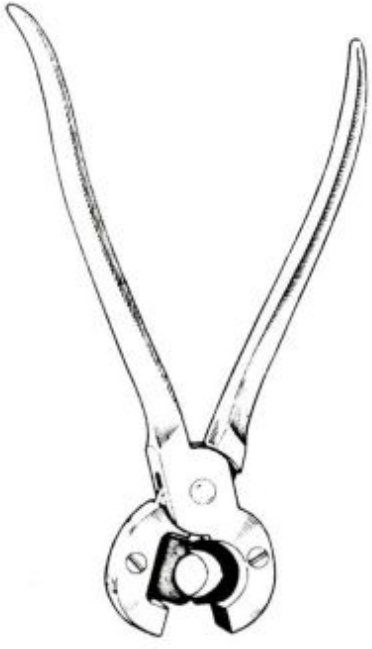


S.445/9 JIG, TERMINATING

S.445/11
BRUSH, COAXIAL

S.445/13
EXTRACTOR, DISC.

S.445/14
INSERTER, DISC.



S.445/15
CUTTER, COAXIAL TUBE

S.445/16
BLADES AND FIXING SCREWS

TOOLS FOR JOINTING COAXIAL CABLE

NOTE : SHEATH STRIPPERS PREVIOUSLY USED ON LEAD SHEATHED COAXIAL CABLES ARE NOW LISTED AS N.F.P.

Refer Page 0-11

JOINTING COAXIAL CABLES

PREPARATION OF CABLE

Carefully lay cables in their permanent position and mark for a joint opening of 660 mm. Provide a 100 mm overlap of cable ends if outer layer quad conductors are included in the cable.

Prepare the left hand side end first, (this is used as a reference point for measurements for the preparation of the right hand side tubes). Remove armouring of outer jacket for 100 mm beyond the joint opening mark. Clean the cable sheathing 100 mm from the opening mark and apply stearine. Cut around, but do not break the lead sheath at the opening mark. Slip the appropriate end cap over the cable.

REMOVAL OF SHEATHING

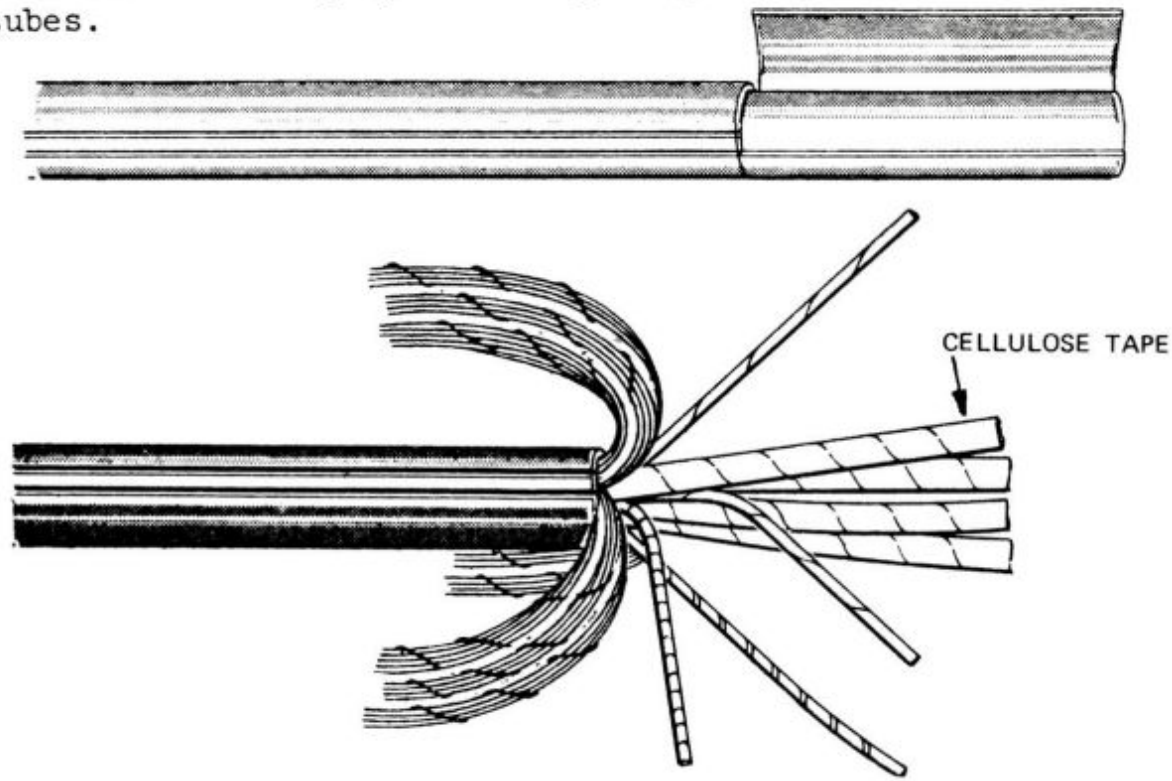
Use a hack knife or suitable sheath stripper to cut along sheathing from the opening mark to the cable end. Take care not to damage the tubes, interstice or layer pairs.

SECURE STEEL TAPES

Flatten cable end to prevent steel tapes springing back. Score around sheathing 150 mm from cable end and remove this section of sheathing only.

Remove outer wrapping paper and lay back outer layer quads if any. Hold the steel and paper tapes of each tube (retighten if necessary) with cellulose tape wrapped on the end in the same direction as the tapes.

Remove remainder of the sheathing up to the opening mark, being careful to avoid any damage to the tubes.

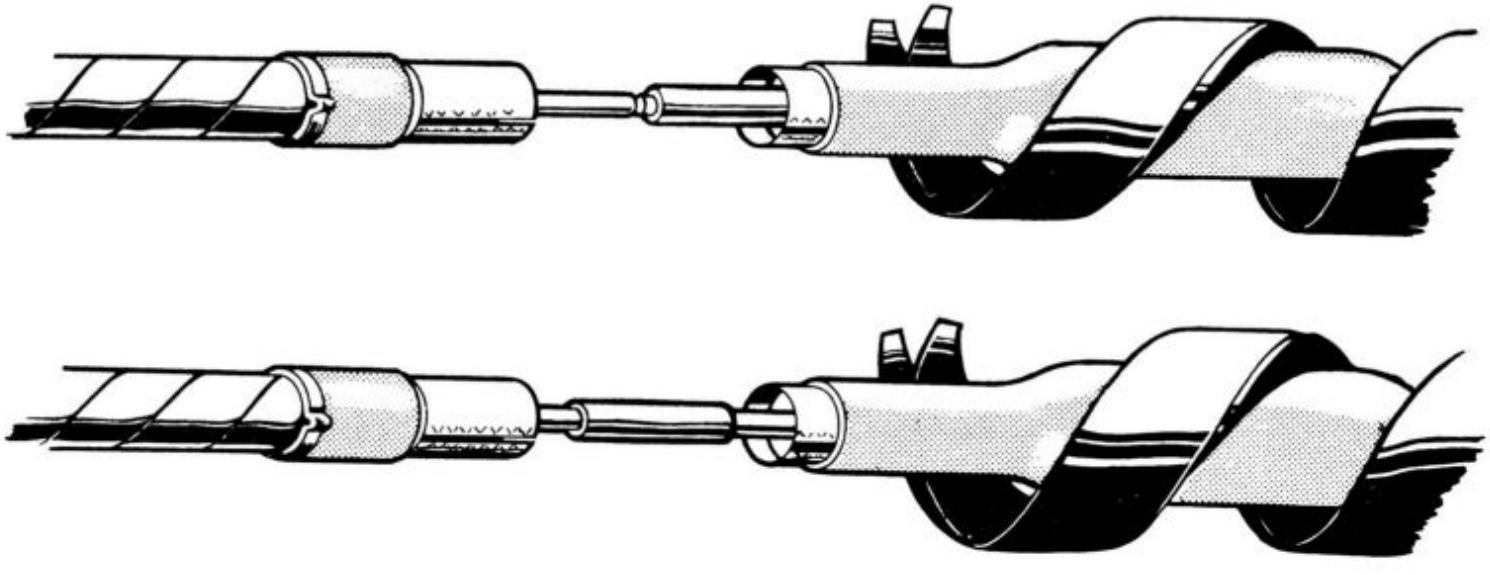


REMOVING CABLE SHEATH END

POSITIONING SLEEVE

Replace the sleeve completely over one inner conductor. This pushes the spacer disc about 3 mm into the tube. Line up both inner conductors and slide the sleeve up to mark on the opposite inner conductor. It is important that the sleeve be CENTRALLY SITUATED in the joint. Using the crimping pliers (S.445/8) make one compression each end of the sleeve. An additional crimp either side of the centre is made to complete the joint.

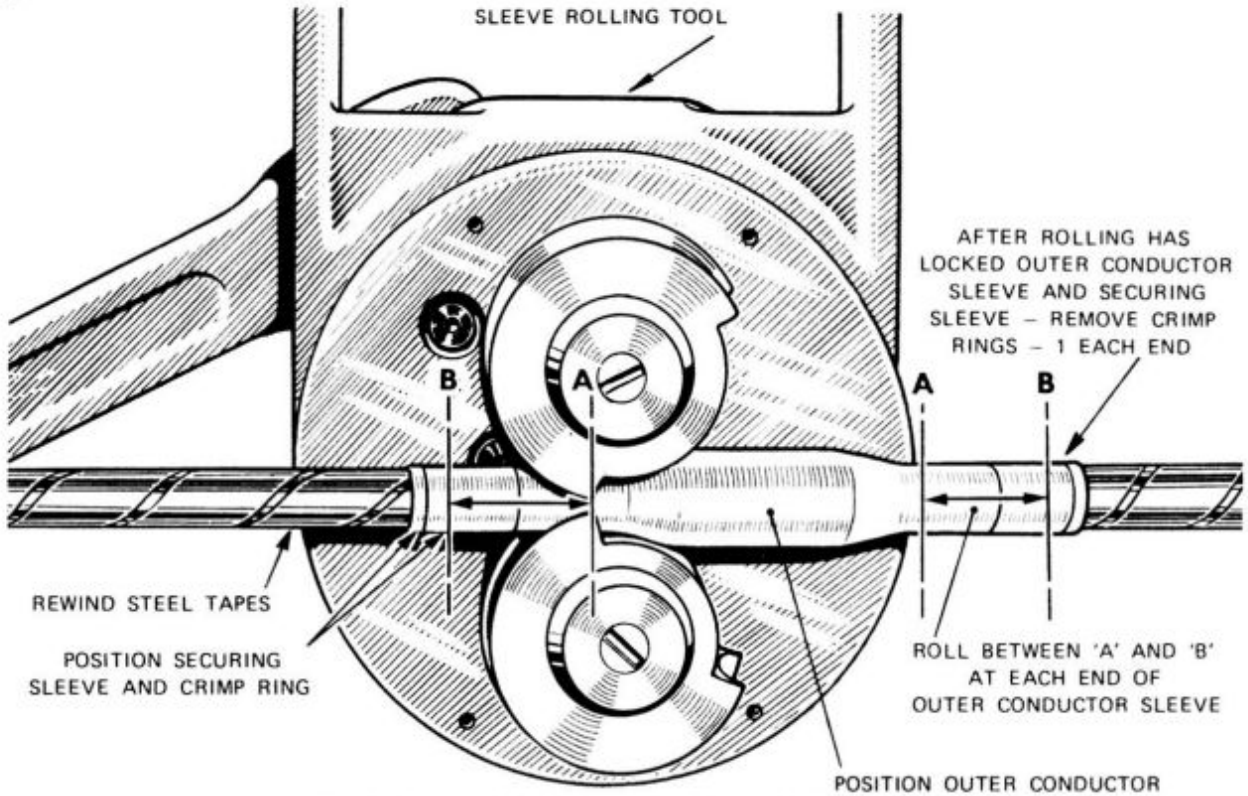
Fit a split polyethylene spacer disc over the inner conductor and flush with the outer conductor on the side of the joint where the solid disc was pushed into the tube.



POSITIONING INNER CONDUCTOR SLEEVE

JOINTING OUTER CONDUCTORS

Position outer conductor sleeve over the joint and up to the securing sleeve on the RIGHT side tube. Rewind the tapes on the LEFT side tube and hold, slide the securing sleeve up to and against the outer conductor sleeve end and crimp lightly, sufficient to hold the steel tapes. Slide the crimp ring up to the securing sleeve and crimp. Using the sleeve roller (S.445/1) roll each outer conductor as illustrated. Cut off the crimped ring as the roller holds the securing sleeve, complete rolling over the securing sleeve.



JOINTING OUTER CONDUCTOR SLEEVE

OPENING COMPLETED TUBE JOINT

REMOVE SECURING SLEEVE

Position crimping pliers over the tube on the sheathing side with the edge against the securing sleeve and hold secure.

Make a cross cut in the securing sleeve with a knife and using long nose pliers lift up one corner and tear off with a winding action as with the outer conductor sleeve.

Take care to avoid damage to the outer conductor.

Using the same method as before, remove the remainder of the outer conductor sleeve from the opposite side, but only remove the securing sleeve on this side if necessary.

REMOVE INNER CONDUCTOR SLEEVES

Using the end cutting pliers (S.445/18) accurately adjust the screw on the pliers making a gap equal to the diameter of the inner conductor.

Position the cutter over one of the inner conductor sleeve halves, press the pliers and the sleeve will split lengthways. Take care, because excess pressure on the end cutting pliers after the adjusting screw has come in contact with the stop will damage the adjusting screw.

Remove the second half of the sleeve in the same way.

BEWARE - CONTACT WITH THE LIVE CONDUCTORS OF A POWER CABLE CAN CAUSE SERIOUS INJURY OR DEATH.

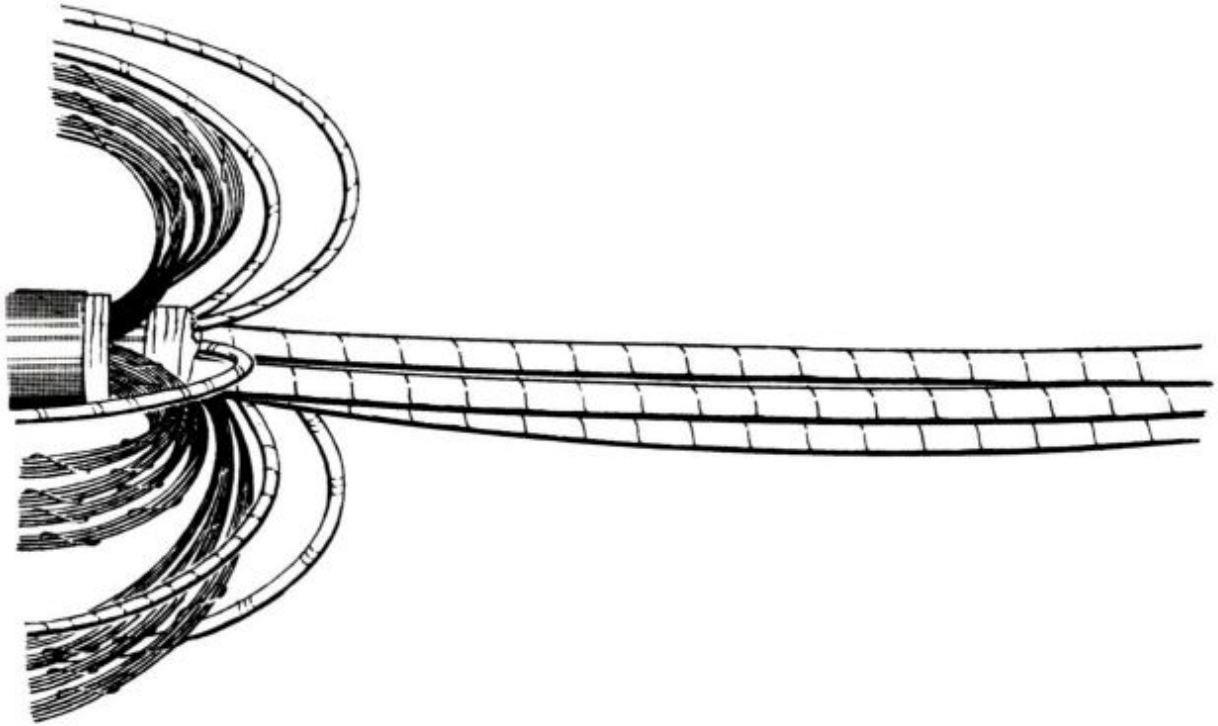
OPENING COMPLETED TUBE JOINT

REFERENCE

LINES Cables	J 3900

PREPARATION OF TUBES

Tie linen tape adjacent to the sheathing and remove the outer paper wrapping. If outer layer quads are included lay these back and tie the linen tape over tubes and interstice quads 25 mm from the first tie. Lay back the interstice and core quads.



CABLE SHEATH REMOVED

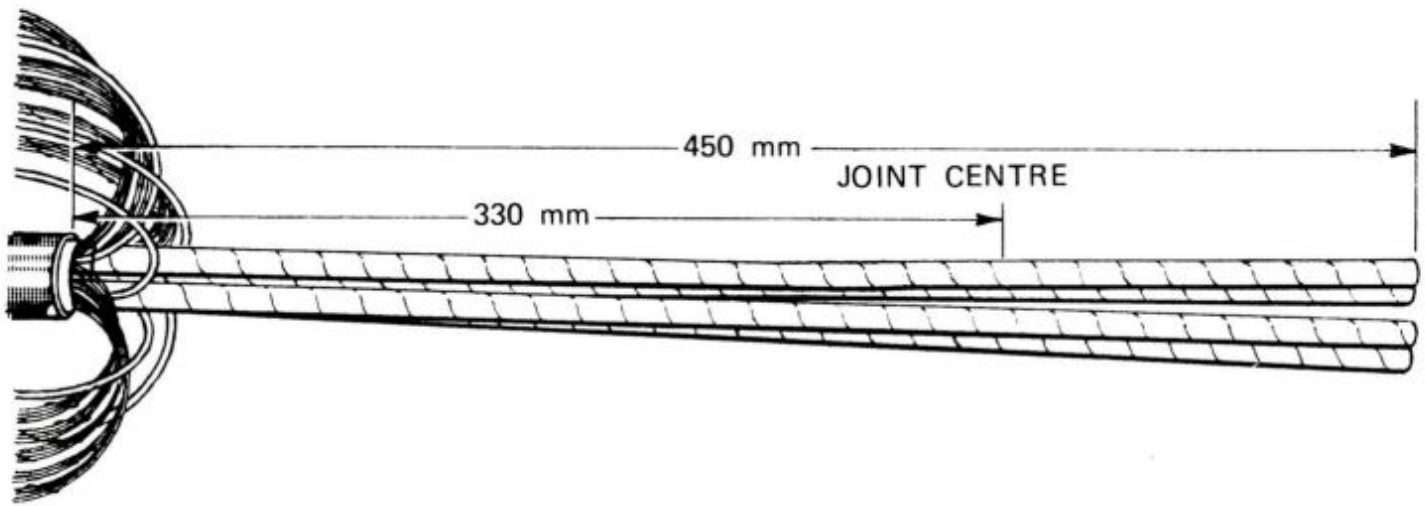
JOINTING COAXIAL CABLES

MARKING TUBES

Mark all tubes 450 mm from cable sheath end and bind cellulose tape over the mark. Using the tube cutters (S.445/15) cut tubes at the 450 mm mark and reform the tube ends. Gently straighten tubes by carefully unwinding tube lay.

Where identification marks are not provided on the paper tapes, adhesive backed numbered tape (S.443/11-12-13) should be attached to each tube.

Mark the joint centre on all tubes, 330 mm from the sheath end.

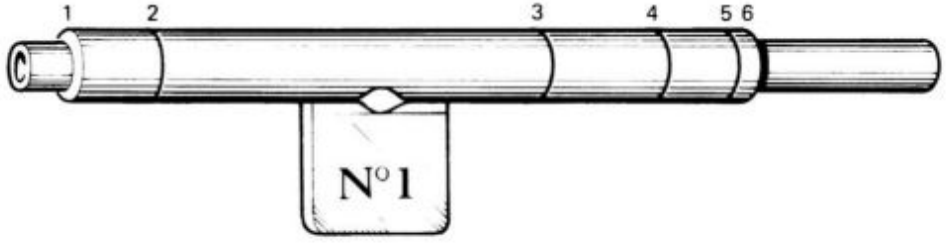


MEASURING JOINT CENTRE

USING MEASURING GAUGE

All measurements from this stage are made with the coaxial measuring gauge No. 1 (S.445/6). The shoulder edge and markings numbered 1 to 6 give exact measurements for placement of crimping rings, securing sleeves and cutting of conductors. THESE MEASUREMENTS MUST BE MADE WITH THE GREATEST CARE.

The first crimping ring (S.443/4) fitted is used as a reference point.

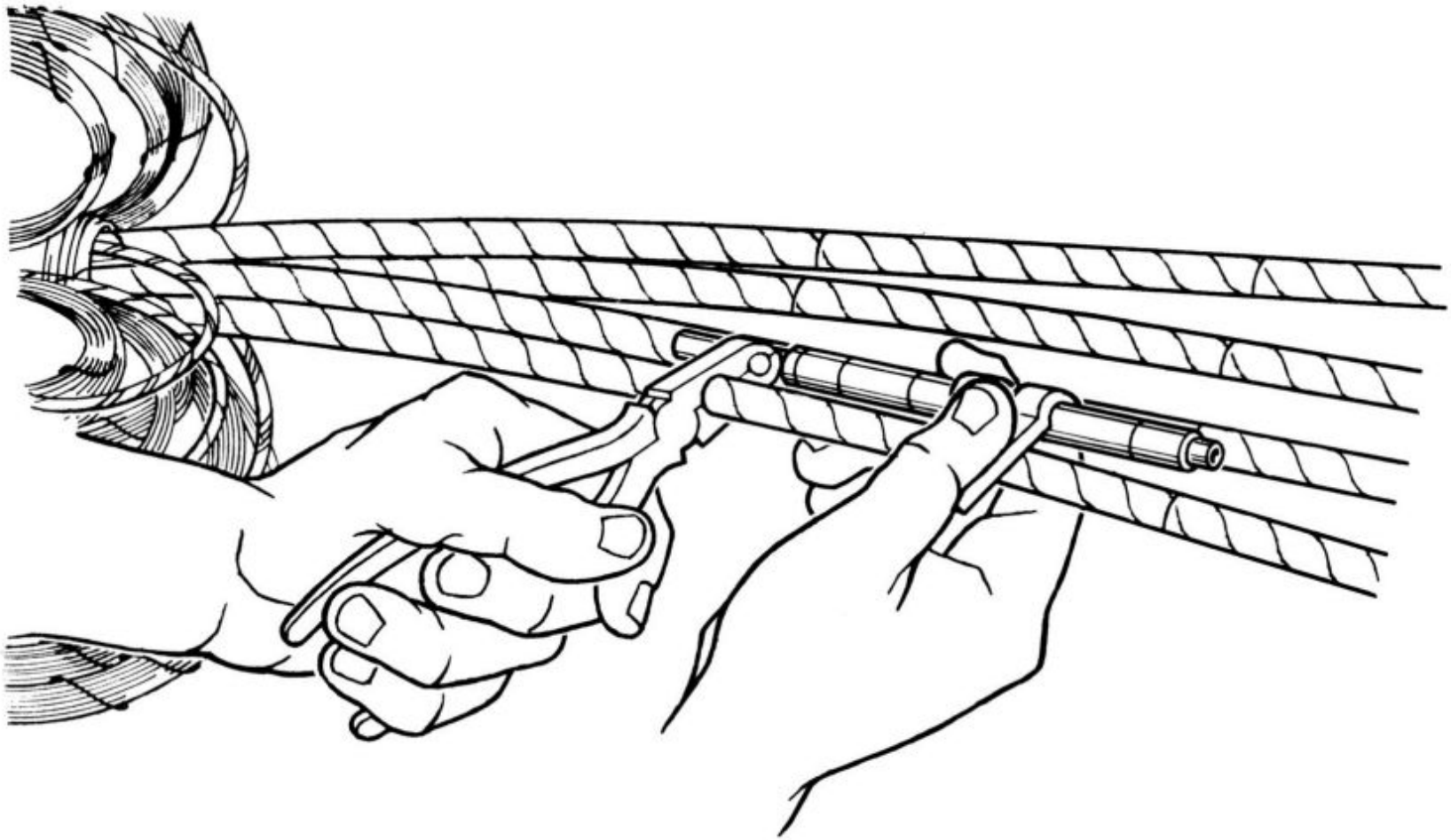


COAXIAL MEASURING GAUGE NO. 1

MARKING TUBES

Position gauge along the first selected tube with the shoulder (1) at the joint centre mark. Mark the tube at shoulder (6). Repeat this operation on all tubes. Fit a crimping ring over each tube and with the inner position of the coaxial pliers crimp the rings at the mark (6). Remove paper wrapping on each tube from the crimped ring to the cellulose tape.

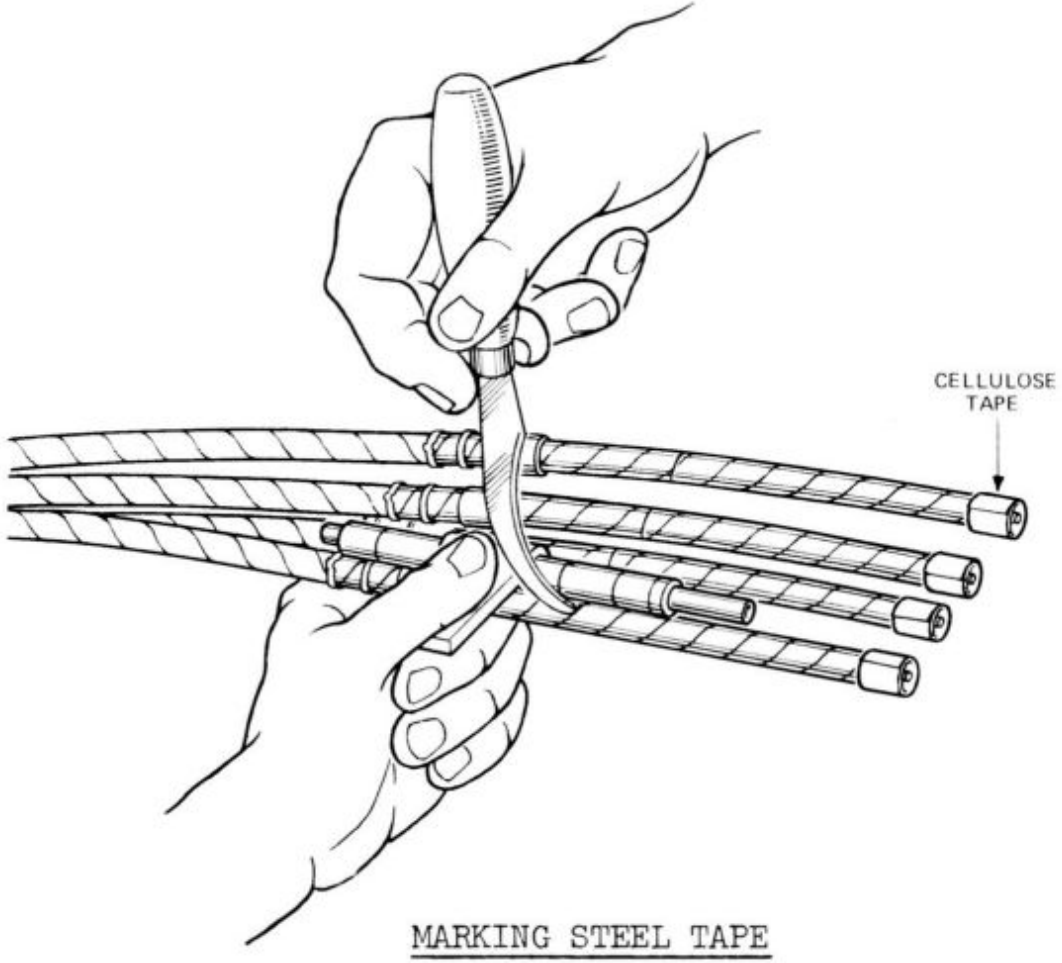
DO NOT TREAD ON CABLES WHEN ENTERING OR LEAVING MANHOLES.



MEASURING AND CRIMPING RINGS AT MARK 6

MARKING STEEL TAPE

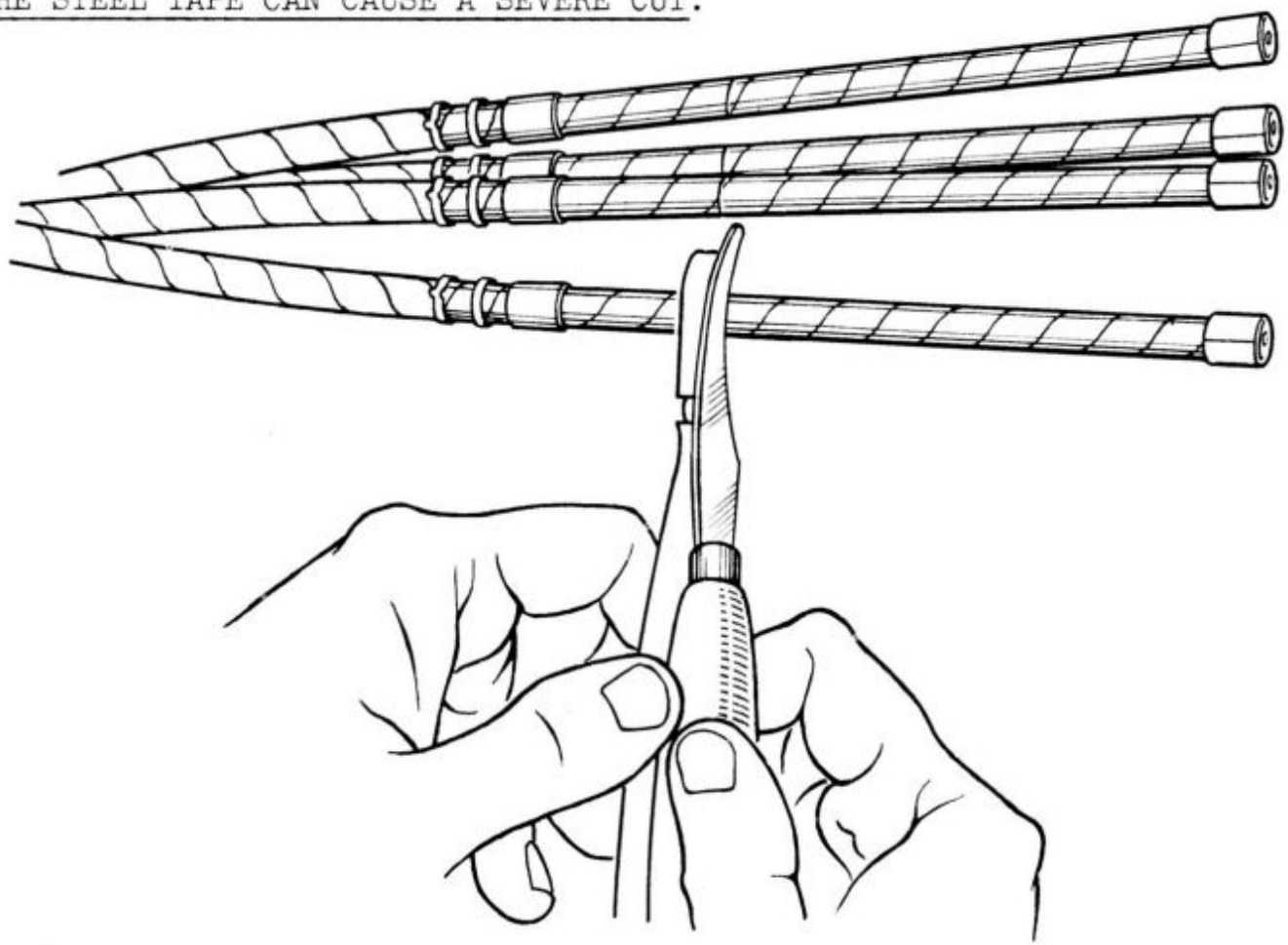
Position gauge along the tube with shoulder (1) at the crimped ring and mark the steel tapes at mark (3) on the gauge. Slide one crimping ring and one securing sleeve (S.443/3) over each tube.



MARKING STEEL TAPE

REMOVING STEEL TAPES

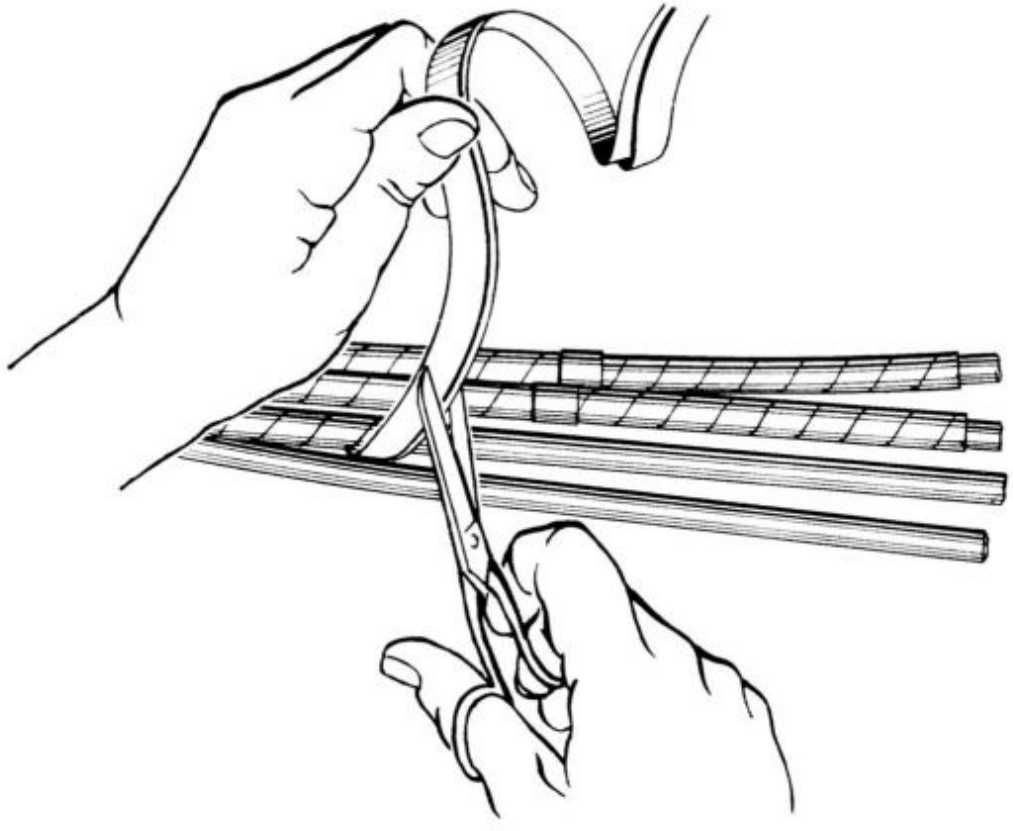
Position the coaxial pliers at mark (3) and score around the steel tapes with a knife. Unwind the steel tapes with long nose pliers. DO NOT USE YOUR FINGERS AS THE SHARP EDGE OF THE STEEL TAPE CAN CAUSE A SEVERE CUT.



MARKING STEEL TAPE

CUTTING STEEL TAPE

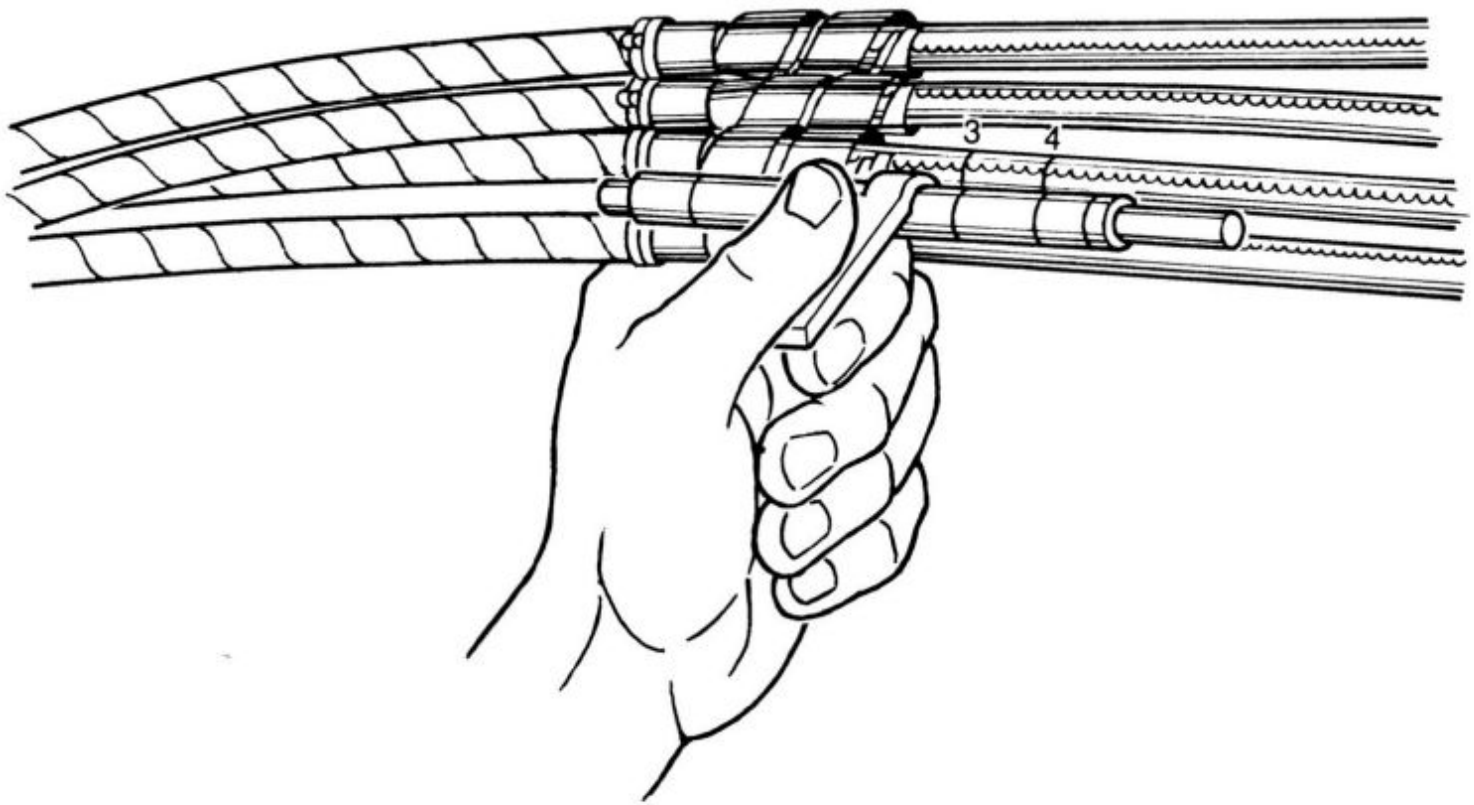
Hold the steel tapes with the fingers, remove the coaxial pliers and without releasing the tapes stretch and cut at the score mark with sharp scissors. Snip off the sharp points.



CUTTING STEEL TAPE

CUTTING OUTER CONDUCTOR

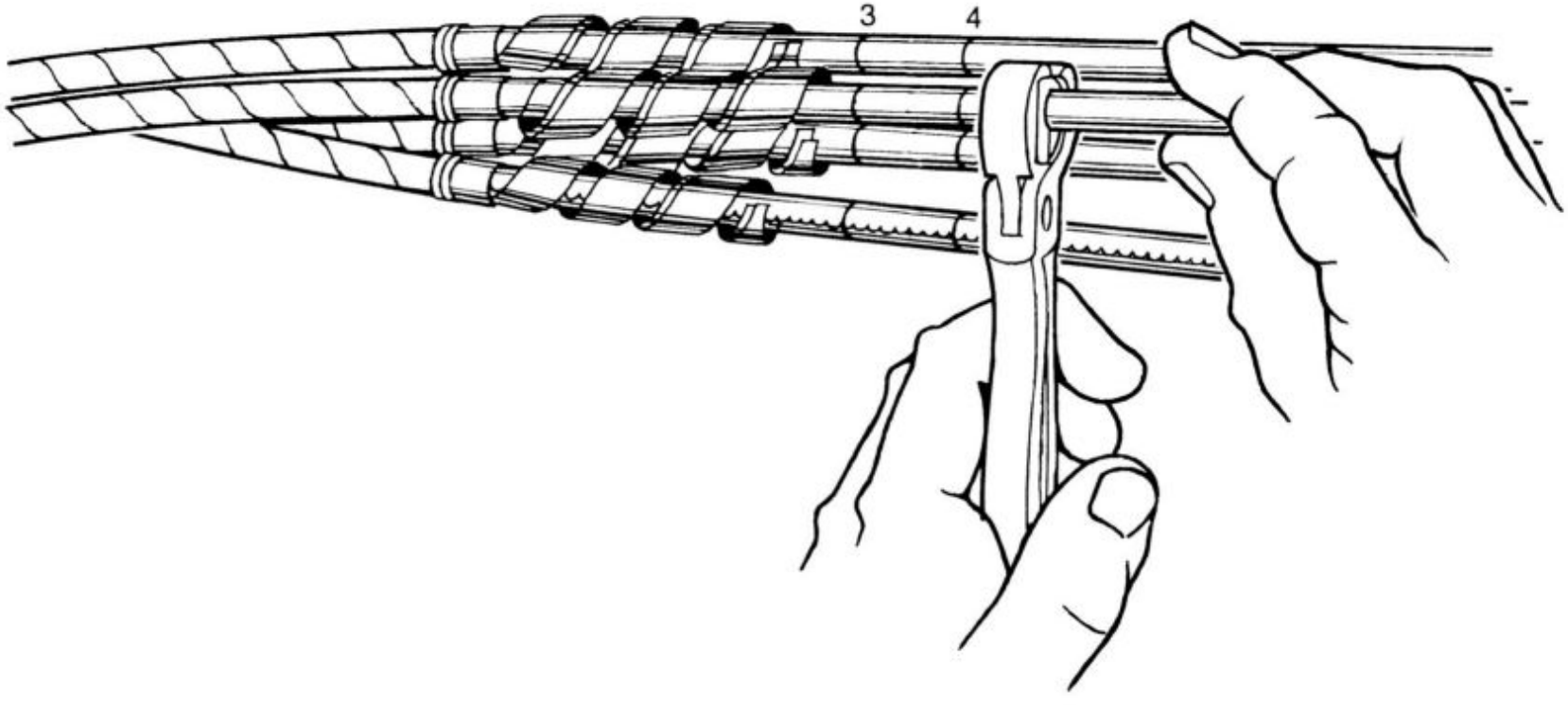
Position gauge along the tube with the shoulder (1) at the crimped ring, and mark the outer conductor at marks (3) and (4). Using the coaxial tube cutters cut the tube 25 mm out from mark (4). Repeat this procedure for each tube.

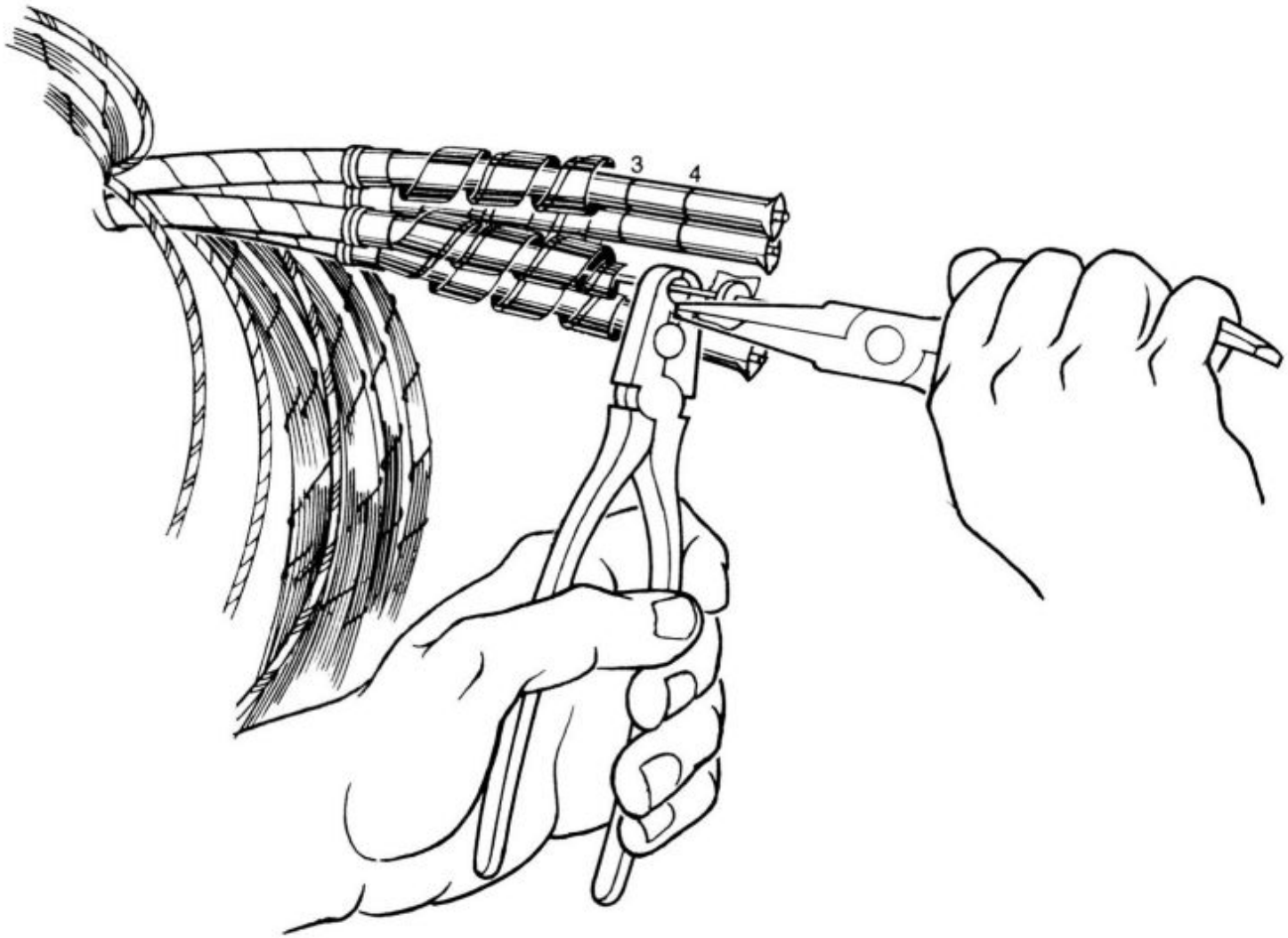


MARKING OUTER CONDUCTOR

REMOVING SURPLUS OUTER CONDUCTOR

Position outer jaw of the coaxial pliers over the tube with the outer edge away from the sheathing and at mark (4). Grasp outer conductor with a pair of long nose pliers as close as possible to the coaxial pliers and tear off surplus tube. Trim off any projections with scissors then remove any visible spacer discs from the inner conductor. Repeat for all other tubes.

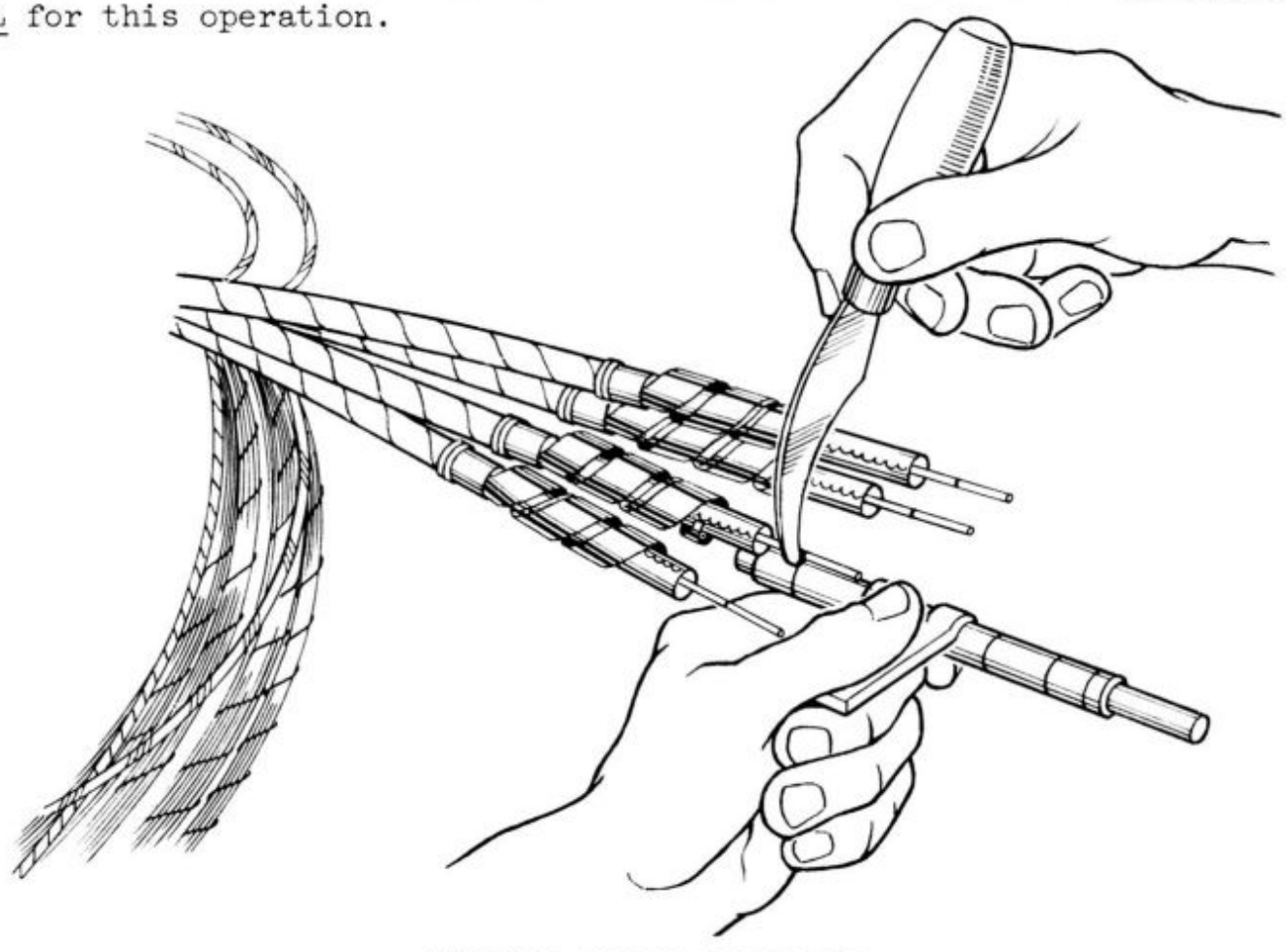




REMOVING SURPLUS OUTER CONDUCTOR

CUTTING INNER CONDUCTOR

Position gauge with the shoulder (1) up to the end of the outer conductor, mark the inner conductor at mark (2) and cut with the coaxial tube cutters. DO NOT USE ANY OTHER TOOL for this operation.

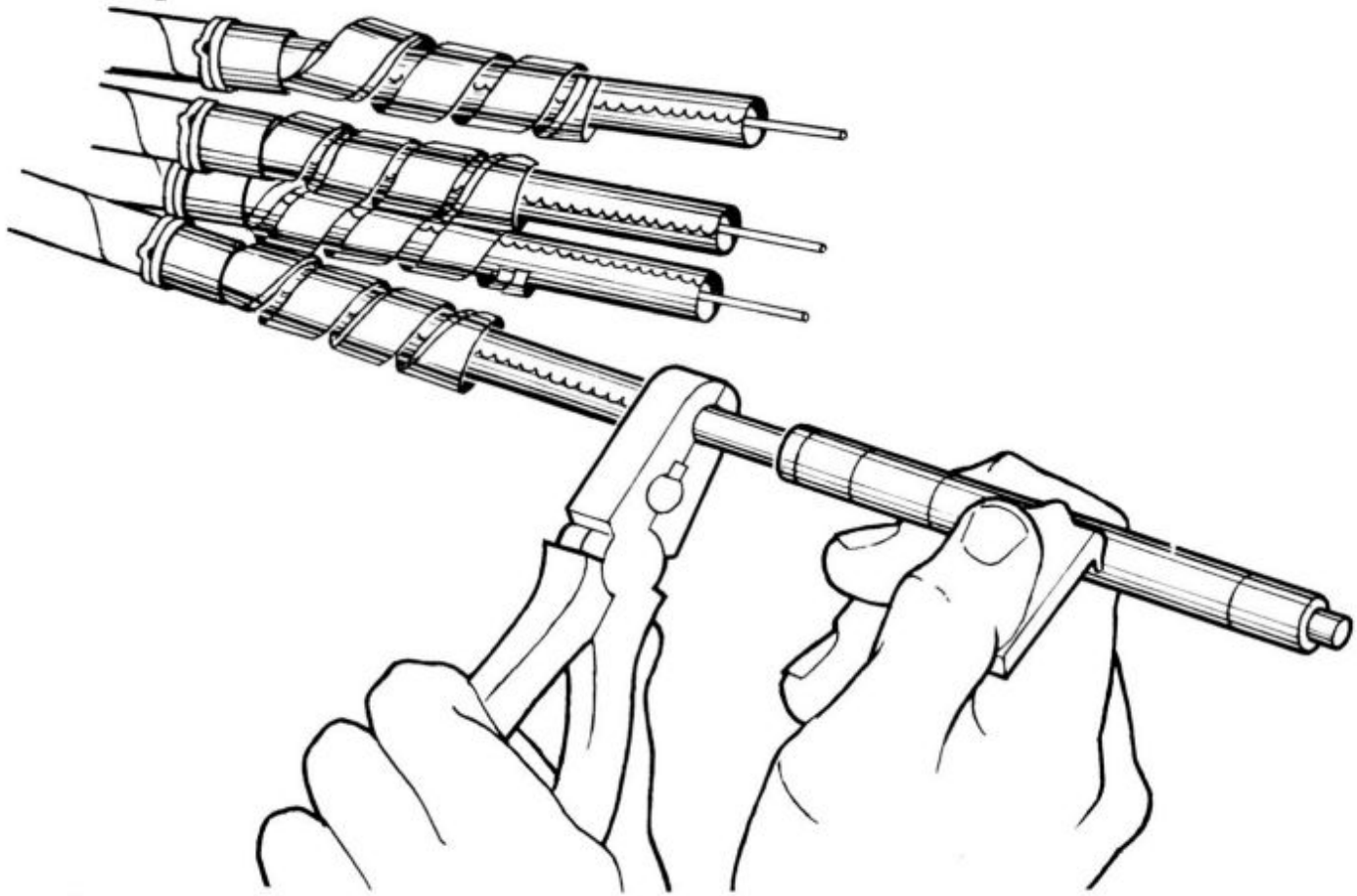


MARKING INNER CONDUCTOR

JOINTING COAXIAL CABLES

ROUNDING OFF OUTER CONDUCTOR

Wipe gauge with a clean cloth and insert the long end of the gauge inside the outer conductor up to shoulder (6) pushing back any spacer discs that are encountered. Pull out the gauge slightly and with the outer jaw of the coaxial pliers, round off the outer conductor up to the end.



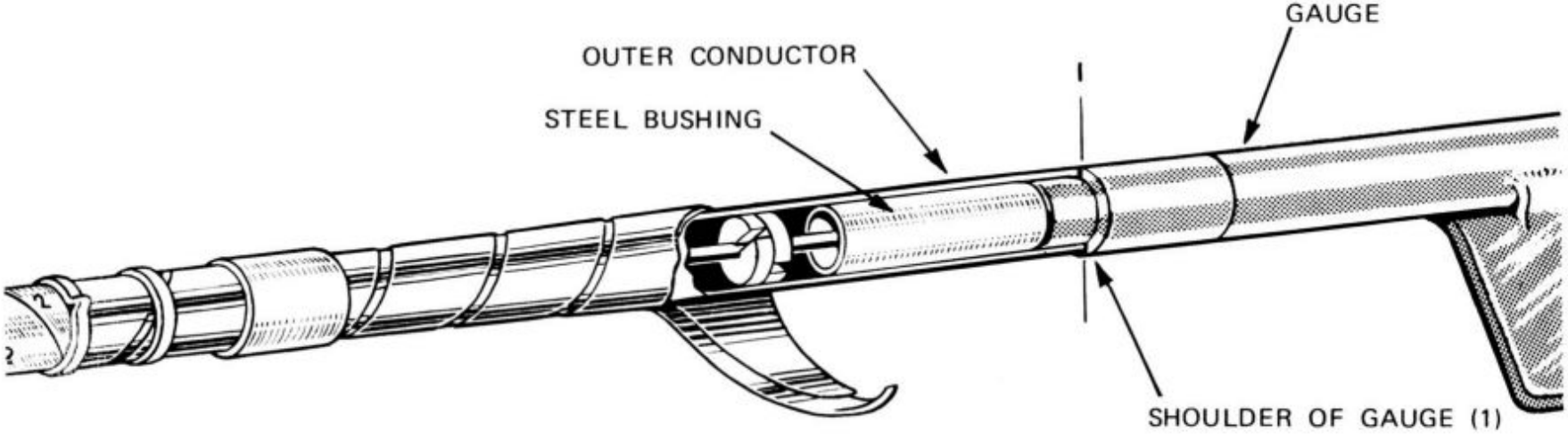
ROUNDING OFF OUTER CONDUCTOR

FITTING STEEL BUSHING

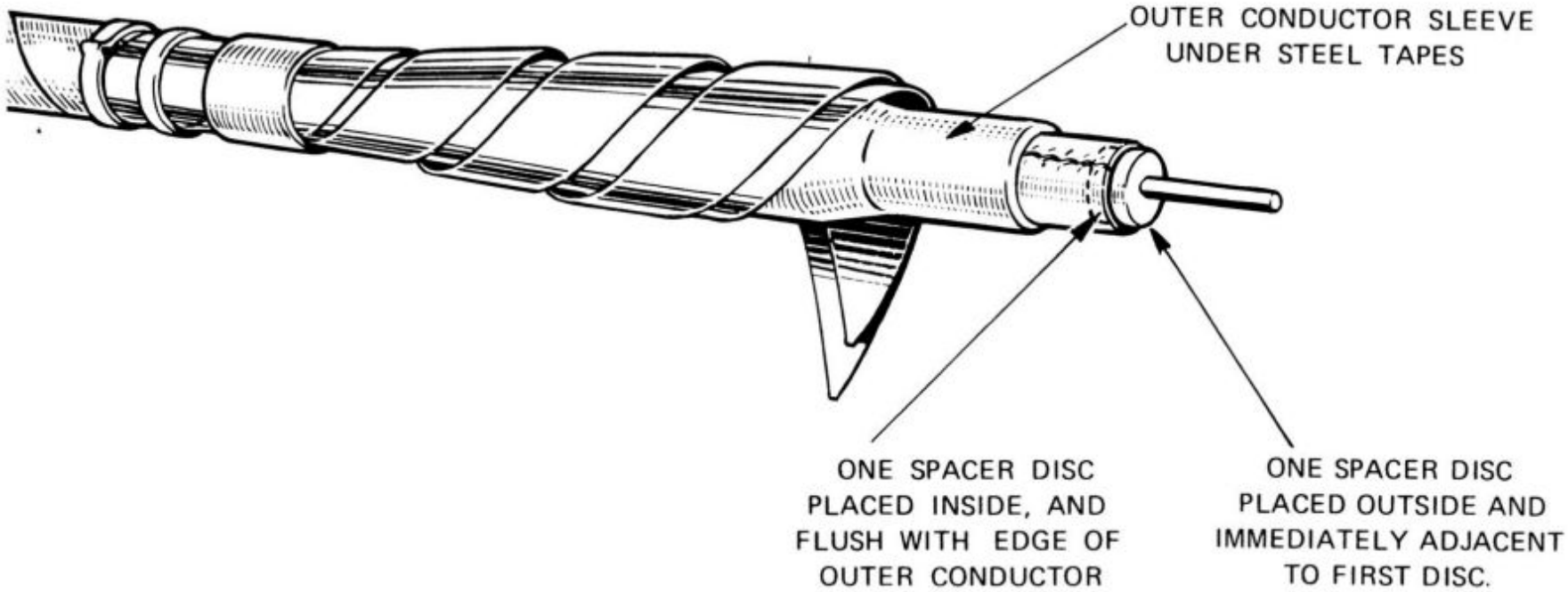
Insert one steel bushing (S.443/5) under each outer conductor. Using the short end of the gauge locate it by pushing until the shoulder (1) touches the outer conductor.

Fit two spacer discs (S.443/6) on each inner conductor, one placed precisely inside the outer conductor and the second exactly outside the end of the outer conductor.

Slide one outer conductor sleeve (S.443/2) under the steel tapes on each tube.



INSERTING STEEL BUSHING



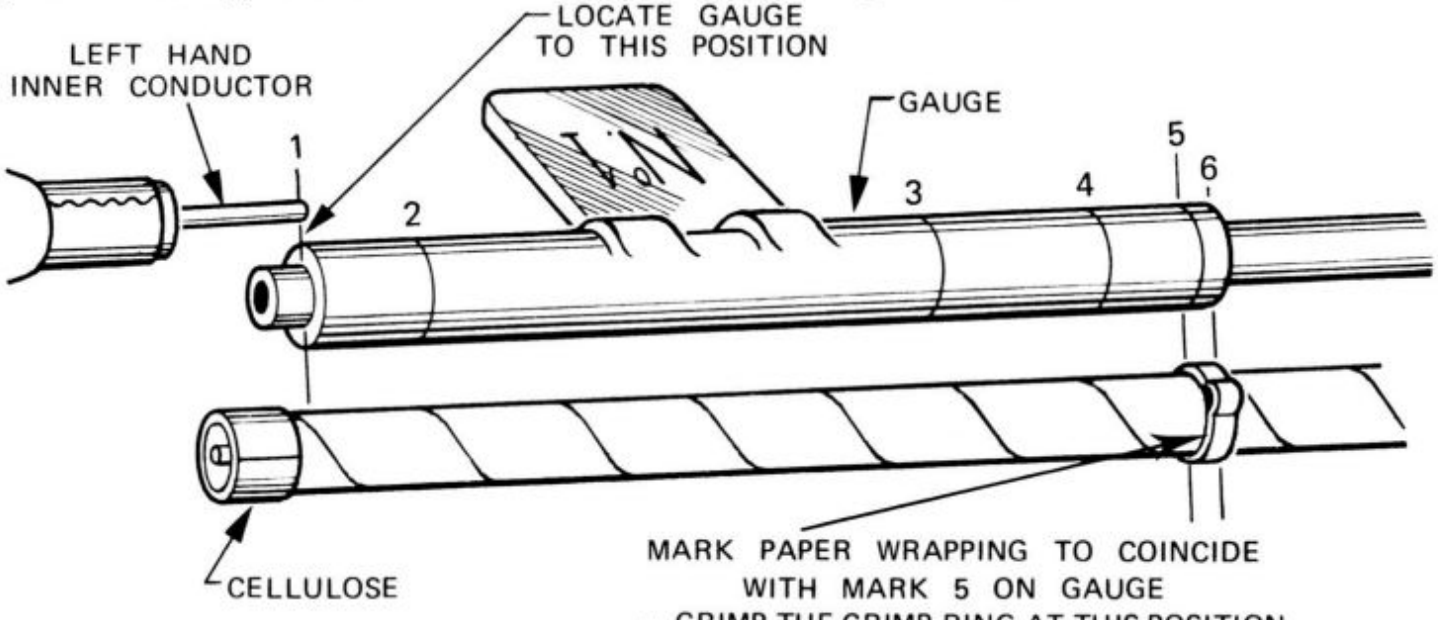
FITTING OUTER CONDUCTOR SLEEVE UNDER STEEL TAPES

PREPARATION OF THE RIGHT SIDE END

Prepare the tubes in the same method as before. (Pages 0-11 - 0-14).

Match tubes to line up tube 1 to tube 1, tube 2 to tube 2 and so on depending on the number of tubes in the cable. It may be necessary to twist the cable ends up to a 90° turn on either side to line the tubes with one another in correct sequence.

Position guage along the selected tube with shoulder (1) against the end of the left side inner conductor and mark paper wrapping on the right side tube at (5). Repeat for each remaining right side tube measuring from the left side inner conductor to which it will finally be jointed. Over each tube slide and crimp, one crimp ring at mark 5. Repeat the same procedure as for the left side up to and including insertion of the steel bushing and fitting the two outer spacer disc's Pages 0-17 - 0-24.

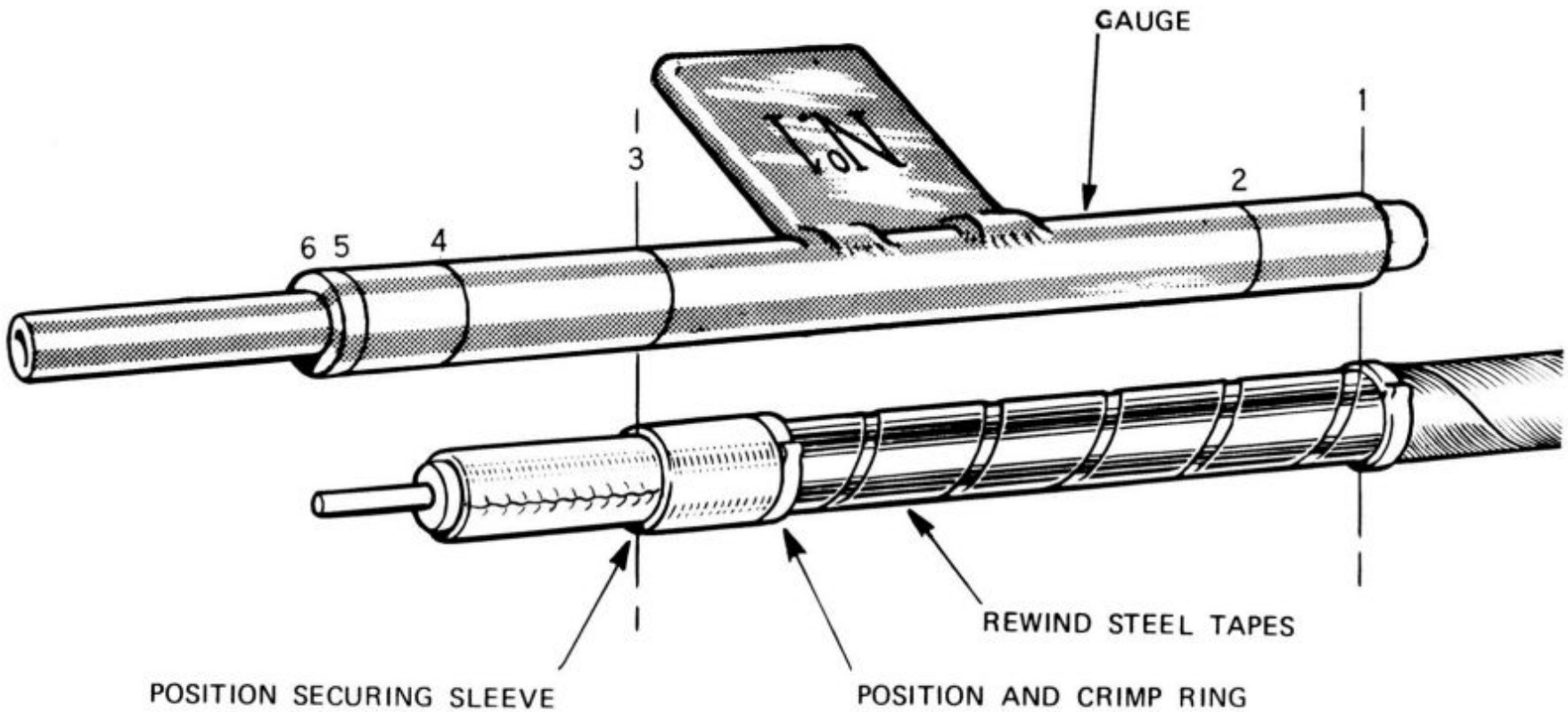


MARKING POSITION OF CRIMPING RING

JOINTING COAXIAL CABLES

FITTING SECURING SLEEVE

Tighten steel tapes with overlap to their original position and to precisely reach the mark (3) and hold in this position. Position the securing sleeve up to mark (3) covering the end of the steel tapes. With the outer jaw of the coaxial pliers lightly crimp the sleeve, just enough to hold the steel tapes. Slide the crimping ring up to the securing sleeve and crimp with the inner jaw of the coaxial pliers.



FITTING SECURING SLEEVE

FORMING TUBES

Position the tube former (S.445/10) between the tubes of the LEFT side cable so that the outer edge is about 125 mm from the sheathing end and gently form the tubes around the former. Repeat for right hand side of cable.

JOINTING OF TUBES

Select the tubes in the most difficult jointing position to joint first. (Bottom back tube.)

FITTING INNER CONDUCTOR SLEEVE

Screw the sleeve on each inner conductor up to the outer spacer disc, remove the sleeve and tap out any metal dust.

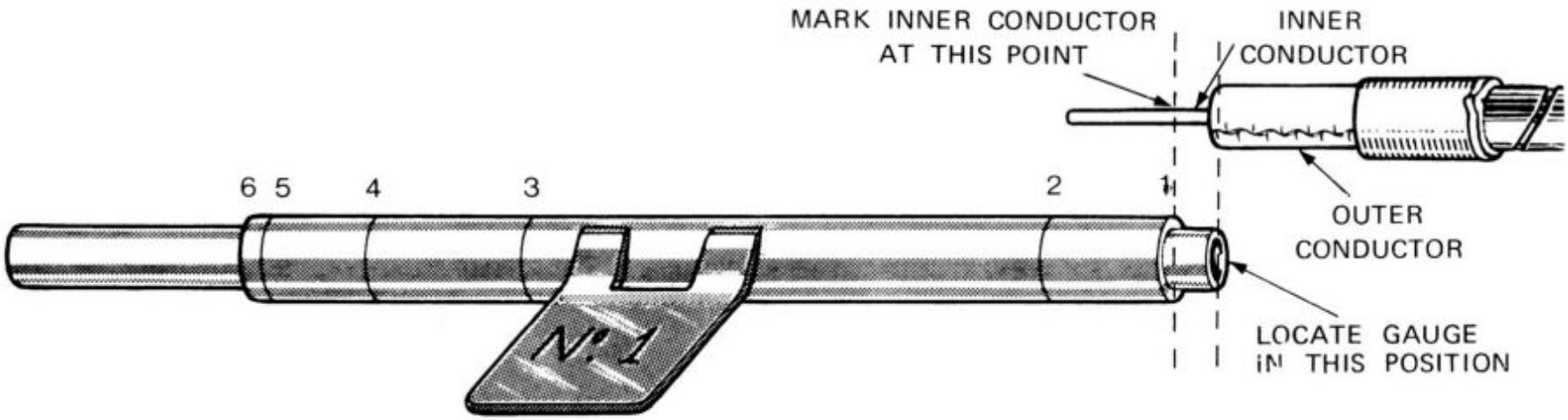
Using a clean knife blade, carefully remove the outer spacer disc from each tube. This disc was to protect the first placed disc during jointing operations.

PREVENT WORKMEN OR MEMBERS OF THE PUBLIC FROM ACCIDENTALLY STEPPING INTO OPEN MANHOLES BY PLACING GUARDS AROUND THE MANHOLE BEFORE REMOVING THE COVERS.

BE CONSTANTLY ON GUARD AGAINST AN ACCIDENT AND DO NOT COMMENCE A JOB UNTIL YOU ARE SURE THAT YOU CAN WORK IN SAFETY.

JOINTING INNER CONDUCTORS

Position the short end of the gauge up to the outer conductor and mark the inner conductor at (1). Repeat this step on the opposite tube. Wipe the inner conductors with a clean cloth to remove all metal dust.

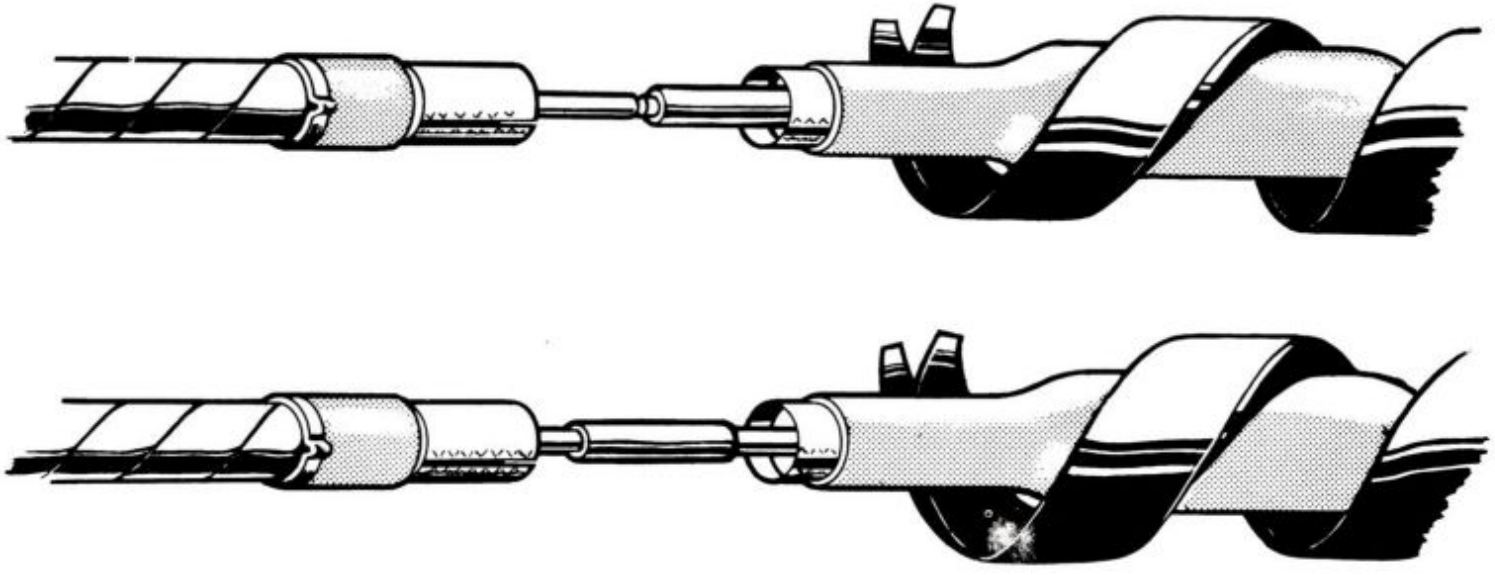


MARKING INNER CONDUCTOR

POSITIONING SLEEVE

Replace the sleeve completely over one inner conductor. This pushes the spacer disc about 3 mm into the tube. Line up both inner conductors and slide the sleeve up to mark on the opposite inner conductor. It is important that the sleeve be CENTRALLY SITUATED in the joint. Using the compression tool (S.445/8) make one compression each end of the sleeve. An additional crimp either side of the centre is made to complete the joint.

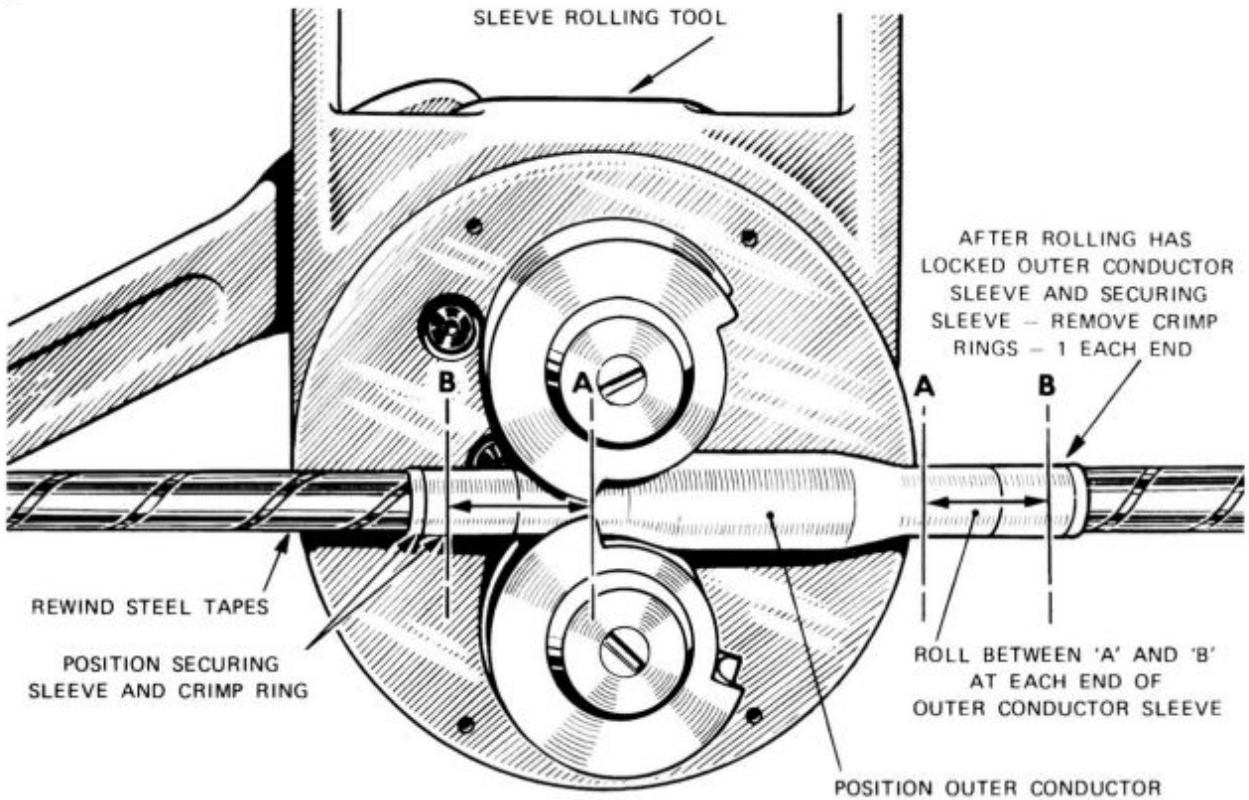
Fit a split polyethylene spacer disc over the inner conductor and flush with the outer conductor on the side of the joint where the solid disc was pushed into the tube.



POSITIONING INNER CONDUCTOR SLEEVE

JOINTING OUTER CONDUCTORS

Position outer conductor sleeve over the joint and up to the securing sleeve on the RIGHT side tube. Rewind the tapes on the LEFT side tube and hold, slide the securing sleeve up to and against the outer conductor sleeve end and crimp lightly, sufficient to hold the steel tapes. Slide the crimp ring up to the securing sleeve and crimp. Using the sleeve roller (S.445/1) roll each outer conductor as illustrated. Cut off the crimped ring as the roller holds the securing sleeve, complete rolling over the securing sleeve.



JOINTING OUTER CONDUCTOR SLEEVE

JOINTING OUTER CONDUCTOR SLEEVE

Wrap all tubes separately between the crimped rings with P.V.C. tape (S.443/14) giving a 50% overlap. Hold the tape ends with cellulose tape. Remove the tube former and fit the joint spacer (S.443/7) against the raised section of the outer sleeve.

JOINTING PAPER INSULATED QUADS AND PAIRS

Joint the centre quads or pairs outside the joint spacers, retaining the spiral lay as much as possible.

Fit identification tags over each quad or pair and joint to the jointing schedule making each twist in the centre of the coaxial joint. All wire twist joints must be soldered.

INTERSTICE QUADS

Joint the interstice quads outside the joint spacers and between their respective coaxial tubes. Solder all wire twist joints.

Insert one dessicant bag in each joint spacer and tie linen tape over each spacer around the jointed quads and coaxial tubes.

Wrap the joint with two layers of kraft paper using 50% overlap.

When outer layer quads are not included in the make-up of the cable two additional layers of kraft paper are used as a final wrapping.

OUTER LAYER QUADS

Outer layer quads must be jointed with sufficient slack to allow ready access to the coaxial tubes.

Quads should be jointed and grouped in bunches of 5 spaced evenly either side of the joint centre. Solder all wire twist joints.

Dry out the joint and wrap two layers of previously dried kraft paper over the completed joint.

PRECAUTION

Dessicant must be protected from the atmosphere. Store it in air tight containers and only open the container when it is necessary.

JOINTING POLYETHYLENE QUADS

Two polyethylene insulated quads may be included in a coaxial cable to provide power feed to unattended underground main repeaters. Alternatively they may be used as carrier quads.

When provided, polyethylene insulated quads are colour coded as follows :-

1st pair (A) wire, White; (B) wire, Blue.

2nd pair (A) wire, Red ; (B) wire, Black.

Polyethylene insulated quads will be located between tubes 1 and 2 and tubes 3 and 4 as interstice quads.

JOINTING THE CONDUCTORS

Joint the conductors leaving 20 mm bare wire twist. Tip solder the conductors with 65/35 resin cored solder. Cover the wire joint with a polyethylene sleeve serial 433/104.

WHEN WORK IS HELD UP TEMPORARILY, AWAITING TRANSPORT OR MATERIAL, DO NOT GIVE THE IMPRESSION OF BEING IDLE -

REMEMBER YOU ARE CONSTANTLY UNDER OBSERVATION BY THE PUBLIC.

OPENING COMPLETED TUBE JOINT

PROVIDING ACCESS

Clear the paper insulated conductors away from the working position. Remove the P.V.C. tape from around the tube to be opened.

CUTTING OUTER CONDUCTOR SLEEVE

Fully open the jaws of the sleeve cutter (S.445/2) and slide it over the tube until the cutting blades are positioned either side of the sleeve centre.

Adjust the cutter blades so that they sit firmly on the sleeve and wind back and forth, tighten a little more, continue this procedure until the sleeve is cut through.

To assist in the cutting process and to avoid distortion to the outer conductor hold the rolled portion of the outer conductor sleeve with the crimping pliers.

Open the jaws and remove the cutters.

REMOVE CENTRE SECTION

Flatten the end of the cut section with a pair of pliers and cut the end with diagonal cutting pliers, removing the remainder with long nose pliers.

CUTTING INNER CONDUCTOR SLEEVE

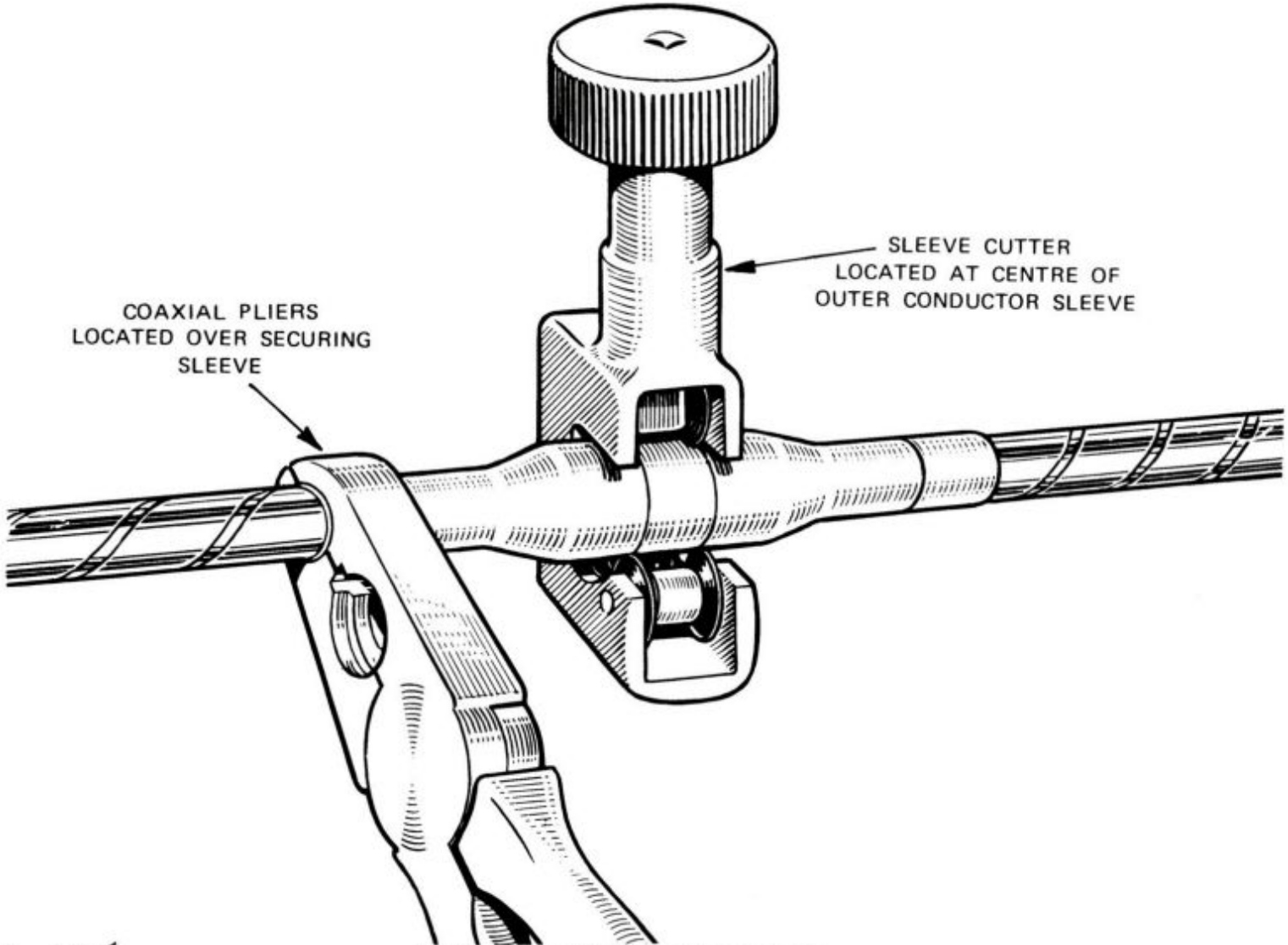
Using the tube cutter, cut the inner conductor sleeve at the centre.

REMOVE OUTER CONDUCTOR SLEEVE

Position the crimping pliers over the securing sleeve on the suspected fault side and hold secure, to prevent tube from twisting.

Make 6 longitudinal cuts with tin snips around the funnel end of the outer conductor sleeve. Lift up one part of the outer sleeve with long nose pliers and wind towards the securing sleeve. Repeat until cut sleeve can be completely removed.

OPENING COMPLETED TUBE JOINT



REMOVING OUTER CONDUCTOR

REMOVE SECURING SLEEVE

Position crimping pliers over the tube on the sheathing side with the edge against the securing sleeve and hold secure.

Make a cross cut in the securing sleeve with a knife and using long nose pliers lift up one corner and tear off with a winding action as with the outer conductor sleeve.

Take care to avoid damage to the outer conductor.

Using the same method as before, remove the remainder of the outer conductor sleeve from the opposite side, but only remove the securing sleeve on this side if necessary.

REMOVE INNER CONDUCTOR SLEEVES

Using the end cutting pliers (S.445/7) accurately adjust the screw on the pliers making a gap equal to the diameter of the inner conductor.

Position the cutter over one of the inner conductor sleeve halves, press the pliers and the sleeve will split lengthways. Take care, because excess pressure on the end cutting pliers after the adjusting screw has come in contact with the stop will damage the adjusting screw.

Remove the second half of the sleeve in the same way.

BEWARE - CONTACT WITH THE LIVE CONDUCTORS OF A POWER CABLE CAN CAUSE SERIOUS INJURY OR DEATH.

OPENING COMPLETED TUBE JOINT

ENGINEERING INSTRUCTION REFERENCE

LINES Cables J 3900

COAXIAL CABLE JOINT ENCLOSURE

Issue 1, 1976

COAXIAL CABLE JOINT ENCLOSURE

GENERAL

The standard joint enclosures for all coaxial cable installations are made from brass and electro-tinned after manufacture. They are made in three diameters, 89, 127 and 184 mm with each enclosure consisting of two end caps and one sleeve together with the necessary screws, plugs etc. Each enclosure complete with accessory items is packed as a unit in a plastic bag to keep the material clean.

Drawing CL-1142, (S.443/201 - 300) shows the construction of the enclosures, and sets out the various combinations required for most situations, for example, where coaxial joints, 12-channel repeaters, leading coils and spur cables may occur.

APPLICATION AND USE

The joint enclosure can be buried directly in the ground or used in manholes or tunnels. Application of protection from corrosion is essential in all cases.

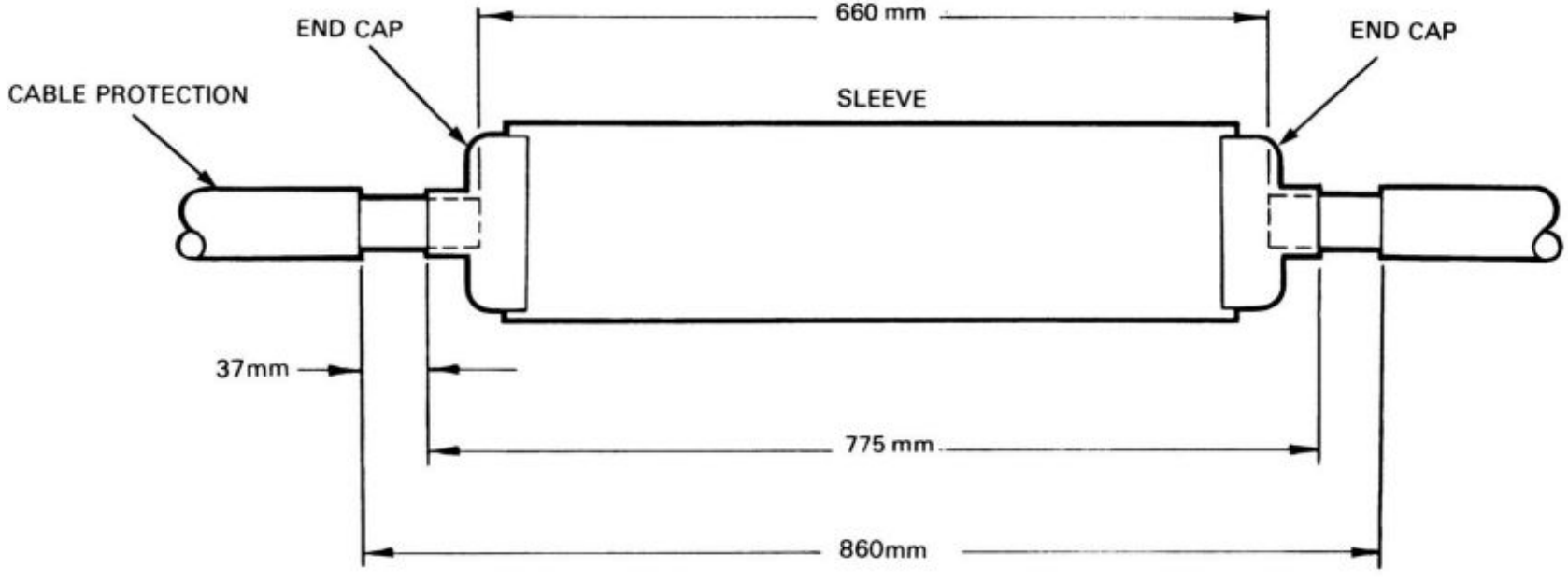
The overall length of coaxial joint enclosures is unchanged irrespective of cable size. The diameter of the joint enclosures and joint sizes follow.

ENCLOSURE DIAMETER	STRAIGHT JOINT	MULTIPLE JOINT
89 mm	2 Tube Cable	-
127 mm	4 and 6 Tube	2 and 4 Tube
184 mm	8 and 12 Tube	6, 8 and 12 Tube

JOINT ENCLOSURE DIAMETERS AND TYPICAL JOINTS

JOINT DETAILS

The overall length of the joint is 775 mm, the sleeve and end caps being nominally 600 mm and 50 mm in length respectively. Allowing 12 mm overlap at each end, this provides the standard joint opening of 660 mm. The main cable ferrules are 50 mm in length and all other ferrules 38 mm long.

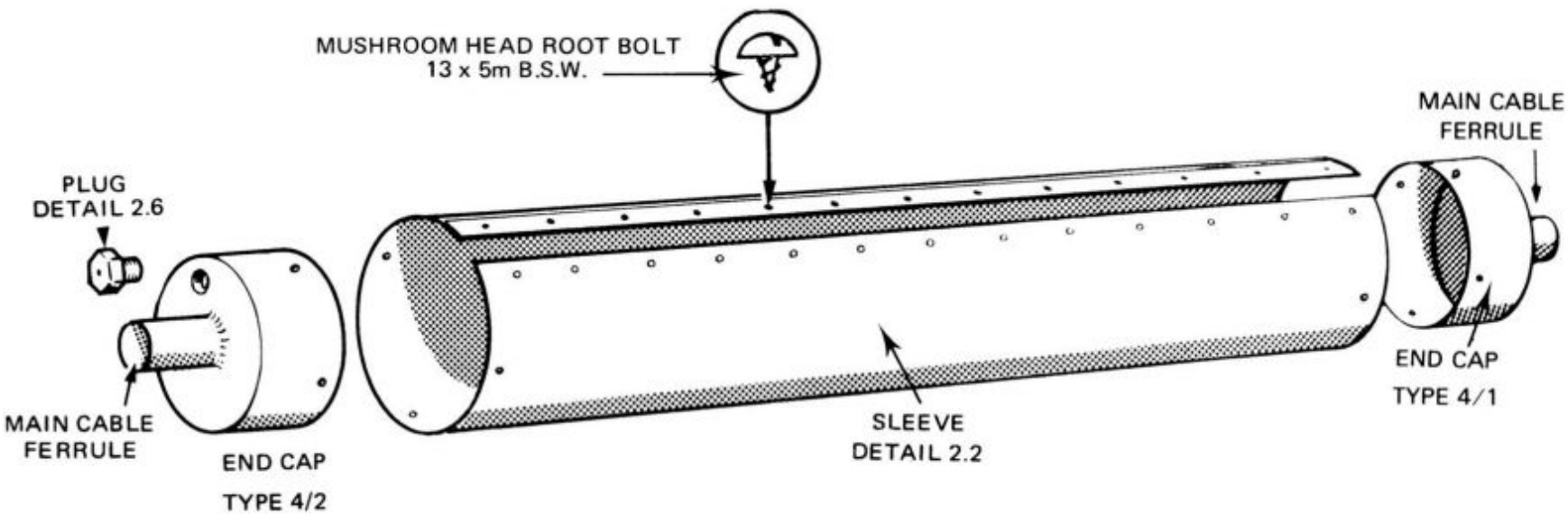


NOTE: Cable cleaned for 100 mm each end.

COAXIAL CABLE JOINT ENCLOSURE

JOINT ENCLOSURE

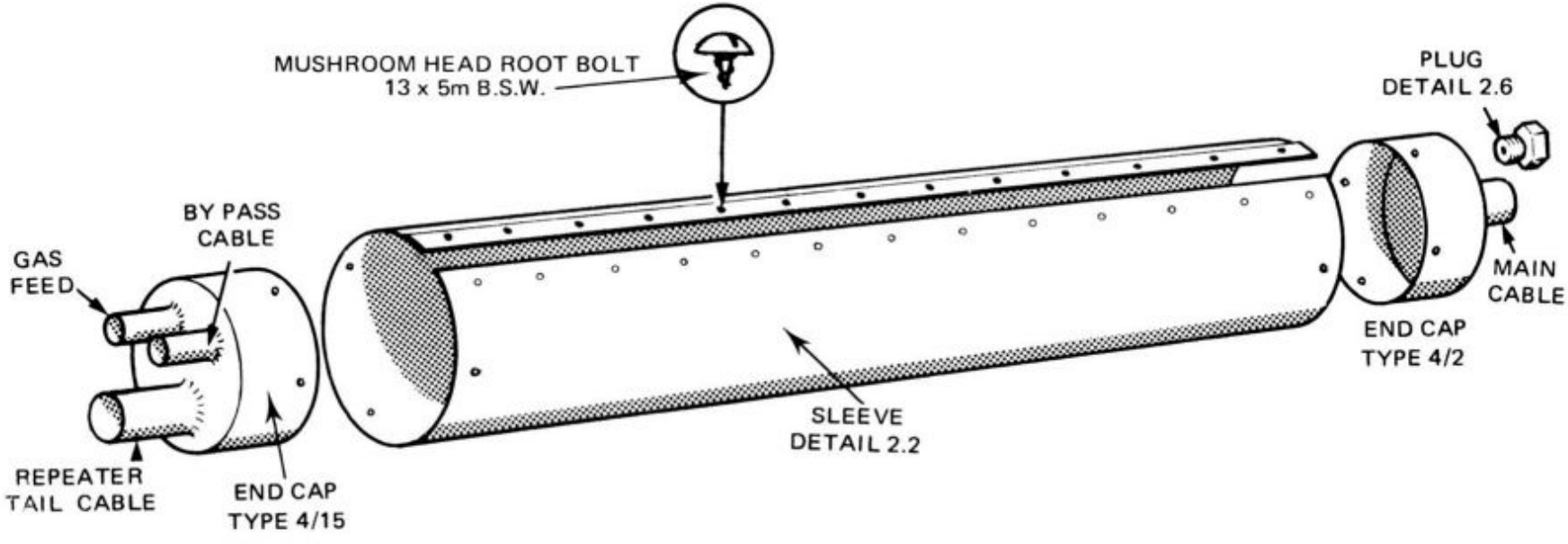
The following figure shows the end caps and sleeve used for a straight joint for four tube non-layer cable, see drawing CL 1142 sheets 2 and 4 (S.443/221).



COAXIAL CABLE JOINT ENCLOSURE S.443/221

JOINT ENCLOSURE

The following figure shows the end caps and sleeve from twin joints used where rectangular repeater housing is installed. See drawing CL 1142, sheets 2 and 4 (S.443/224).



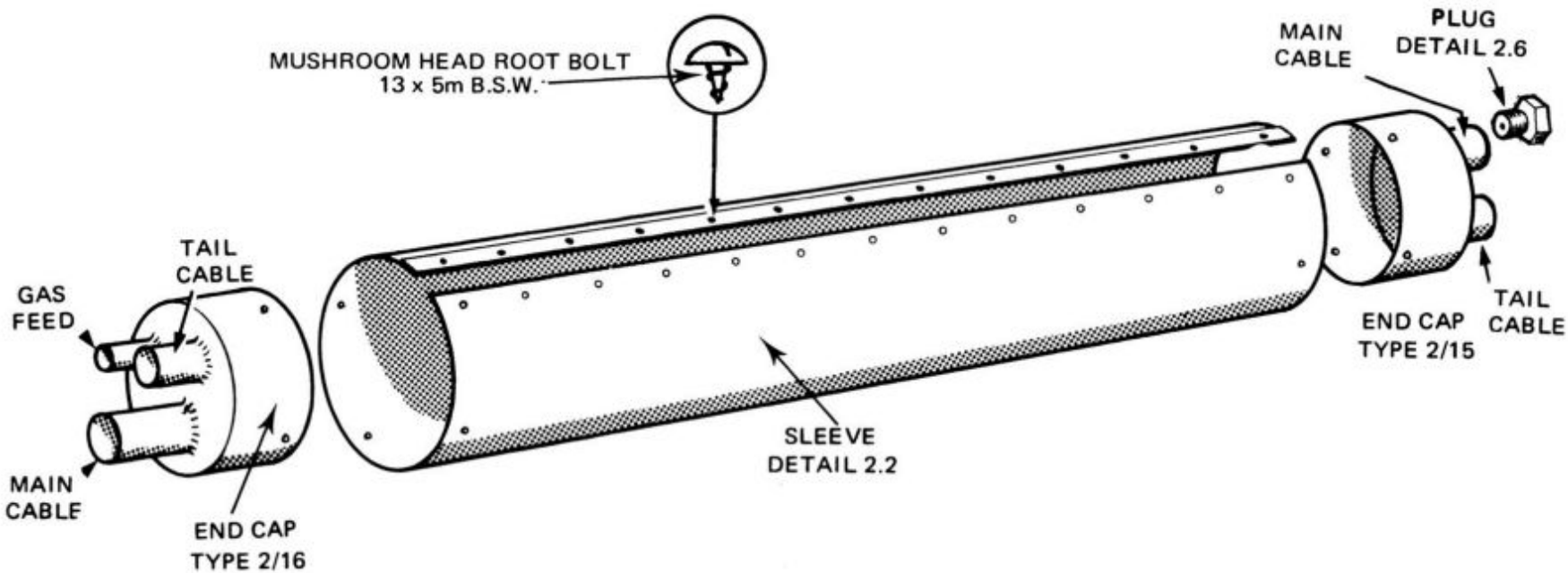
COAXIAL CABLE JOINT ENCLOSURE S.443/224

NOTE: The gas feed ferrule in this joint is used for the order wire cable.

COAXIAL CABLE JOINT ENCLOSURE

JOINT ENCLOSURE

The following figure shows the end caps and sleeve used as an alternative to the previous figure and used for 2-tube coaxial cables only. See drawing CL-1142, sheets 2 and 3 (S.443/204).



COAXIAL CABLE JOINT ENCLOSURE S.443/204

FITTING JOINT ENCLOSURE

Set up cables and mark for a joint opening of 660 mm.

Remove armouring or outer jacket for 100 mm beyond the joint opening mark.

Cut around, but do not break the lead sheath at the opening mark.

Clean the lead sheath 100 mm back from the joint opening on all cables to be jointed.

Slip the appropriate end cap over the cable.

Remove lead sheath and complete jointing as in Section 02,034.

Place sleeve around the joint and fix to the end caps with a seam on top, using tinplated mushroom head bolts supplied.

Wipe around the seam and around the end caps making sure that all bolt heads are covered with solder.

Centre the joint enclosure over the joint opening and wipe the cable to the ferrules with a ball wipe using 35/65 wiping solder.

FLASH TEST

Inser a schrader valve holder and valve in the gas injection plug at one end of joint and connect to a cylinder of air.

Proceed to flash test as for normal joints as in Section G.

INSULATING LEAD SHEATH AND SLEEVE FROM EARTH

GENERAL

To prevent the flow of stray currents in the sheath of coaxial cables which can cause possible interference to signals operating in the tubes and to minimise electrolytic corrosion, the cable sheath has to be completely insulated from earth. This is also the reason for isolating the sheath from MDF loading pots and other earthed attachments.

The cable sheath can still be earthed at one or more points providing that the earths are at the same potential thus preventing any current flow through the sheath.

The exposed lead sheath and sleeve have to be sufficiently insulated to prevent any leakage to earth. (For joint enclosure see page P-2), the recommended procedure to insulate the sheath is:

DENSO PASTE

Clean all exposed surfaces thoroughly. Apply Denso paste (N/S) to all exposed surfaces of the cable and joint enclosure.

DENSO MASTIC

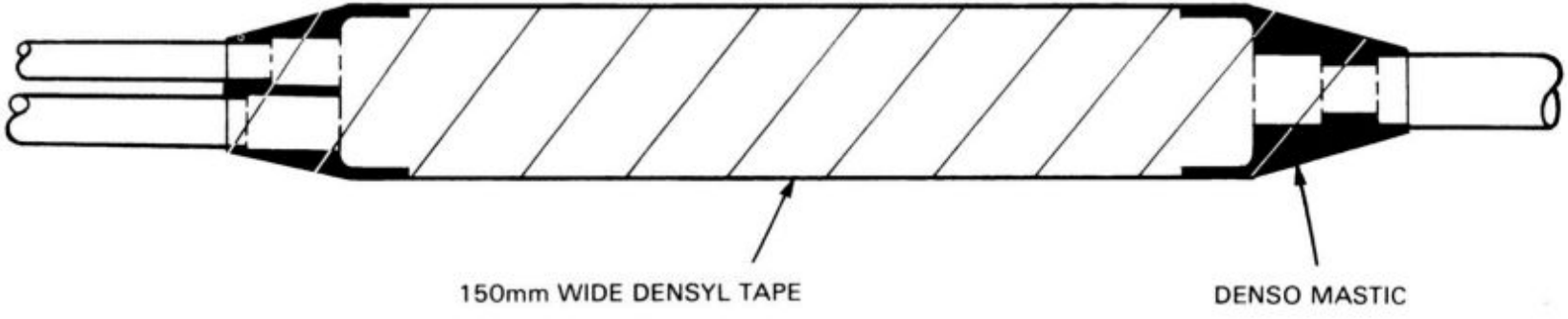
Apply Denso Mastic (soft filling) to all recesses (joint crutch etc.) of the cable and joint enclosure so that when Densyl Tape (N/S) is applied over the filling and joint no air space will remain and the tape can be applied evenly over the whole area to be covered. See page P-9.

DENSYL TAPE

Starting 40 mm over one end of the polyethylene jacket, wrap a 150 mm wide strip of Densyl tape helically over the whole joint. Allow a 50% overlap and tape to 40 mm over the polyethylene sheath at the other end of the joint.

NOTE:

Where there is more than one cable at the end of a joint, wrap a piece of Densyl tape approx. 115 mm wide x 150 mm long around each cable and butt to the Denso mastic so that when the joint is completely enclosed in Densyl tape no surface of the joint or cable is exposed. It may be necessary to cut strips of Densyl tape to cover the filling between cables.



APPLYING DENSO MASTIC FILLING AND DENSYL TAPE

BURIED JOINTS

Where joints are buried directly in the ground they should be enclosed in a joint protection sleeve (N/S) or covered with denselt tape (N/S). To apply Denselt tape, wrap helically with a 50% overlap in the opposite direction to the densyl tape, then apply heat and smooth off with a wiping pad.

ENGINEERING INSTRUCTION REFERENCES

E.I. LINES, Cables	J 3920
	SY 3902

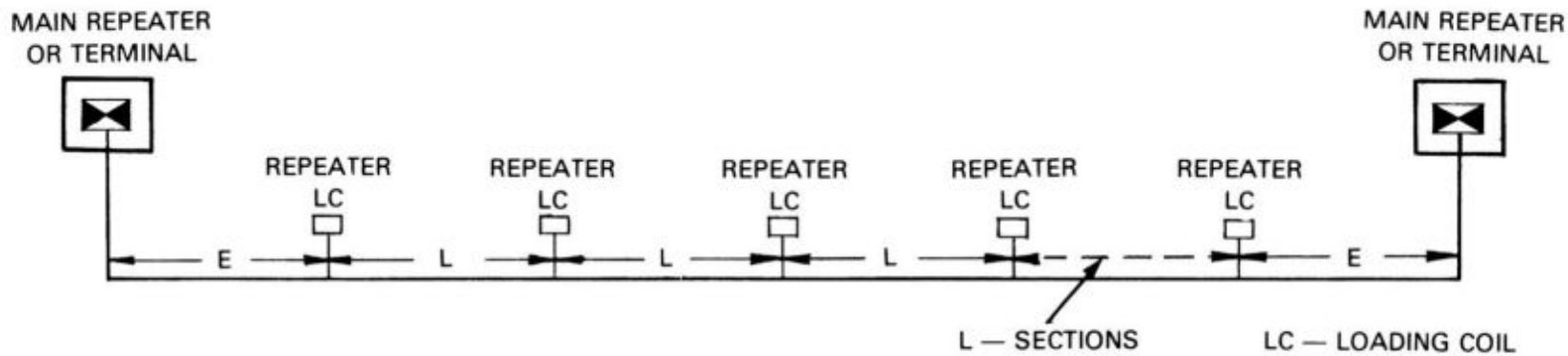
LOADING PAPER INSULATED PAIRS IN COAXIAL CABLE

Issue 1, 1976

LOADING PAPER INSULATED PAIRS IN COAXIAL CABLE

GENERAL

Paper insulated conductors in coaxial cable which require loading, are normally allocated by the responsible Officer associated with the work authority. Ideally the length of the loading section (L) should be 1500 m with end sections (E) of 750 m to conform with 60 MHz working.



LOADING AND REPEATER SECTIONS 60 MHz

BUILDING OUT SHORT SECTIONS OF CABLE

In some special cases, e.g. where a manhole cannot be correctly placed due to existing consturction, building out of the cable is required. In this case utilise capacitors in accordance with the following :-

QL pairs 46.5 nF/Km (0.075 F/mile)
QT pairs 41.0 nF/Km (0.066 F/mile)
Twin pairs 52.8 nF/Km (0.085 F/mile)

LOADING COILS

Pairs for V.F. operation including local and long haul order wires, are loaded with 88 mH loading coils. The loading points are placed at repeater positions for 60 MHz working.

CAPACITY MEASUREMENTS

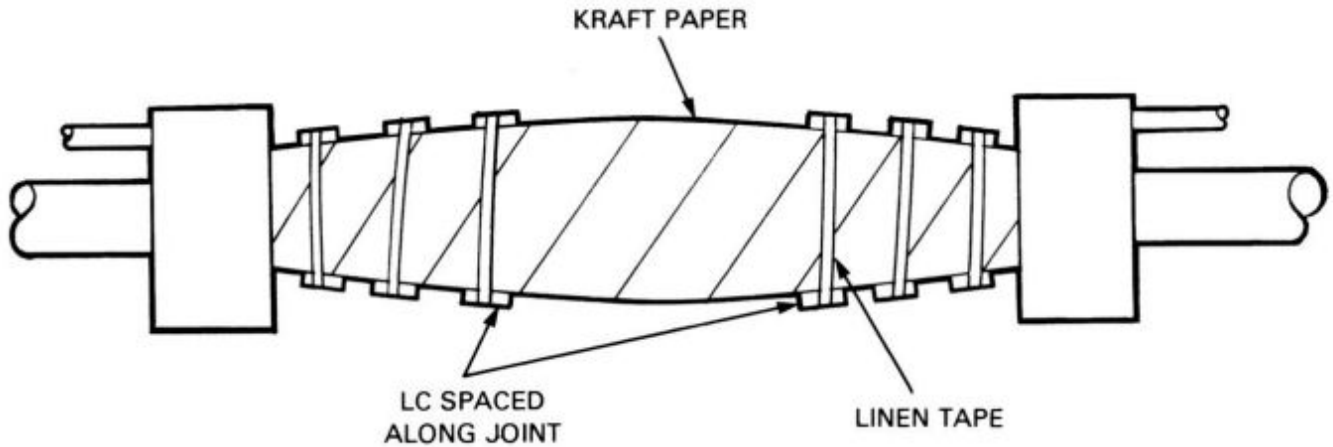
Measurements for capacity unbalance are made by the Transmission Measurements Section during the paper insulated conductor Jointing operations Capacitors are fitted during these operations (See Section E).

INSTALLATION OF LOADING COILS

Loading of interstice or core pairs in coaxial cable is done within the joint using single 88 mH loading coils. The coils are kept separate from the coaxial tubes by placing a double layer of kraft paper around the tubes. The coils are then spaced along the joint and tied in position with linen tape. Enclose coils in an additional double layer of kraft paper. (See Section E for installation of single 88 mH loading coils.)

WHEN ENTERING OR LEAVING MANHOLES AVOID STEPPING ON CABLES.

LOADING PAPER INSULATED PAIRS IN COAXIAL CABLE



LOADING COILS IN COAXIAL JOINT

EXTERNAL LOADING

When a coaxial cable has layer pairs which require loading, a loading pot is installed in the manhole. The tails of the loading pot are straight jointed in the coaxial joint. (See Section E.)

NOTE: At Repeater positions where there are two joints, loading and building out is always situated at the joint closest to the major attended repeater station.

ENGINEERING INSTRUCTION REFERENCES

LINES Cables	SY 3906
	SY 3930

TERMINATING COAXIAL CABLES

Issue 1, 1976

TERMINATING COAXIAL CABLES

GENERAL

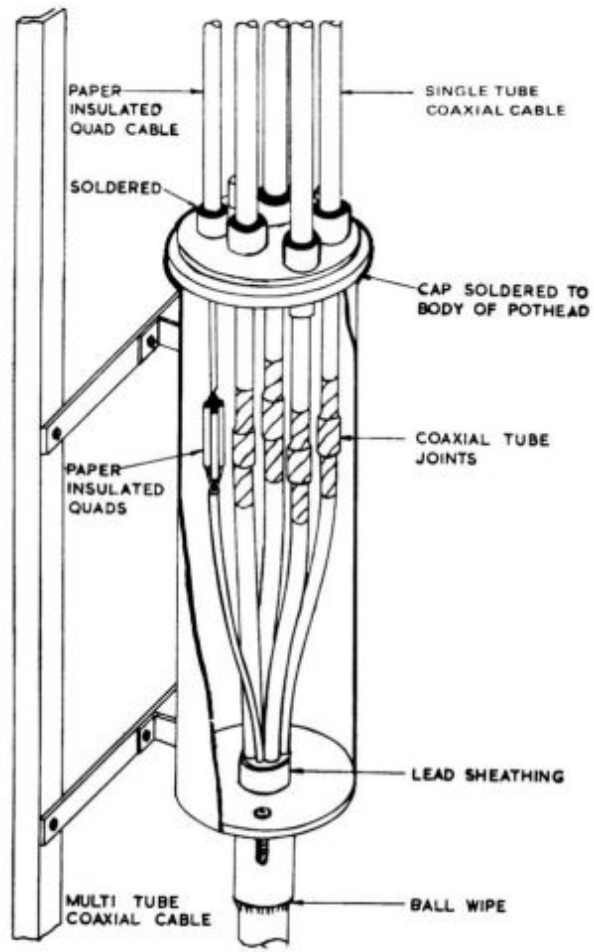
At terminal and main repeater stations multi-tube coaxial cable is jointed to single tube lead covered cable through a Pothead Joint (N/S). Each tube is then extended individually and terminated to the equipment (See page R-7). The paper insulated conductors are connected to a cable tail leading to the distribution frame. The figure used is a Pothead Joint for a four tube coaxial cable.

PREPARING CAP AND BODY

Tin all parts of the cap and body which will require soldering. Remove the polyethylene jacket on the four tube cable to approximately 1 metre below the proposed joint location. (See figure on page R-3.) Shape the cable into place to prepare for a joint opening of 470 mm. Place the body of the pot over the four tube coaxial cable. Using securing screws temporarily anchor the cable and body to the supporting frame in the position the cable pothead will finally rest.

MARKING FOUR TUBE CABLE

Mark cable ("a" mark) where the bottom of the body will be wiped (using 35/65 solder) to the four tube coaxial cable (See figure on page R-3.)



POTHEAD JOINT - FOUR TUBE COAXIAL CABLE

TERMINATING COAXIAL CABLES

MARKING AND CUTTING SINGLE TUBE CABLE

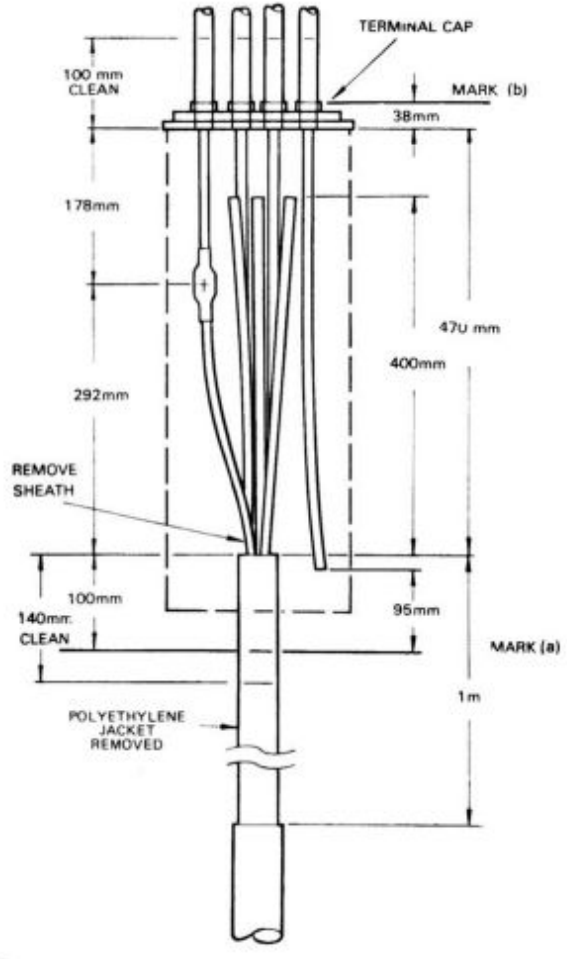
Arrange the single tube cables around the body of enclosure. From the bottom of the enclosure ("a" mark) mark each single tube cable 95 mm up, cut the cables at this point and remove surplus cable. Remove the securing screws from the lugs and allow the body to slide down the main cable, past the ("a" mark).

PREPARING FOUR TUBE CABLE

Mark and cut the sheathing of the four tube, coaxial cable 100 mm above the "a" mark (See figure) then clean and use stearine for 140 mm below this mark. Remove the sheathing, tie with linen tape. Using marker tape (S.443/11) number each tube from 1 to 4. The tubes can then be marked and cut 400 mm from the sheath end. Carefully straighten the tubes for jointing.

PREPARING SINGLE TUBE CABLES

Fit the single tube coaxial cables through the terminal cap outlets making sure that each cable is correctly lined up with its appropriate tube in the main cable. Position the cable ends around the prepared main cable. Slide the terminal body over the cable ends and secure to its final position on the mounting rack. Fit the terminal cap into the recess, adjust each single tube cable until all cables are correctly lined up. Mark around the lead sheathing of each single tube cable level with the outlet tube of the cover ("b" mark). Slide the cap along the cables away from the score mark and secure it into a temporary position.



SETTING UP CABLES FOR TERMINATING.

TERMINATING COAXIAL CABLES

Remove the screws holding the terminal joint enclosure and slide the enclosure over the joint area on the main cable.

MARKING SINGLE TUBE CABLES

Measure 38 mm from the score mark on each single tube cable towards the cable end on all cables. Make a score mark around the cables at this point. Clean the lead sheath for 100 mm and remove the sheathing from the score mark.

Remove the paper wrapping from each tube with the exception of the last two layers.

Using marker tape (S.443/11) number each tube 1 to 4 to correspond with the 4 tube cable.

PREPARING TUBES FOR JOINTING

Mark the tubes in the main cable 292 mm from the cable sheath (this mark will be the final length of the inner conductor). Prepare the lower cable in the same way as described in Section 0 (for the left side cable). Make the joint opening 470 mm. Prepare the single tubes as for the right side cable described in Section 0. Joint all tubes, test and wrap.

DO NOT WORK ALONE IN MANHOLES WHERE GAS HAS BEEN DETECTED.

JOINTING PAPER INSULATED CONDUCTORS

Fit the conductor pair cable through the terminal cap outlet and mark the sheathing as for the single tube cables and prepare for conductor pair jointing.

Using Model MR-1 hand tool (S.114/116), connector joint the core, interstice and outer layer pairs. Make the joint position of each pair in the centre of the joint (See figure on Page R-2).

CLOSING THE JOINT

Insert between the tubes one bag of dessicant and wrap the complete joint with two layers of kraft paper and hold secure with linen tape.

Using marker tape (S.443/11) number the single tubes 100 mm above the end cap on the Pothead joint.

SECURE THE TERMINAL ENCLOSURE

Slide the enclosure over the joint to its final position and secure to the mounting rack. Lower the terminal cap and fit into the terminal enclosure.

SEAL THE TERMINAL JOINT ENCLOSURE

Using 35/65 solder wipe the lower entrance tube to the main cable and finish with a smooth ball wipe. Wipe the terminal cap to the terminal joint enclosure in a similar way.

Solder each single cable to the outlet tube using 65/35 activated resin cored solder and a fine gas flame.

TERMINATING COAXIAL CABLES

NOTE: Plumbing and soldering must be done quickly and efficiently to avoid overheating of the cables.

PRESSURE TEST (Flash Test)

Apply pressure of 100 to 140 kilopascals to enclosure and test for leaks with an approved foaming solution to all wiped and soldered areas.

TERMINATING SINGLE TUBE CABLES

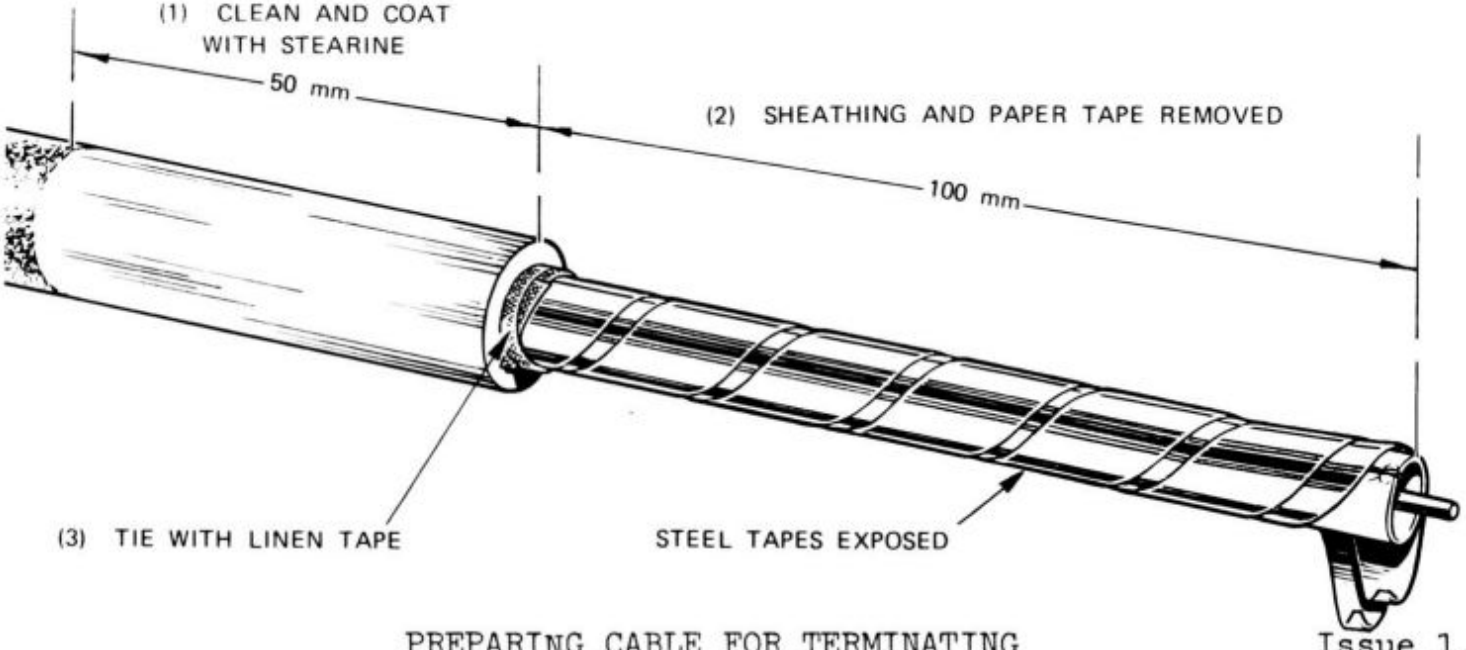
GENERAL

Coaxial tubes are terminated at all repeater stations and at terminal equipment ends of each cable route.

All tubes should be isolated from earth on coaxial cable routes between Radio terminals and Long Line Equipment terminals (including Television operation centres and also all tubes of cables linking television operating centres with Television Studios).

PREPARATION OF CABLES

Score around the sheathing 100 mm from the end of (A.P.J.) cable (S.482/1401). Mark the cable for a further 50 mm remove P.J., clean the sheath and coat it with stearine. Remove the lead sheathing up to the score mark and tiw a narrow strip of linen tape around the tube against the sheathing. Remove the paper wrapping up to the linen tape.

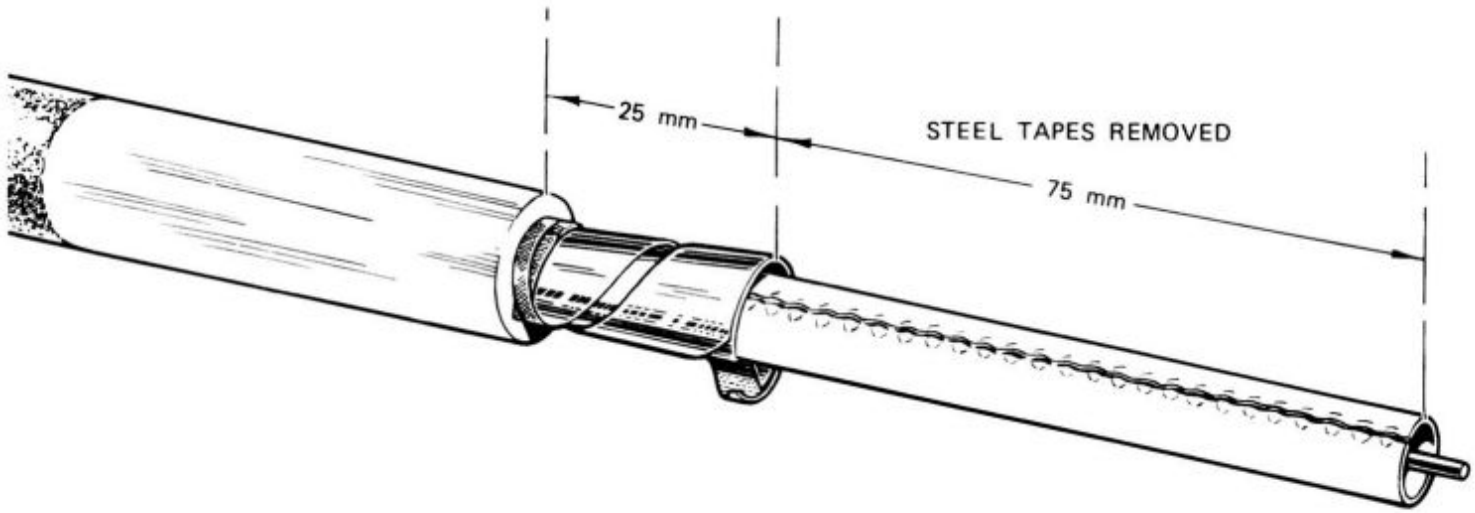


PREPARING CABLE FOR TERMINATING

TERMINATING SINGLE TUBE CABLES

CUTTING STEEL TAPES

Mark the steel tapes 25 mm from the sheathing end and position the outer edge of the coaxial pliers exactly at the 25 mm mark. Score around the tape with a knife, remove coaxial pliers, unwind tapes and cut along the score mark with scissors. Cut off sharp corners.

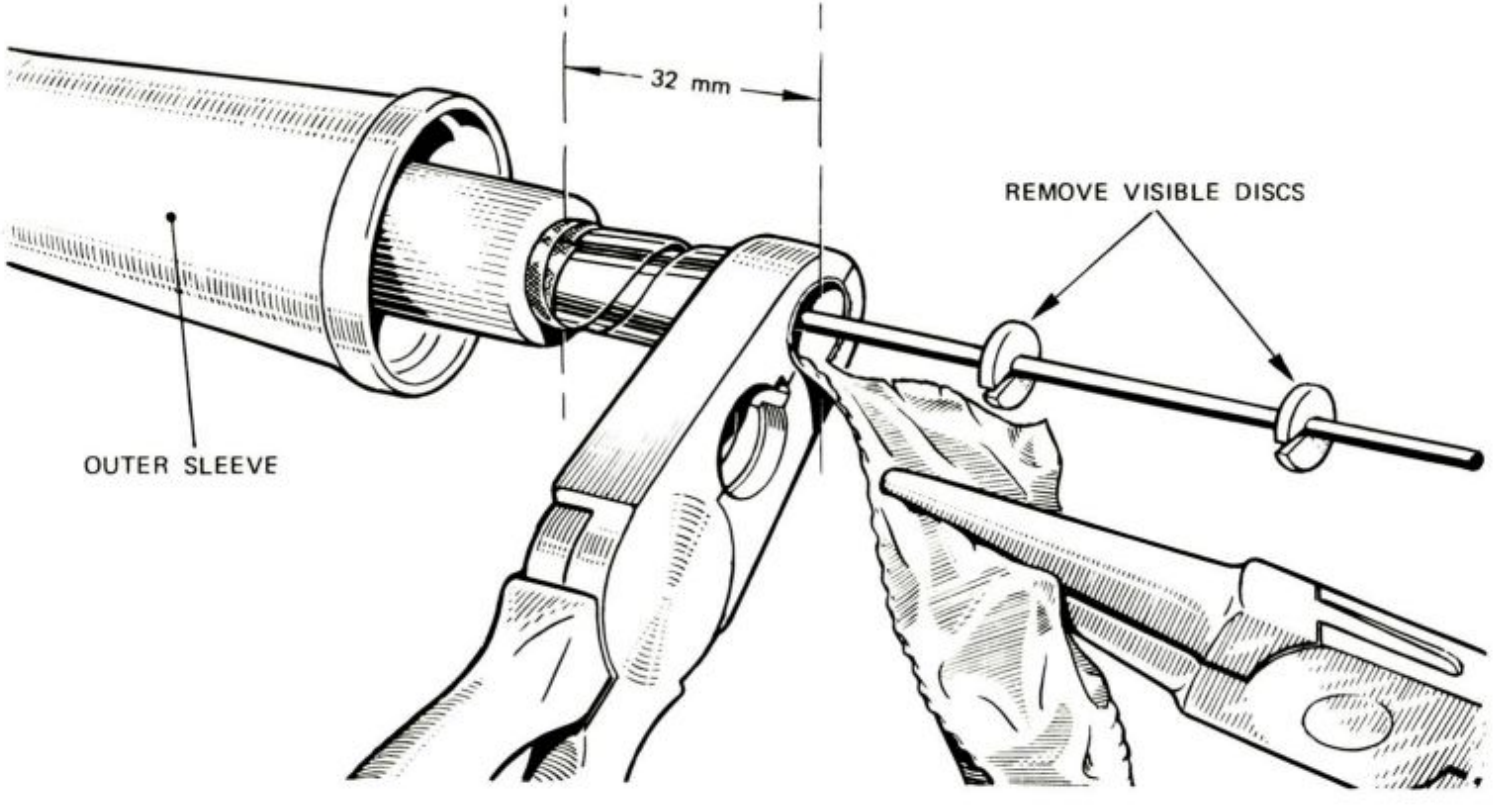


REMOVING STEEL TAPES

CUTTING OUTER CONDUCTOR

Mark outer conductor 32 mm from the sheathing end, position the coaxial pliers with the outer edge exactly on the 32 mm mark, tear off the outer conductor with long nose pliers.

Remove any visible discs and fit the outer sleeve (small end first) over the cable.

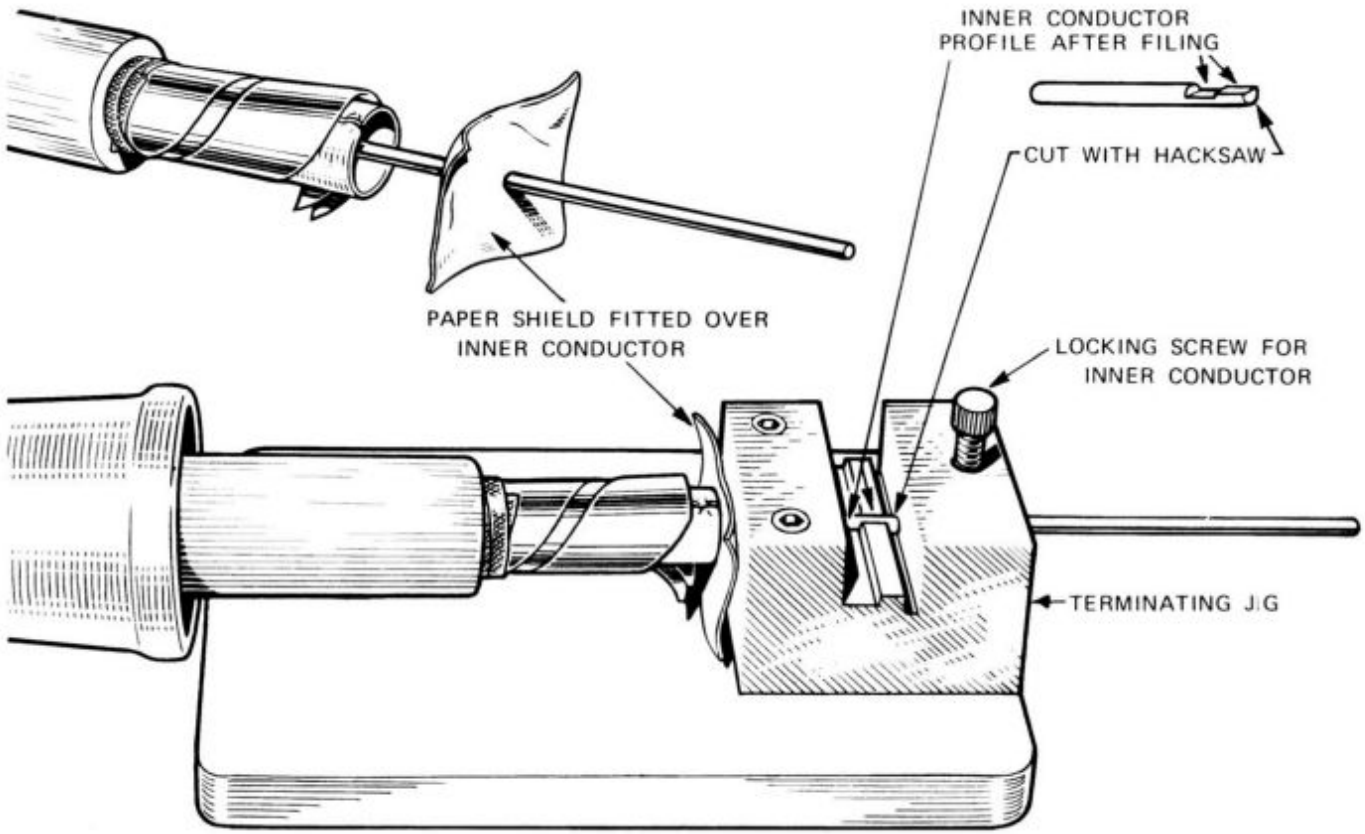


REMOVING OUTER CONDUCTOR

TERMINATING SINGLE TUBE CABLES

PREPARATION OF INNER CONDUCTOR

Fit a piece of stiff paper over the inner conductor to prevent metal filings entering tube. Pass inner conductor through the terminating jig, (S.445/9), and slide jig up to the jig settings. File the centre conductor to the jig profile and cut with a hacksaw blade in the slot provided. Remove jig and wipe conductor with a clean cloth, then remove the protective paper.

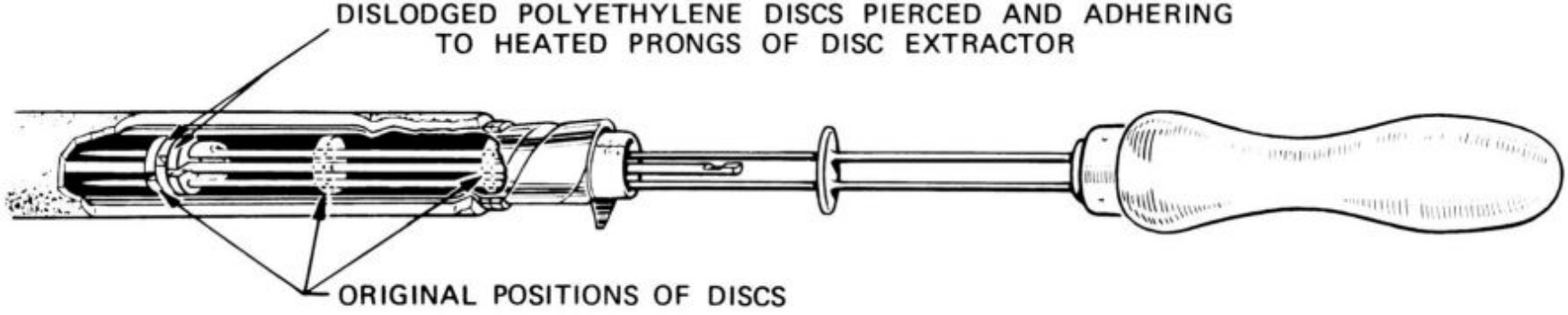


PLACING TUBE IN TERMINATING JIG

SPACER DISCS

Because the polyethylene discs can be damaged during soldering operations, they are removed and replaced with yellow heat resistant PTFE (Polytetrafluroethylene) Discs. (S.443/8.)

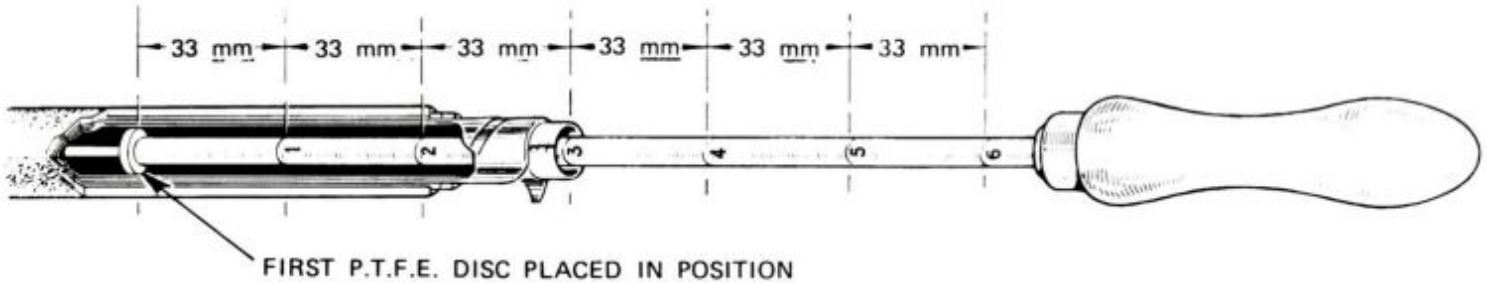
To remove discs, heat the disc extractor and insert into tube, press until the extractor has been forced through 3 polyethylene discs, allow to cool and withdraw. The discs will adhere to the extractor. When, on inspection, the first polyethylene disc is within 12 mm of the end of the outer conductor 4 polyethylene discs should be removed.



REMOVING SPACER DISCS FROM TUBE

THE DISC INSERTING TOOL

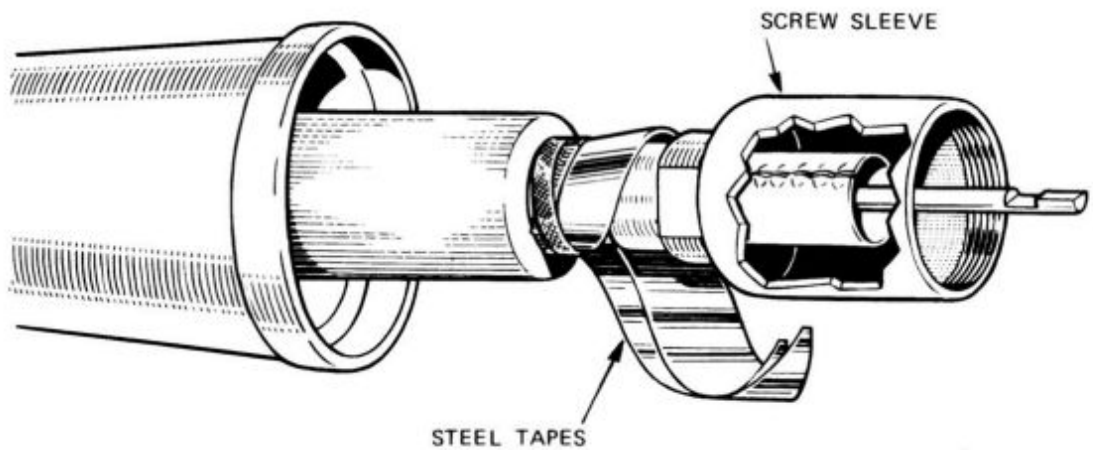
The disc inserting tool (S.445/14) is used to insert the PTFE discs. Each disc is inserted separately.



INSERTING PTFE DISCS

SCREW SLEEVE AND LUVICAN BUSH

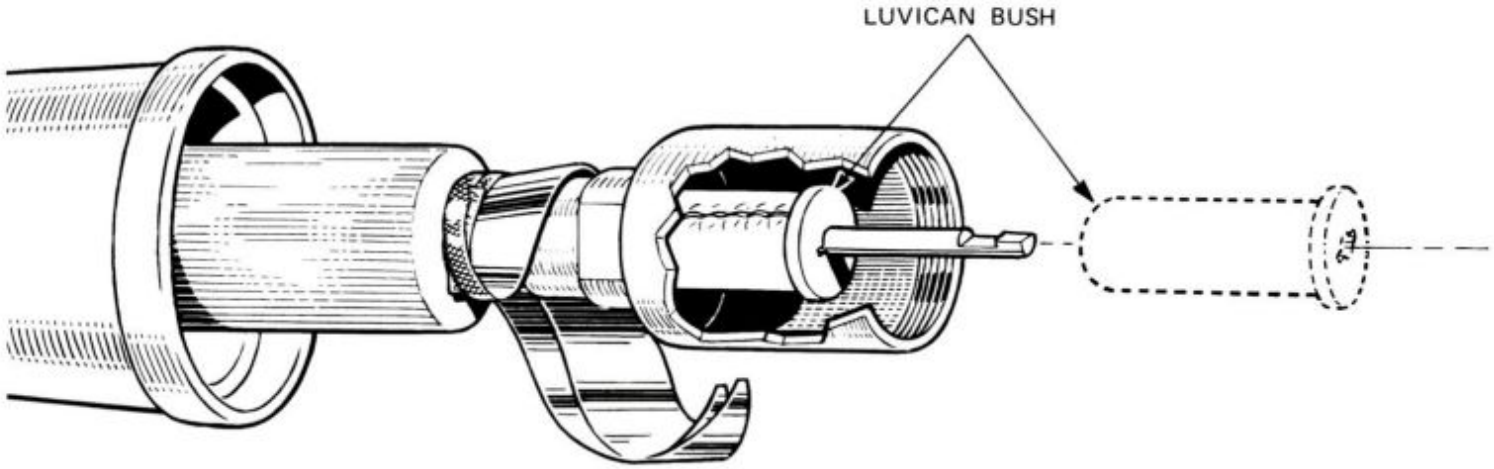
Place the screw sleeve, small end first, over the outer conductor and under the steel tapes.



PLACING SCREW SLEEVE OVER OUTER CONDUCTOR

INSERTING THE LUVICAN BUSH

Insert the Luvican Bush over the inner conductor and under the outer conductor until the collar is hard against the end of the outer conductor.

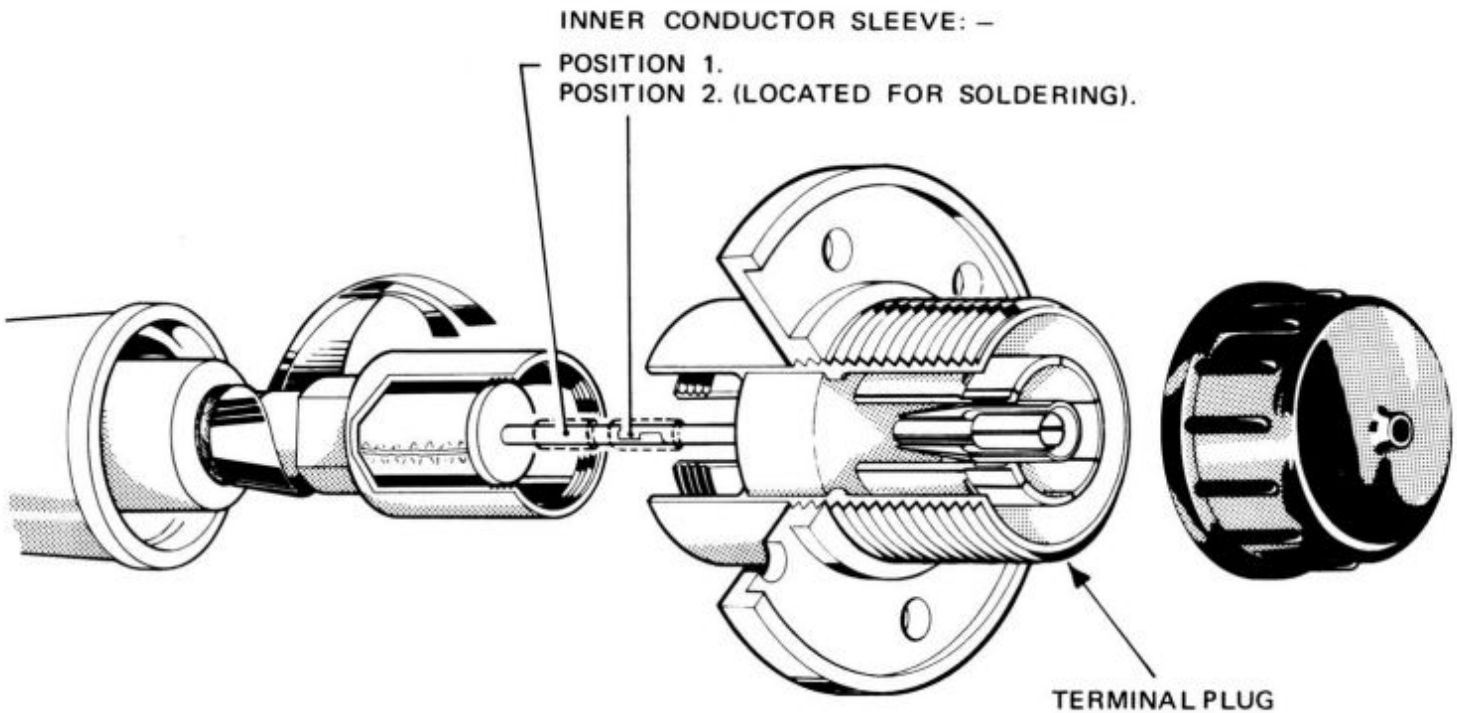


INSERTING THE LUVICAN BUSH OVER INNER CONDUCTOR

TERMINATING SINGLE TUBE CABLES

JOINTING INNER CONDUCTOR

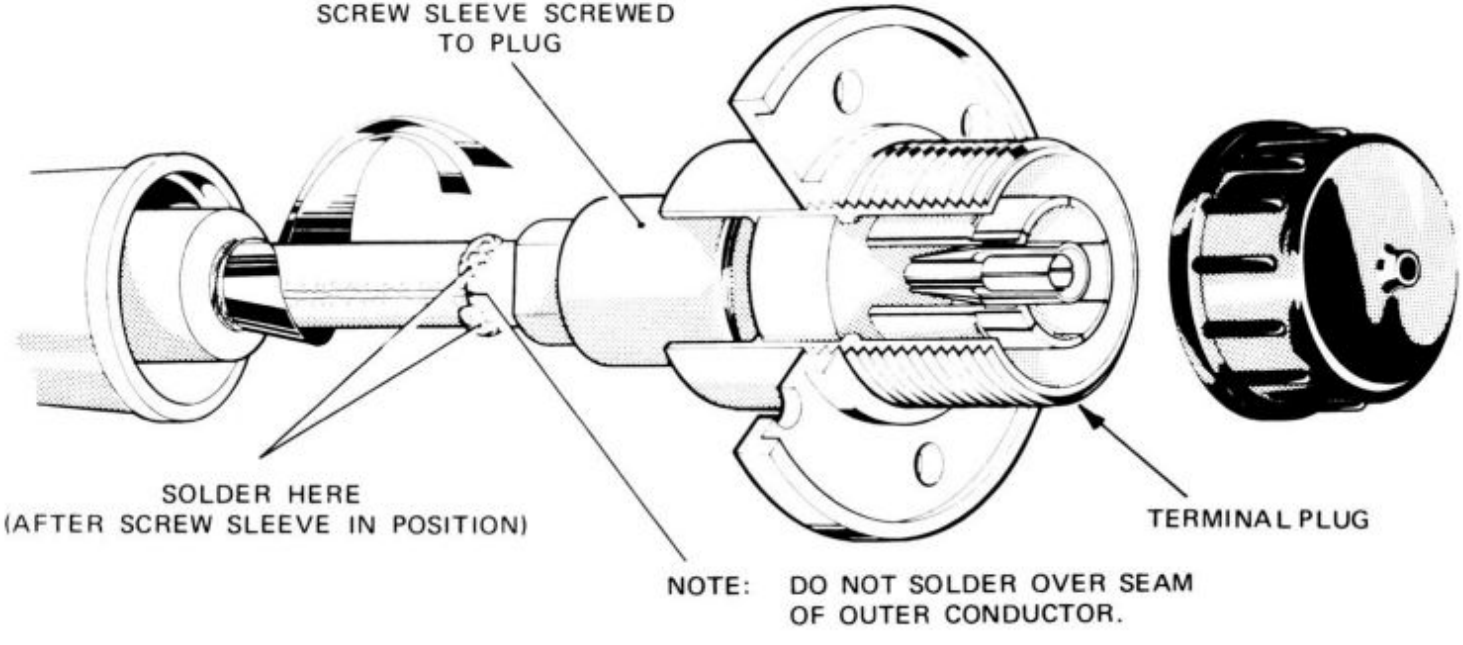
Slide the inner conductor sleeve over the cable side of the inner conductor, align, locate and link the inner conductors of the cable and the terminating plug then slide the sleeve centrally over the joint. Solder with a small soldering iron using 65/35 activated resin cored solder.



JOINTING THE INNER CONDUCTOR

JOINTING THE OUTER CONDUCTOR

Slide the screw sleeve up to the threaded portion of the terminating plug and screw finger tight. Using 65/35 activated resin cored solder, solder the edge of the screw sleeve around but not over the seam of the outer conductor.

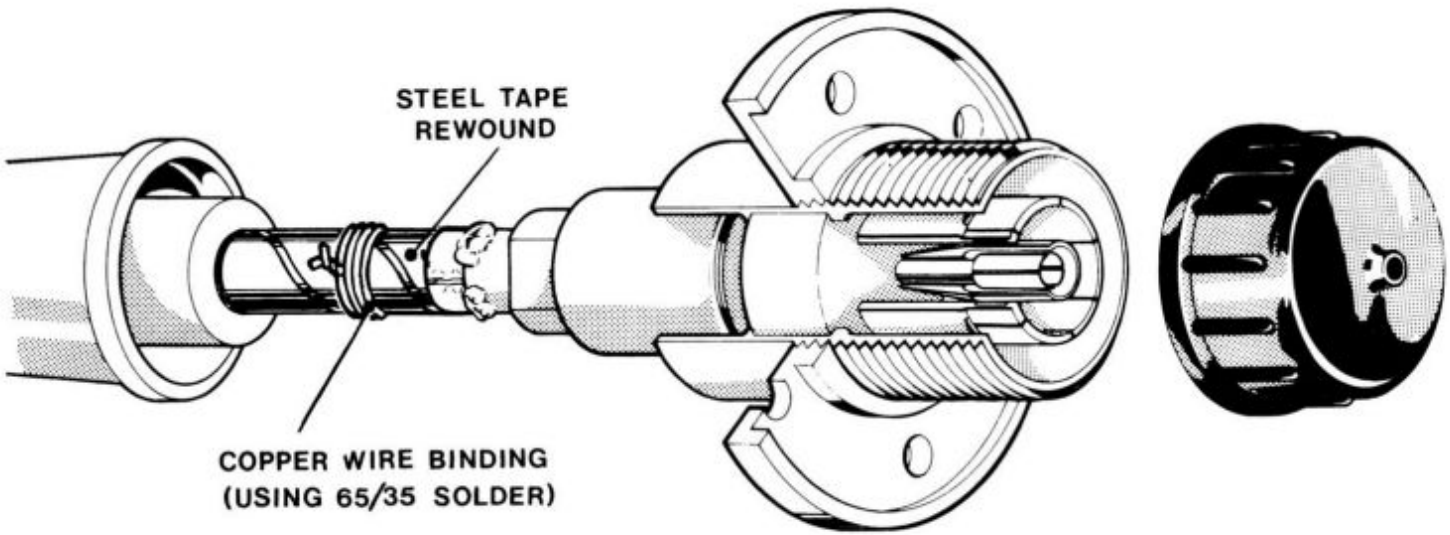


JOINTING OUTER CONDUCTOR

TERMINATING SINGLE TUBE CABLES

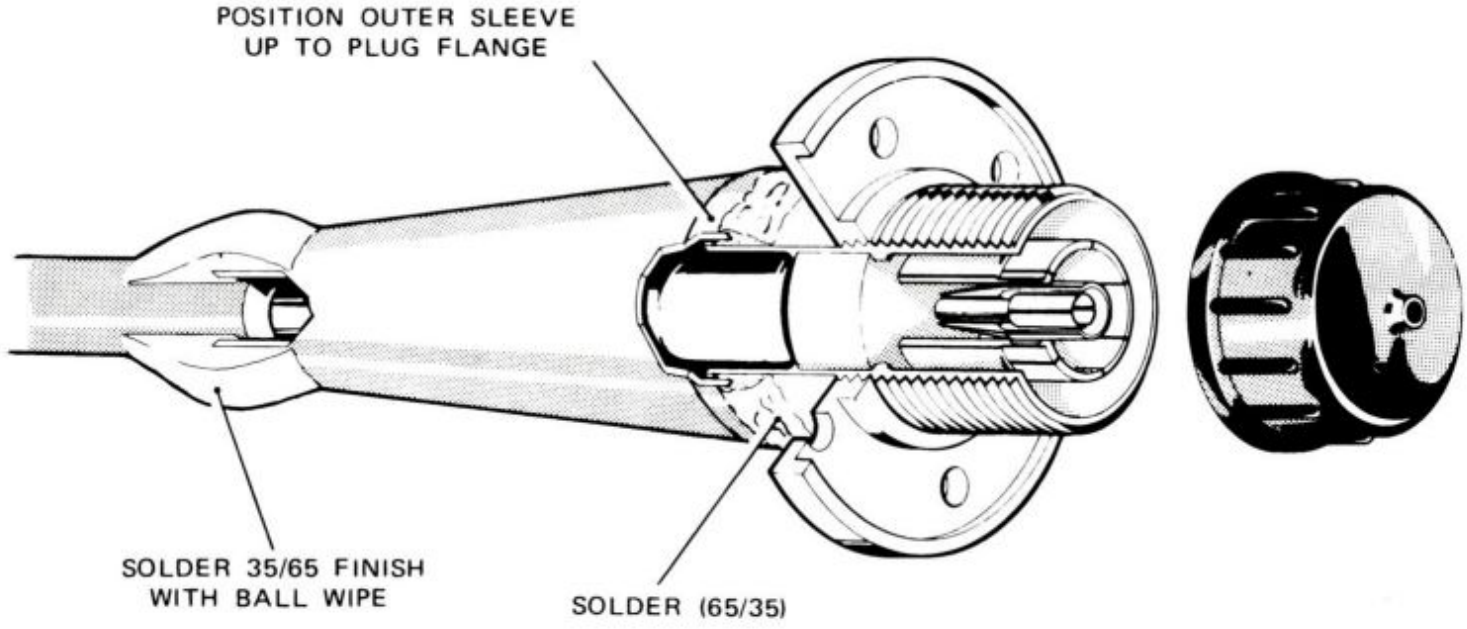
CLOSING TERMINATION

Rewind the steel tapes and secure with 3 turns cf fine copper wire and solder to steel tapes with 65/35 activated resin cored solder.



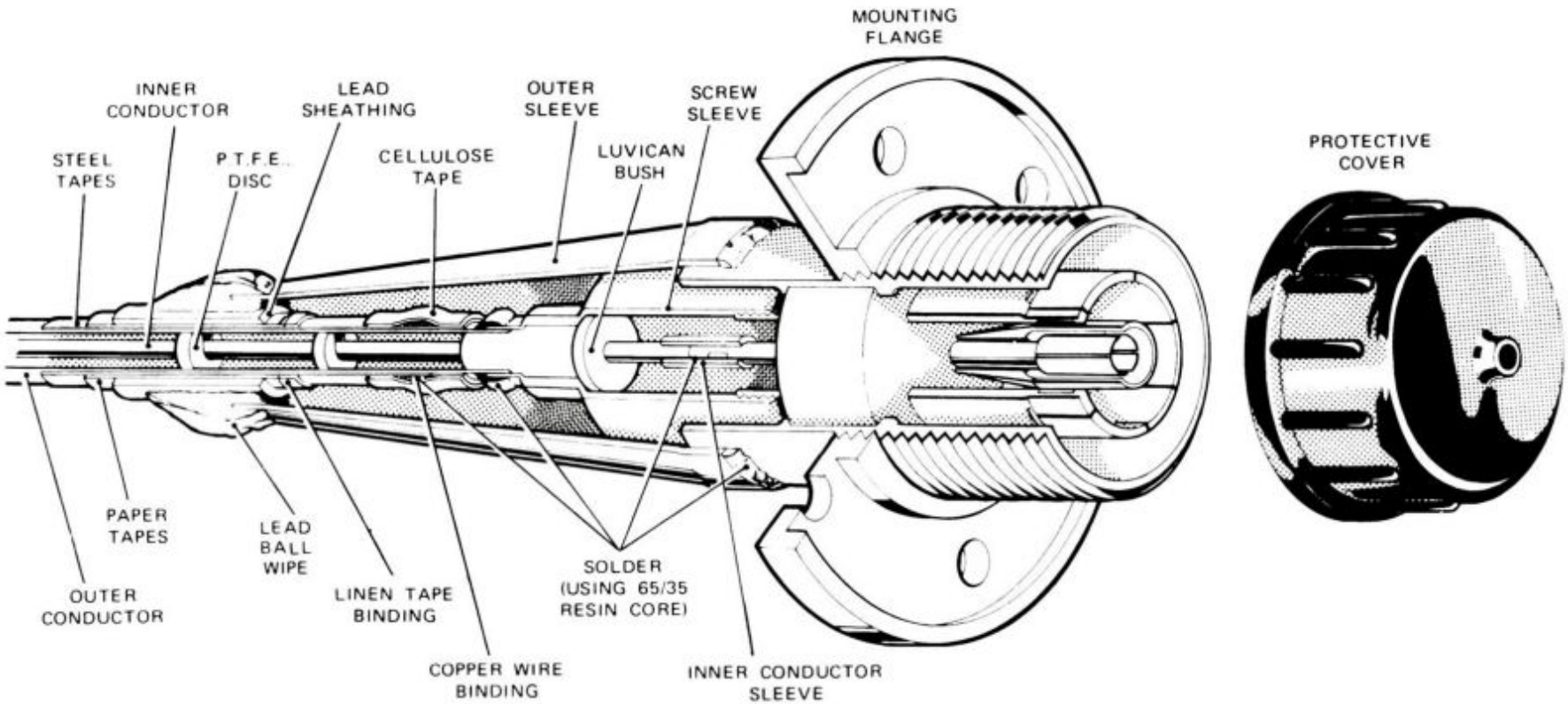
SECURING STEEL TAPE

Position the outer sleeve up to the plug flange. Plumb the lower edge of the sleeve to the lead cable with 35/65 wiping solder finished with a ball wipe. Pack the lower end of the outer sleeve if necessary. Solder outer sleeve to plug flange using 65/35 resin cored solder.



FITTING OUTER TERMINATING SLEEVE

TERMINATING SINGLE TUBE CABLES



TERMINATION COMPLETE

CYLINDRICAL REPEATER HOUSING

Issue 1, 1976

CYLINDRICAL REPEATER HOUSING

GENERAL

Cylindrical Repeater housing is used in conjunction with 2, 4 and 6 tube (CX) cables and will accommodate the following makes and combinations of repeater equipment.

Siemens, S.T.C., N.E.C. and Philips-T.M.C.

A suitable thermal environment is necessary for correct repeater work. This is done by using a cylindrical type manhole in rural areas, see Drawing CL 1209 or, by using a variation of manholes in urban areas to suit the particular situations. See Drawing CL 1230.

DESCRIPTION OF REPEATER HOUSING

The repeater housing consists of two main parts:-

(i) "Apparatus Case" for terminating Coaxial Cable and associated conductor pairs and for housing coaxial transmission repeater equipment.

(ii) "Joint Case" for attachment to the apparatus case. The joint case is used to house the air spaced tubes jointed to the flexible coaxial terminal assembly cables.

E.I. LINES CABLES SP 5900 AND ANY STATE E.I. MUST BE READ AND UNDERSTOOD BEFORE WORKING ON ANY CABLE WHICH HAS POWER FEED WORKING THROUGH THE CABLE. SEE PAGE C4.

The Apparatus Case is made from 3 mm mild steel and externally protected with stove powdered epoxy. The domed lid is held in place by 12 high tensile bolts and has two "O" ring seals. A clear inner dust cover is positioned beneath the lid to prevent any foreign matter entering the housing when the lid is removed during maintenance work.

The interior of the apparatus case provides for the termination of up to 12 flexible coaxial leads using straight coaxial connectors. The outer conductor is isolated from earth, and the connectors are grouped on three main plates spaced at 120° degree intervals on the inner wall of the apparatus case.

The Joint Case is a casting attached to the apparatus case by 11 studs with the mating surfaces sealed with Dow Corning Silastic 738.

The joint case provides four main functions:

(i) Turning section for flexible leads.

(ii) Separate jointing chambers for each coaxial cable.

(iii) Gas pressure order wire and contactor alarm termination.

(iv) Gas pressure air flow directional valve.

THE CABLE OR HOUSING ASSEMBLY OF THE CYLINDRICAL REPEATER HOUSING MUST NOT BE OPENED, UNTIL THE AIR PRESSURE IS RELEASED THROUGH THE VALVE HOLDER.

CYLINDRICAL REPEATER HOUSING

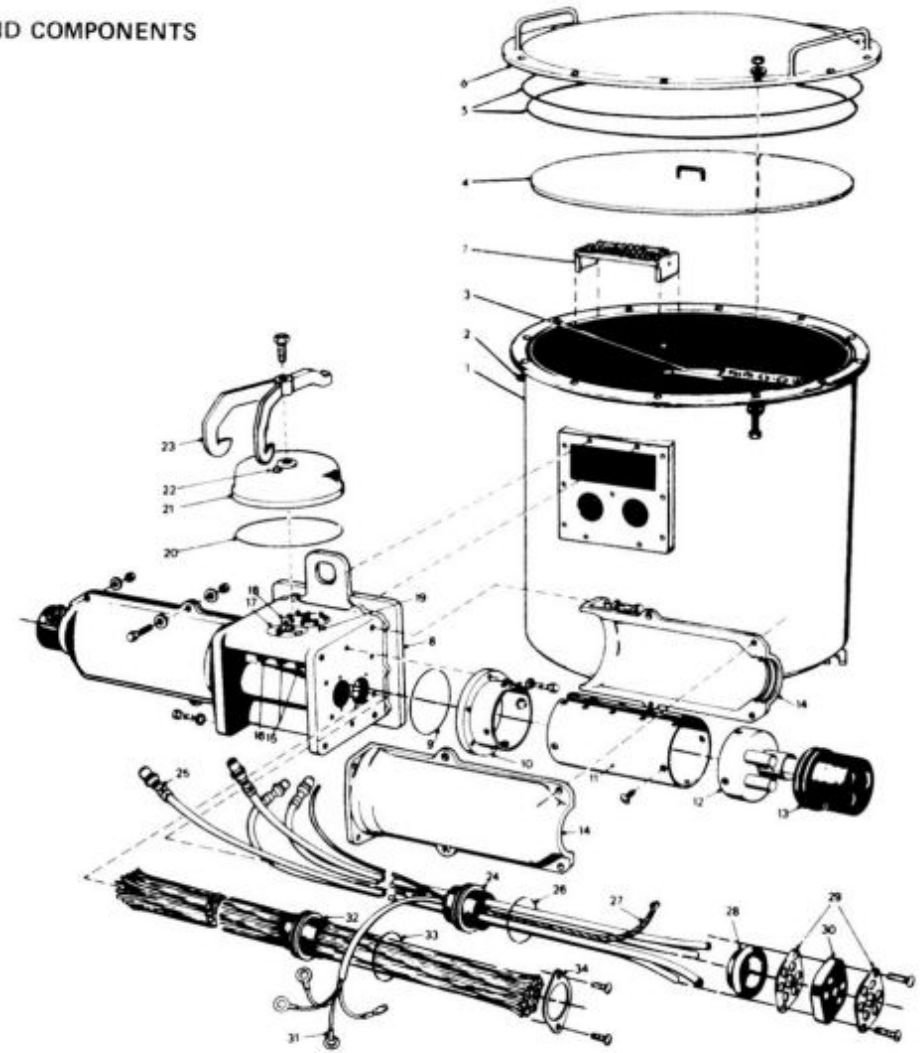
CYLINDRICAL REPEATER HOUSING AND COMPONENTS

1. APPARATUS CASE
2. EARTH CONNECTION
3. CONNECTOR TERMINAL PLATE
4. INNER DUST COVER
5. "O" RINGS
6. LID
7. **PROTECTOR STRIP**

8. JOINT CASE
9. "O" RING
10. FLANGE RING
11. JOINT ENCLOSURE
12. END CAP
13. GROMMET
14. JOINT PROTECTION COVERS
15. PILOT VALVE CONNECTIONS
16. WATERPROOF TERMINAL CONNECTION
17. GAS PRESSURE DIRECTIONAL SWITCH
18. TERMINAL BLOCK
19. AIR NEEDLE VALVE
20. "O" RING
21. GAS CONTROL AND TERMINAL COVER
22. VALVE HOLDER (SCHRADER VALVE)
23. G.P. CONTROL COVER CLAMP

24. CABLE TERMINAL SET
25. CONNECTORS
26. "O" RING
27. SUPERVISORY PAIR CABLE
28. RUBBER INSERT
29. CLAMPING PLATES
30. GROMMET
31. ORDER WIRE GAS ALARM PAIR

32. THROUGH CABLE ASSEMBLIES
33. "O" RING
34. LOCKING PLATE



Supervisory Circuits. The rectangular opening in each main plate will accept an eleven pin socket which must be fitted to the housing when the type of system to be installed on a particular bearer requires supervisory circuits. The terminating and wiring for these sockets will vary according to the type of system installed.

Protecting Repeater Equipment. If earthing of the outer conductors is required two banana type earth sockets are fitted to the main plate to ensure that when the coaxial sockets are connected to the coaxial line plugs, the outer conductors will be earthed before contact is made by the inner conductors.

Termination of External Pairs. The Protector strip, mounted directly above the flexible cable entry opening, is fitted with 24 pairs of Protector springs which accept a gas type Protector (S.442/22) with 230 volt rating. The strip can be turned through 180° to facilitate the termination of the 12 external pairs. (Six pairs into the housing and and six pairs out.)

Component Parts

The Repeater Housing, provides as a complete unit, an apparatus case for repeater equipment, a joint case for the termination of air spaced tubes and gas alarm components to cater for the different types and sizes of cables. However, various additional parts are required for each specific installation. Items of additional equipment to be ordered separately are:-

(i) Flexible coaxial cable terminal set contents for left and right side cable. The Serial/Item is dependent on size of coaxial cable installed.

(ii) 2 end caps and ferrules required (as for diameter of cable installed).

(iii) 2 grommets and ferrules required (as for diameter of cable installed).

(iv) Through cable units 10 or 30 pair as required (used for cable pairs which are not terminated in the apparatus case).

CYLINDRICAL REPEATER HOUSING

HANDLING OF HOUSING

When unpacking the housing take care to ensure that seals are not broken, or that any plastic covers are removed until absolutely necessary, in order to prevent dust and foreigh particles from entering the housing interior.

Positioning of Housing. Lower the repeater housing into position using suitable lifting gear attached to the lifting eyes provided. Any undue or rough handling of the housing may cause chipping or cracking of the stoved epoxy coating creating a corrosion hazard. In the event of damage taking place to the coating, the cracked or chipped area must be thoroughly cleaned, dried, and repaired with an epoxy resin kit.

INSTALLATION

On installations where the cylindrical manhole is used, secure the repeater housing to the floor by bolting it to the ferrules provided. When the manhole shown in Drawing CL 1230 is used, place the repeater housing in position, and bolt to masonary anchors fitted in the floor. The apparatus case must always be bolted down before the joint case is fitted. This will prevent the housing from tipping forward causing possible damage to the protective coating.

BEFORE WORKING AT ANY PIT, MANHOLE OR JOINTING CHAMBER, US A COMBUSTABLE GAS DETECTOR TO CHECK FOR THE PRESENCE OF GAS (SEE SECTION W, CABLE JOINTING NO. 1).

PREPARATION OF AIR SPACE TUBE CABLE FOR JOINTING

To define the length of cable required, measure to the centre of the protection cover which is attached to the housing, this centre point is where the cable should be cut in readiness for jointing. Cut both cables at this mark and remove surplus cable.

ON THE RIGHT SIDE CABLE, measure 535 mm from the cable end along the plastic jacket and SCORE mark the cable at this point. Remove the plastic jacket to the score mark.

REMOVING CABLE SHEATH

Measure 440 mm from the cable end and make a circular cut around the lead sheathing at this point. (See Section O for removal of sheathing from Coaxial Cable.)

Slide the rubber grommet and end cap in that order over each cable and along the plastic jacket.

Tie linen tape adjacent to the sheath and remove the outer paper wrapping. Lay back the outer layer paper insulated conductors.

MARKING TUBES

Where identification marks are not provided identify the tubes and apply adhesive backed numbered tape to the appropriate tubes. (S.443/11 or 12.)

Measure from the end of each tube 275 mm back along each tube and mark the tube. This mark will be the centre of the COMPLETED RIGHT SIDE JOINT.

CUTTING TUBE ENDS

From the centre, mark 50 mm towards the end of the cable, bind each tube with 25 mm cellulose tape and cut away the tube ends beyond the outer edge of the tape.

MARKING TUBES

Position the Coaxial Jointing Gauge No. 2 (S.445/17) with the shoulder mark 1 at the centre mark of the joint with the body of the gauge directed towards the cable sheath. Mark each tube in turn at position 7 on the gauge. Bind each tube at this mark with 25 mm cellulose tape. Score around each tube with a sharp knife at the mark and remove the paper wrapping.

MARKING STEEL TAPES

On each tube in turn place the shoulder of the gauge at the edge of the paper wrapping and mark the steel tapes at position 5 on the gauge. Lock the coaxial pliers on the tube at this mark then score around the steel tapes with a sharp knife. Using long nose pliers unwind the steel tapes and hold them with the fingers, remove the coaxial pliers and without releasing the fingers stretch the steel tapes. With sharp scissors cut the steel tapes at the same mark and snip off the sharp points.

THOROUGHLY DRY OUT MANHOLE NEAR JOINT BEFORE OPENING CABLES.
RETURN ALL SCRAP CABLE, LEAD SHEATH AND WIRE TO STORE ON COMPLETION OF THE JOB.
SAFE WORK DEPENDS UPON WELL KEPT TOOLS, USING THE RIGHT TOOL FOR THE JOB AND USING IT CORRECTLY.

MARKING OUTER CONDUCTOR

Place the shoulder of the gauge at the edge of the paper wrapping and mark the outer conductors at position 6 on the gauge. Lock the jaws of the coaxial pliers at this mark and using a pair of long nose pliers grasp the outer conductor as close as possible to the coaxial pliers and tear the outer conductor away. After removing the pliers trim off any rough edges or projections at the end of the outer conductor.

REMOVING SPACER DISCS

See Section O for method of removing and replacing spacer discs. Remove any visible polyethylene discs from the inner conductor. Heat the disc extractor (S.445/13) and remove three additional discs from the inside of each tube. Insert the narrow end of the gauge inside the tube and round off the outer conductor. Using a disc inserter (S.445/14) replace the discs removed with three PTFE discs (S.443/8).

OUTER CONDUCTOR SOLDERING SLEEVE

Wrap the steel tapes tightly by hand and push the outer conductor soldering sleeve over the steel tapes so that the soldering sleeve is level with the outer conductor, and with two of the three holes in the sleeve evenly placed each side of the longitudinal joint in the outer conductor. The edge of the steel tapes must be visible through the holes in the soldering sleeve. Repeat on the remaining tubes.

SOLDERING SLEEVE

With a hot soldering iron solder the outer conductor sleeve, steel tapes and outer conductor through the holes in.the soldering sleeve.

Position the shoulder of the gauge jointing No. 2 at the edge of the outer conductor and with a sharp knife score the inner conductor at the 2 mark.

Insert the PTFE bush over the inner conductor, and under the outer conductor until the collar is hard against the outer conductor. Cut off inner conductor at the score mark.

PREPARATION OF LEFT HAND CABLE

Prepare the left hand cable the same as the right hand side, then protect both cable ends with a suitable cover. If two cable jointers are employed the right and left sides may be prepared simultaneously.

FITTING THE JOINT CASE TO THE APPARATUS CASE

Remove the protection cover from the apparatus case. The joint case is fastened to the apparatus case by eleven high tensile stud bolts. Seal the mating surfaces of these parts with Dow Corning Silastic 738 or similar jointing compound. With a clean cloth wipe both surfaces to remove any dirt or trace or oil and apply two 2 mm beads of Silastic 738, 5 mm in from each edge of the mating surface of the apparatus case. Position the joint case and the stud bolts to the apparatus case. Hand tighten all nuts, then alternately and progressively tighten the nuts to 20 Nm with a 9 mm socket and torque wrench.

BEWARE OF LEAD POISONING - AFTER HANDLING LEAD OR LEAD COVERED CABLE, WASH YOUR HANDS AND FACE THOROUGHLY WITH SOAP AND WATER BEFORE EATING OR SMOKING.

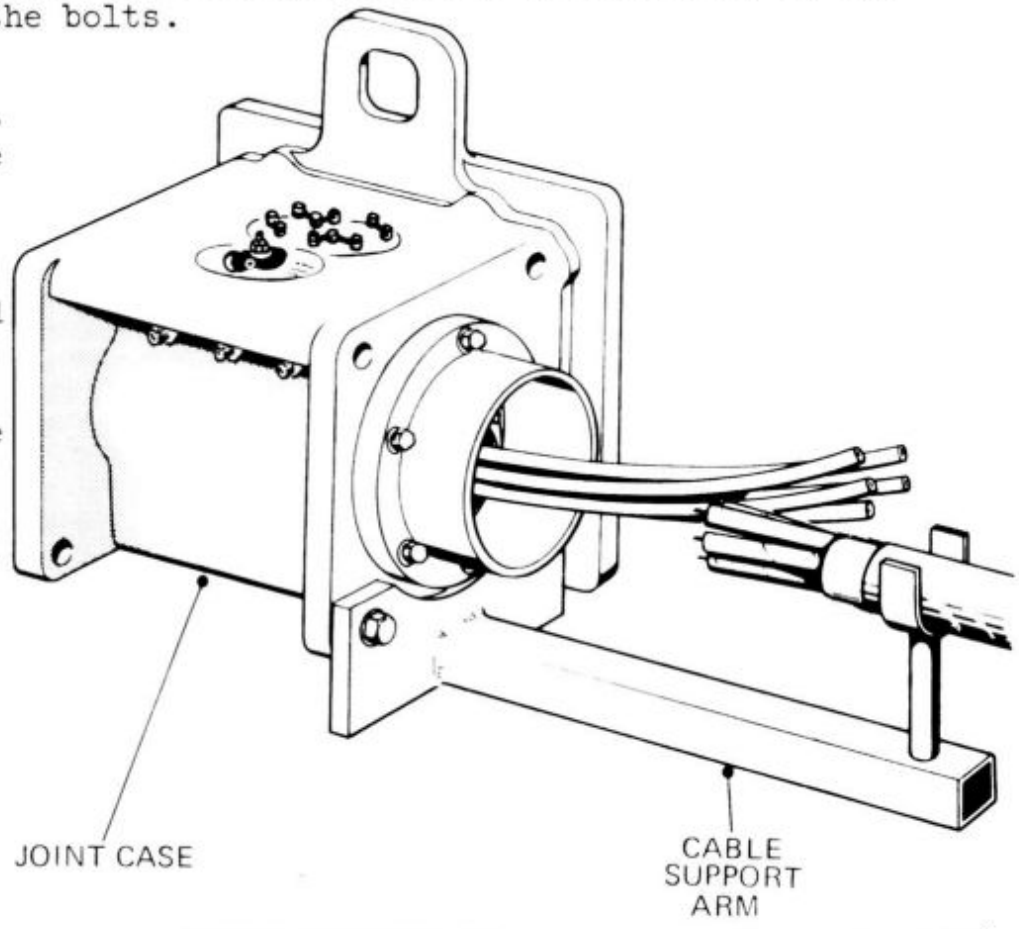
SILICONE RUBBER "O" RINGS

Lightly lubricate the Silicone rubber "O" rings with petroleum jelly and position them in the groove on each flange ring. Bolt the flange rings into position on each side of the joint case with the six high tensile bolts provided. With a 6 mm socket and torque wrench tighten the bolts to 10 Nm. Take the same precautions as described in the previous paragraph when tightening the bolts.

CABLE SUPPORT ARMS

The cable support arms left and right side (Drawing CL 1200, Sheet 22) are temporarily bolted to each side of the joint case. The arms support the coaxial cable in their correct position while the tubes are jointed to the semi-flexible coaxial cable of the terminal assembly. The support arm is offset therefore care must be taken to ensure that they are fitted to match up with the offset entry ferrule in the end caps. The support arms are removed on completion of the coaxial jointing.

PLACE GUARDS AROUND ALL MANHOLES, JOINTING PITS, TRENCHES AND ANY OBSTRUCTIONS WHICH MIGHT ENDANGER THE SAFETY OF PEDESTRIAN OR VEHICULAR TRAFFIC.



CABLE SUPPORT ARM

TERMINAL ASSEMBLY

The terminal assembly is supplied with Red and Green tubing fitted to each connector. RED indicates the right side cable assembly and GREEN the left side cable assembly. All semi-flexible coaxial cables of the assembly are identified with numbered tape.

FITTING ASSEMBLY

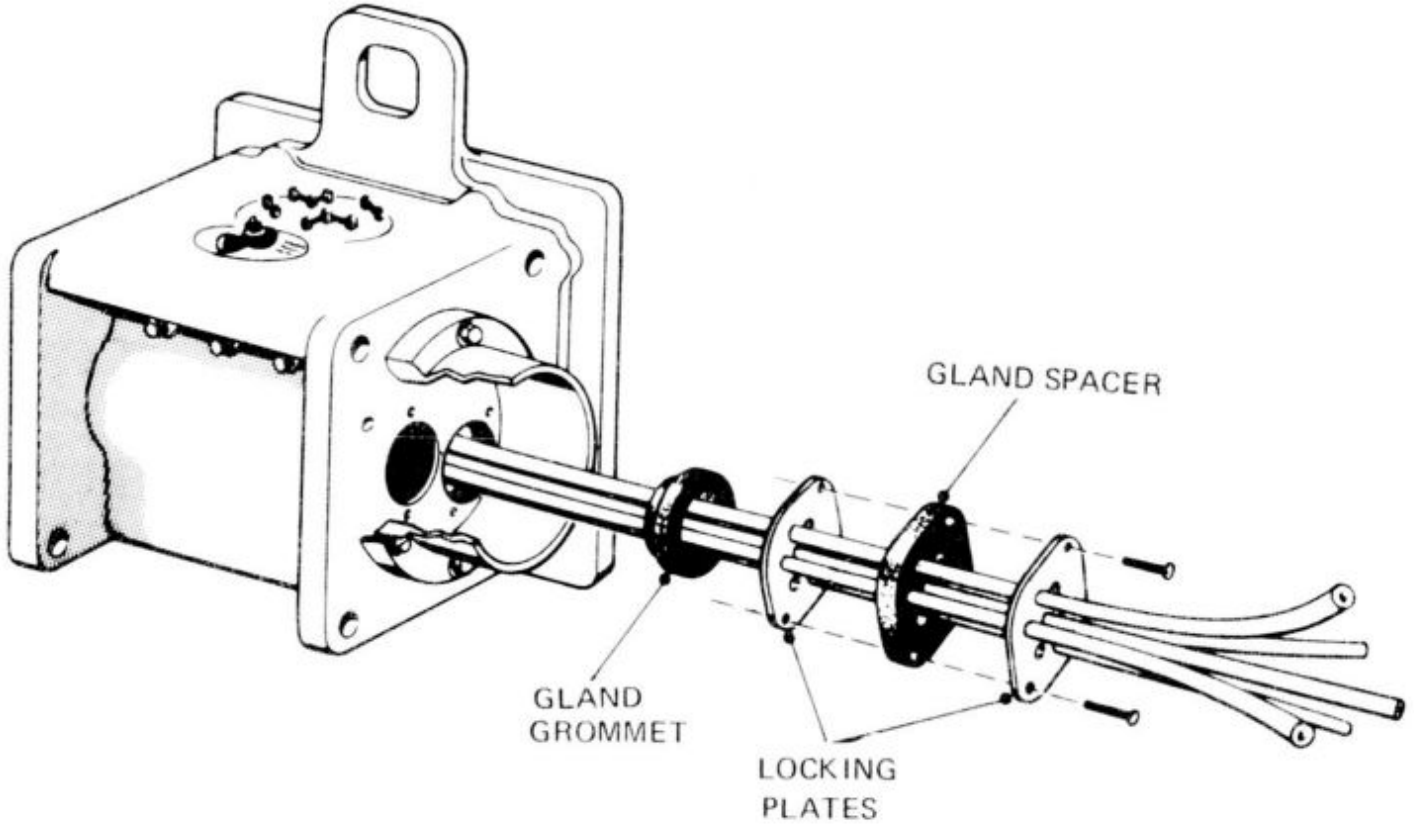
The method of fitting the assembly is by feeding the connectors and supervisory pairs cable through the cable entry in the joint case and from within the apparatus case. The epoxy block of the assembly is located just inside the joint case entry. Rotate the assembly so that the identification number of each semi-flexible cable is adjacent to the corresponding number of each tube in the air spaced cable. Locking plates are fitted to the inside of the apparatus case.

FITTING RUBBER INSERT

To secure the assembly outside the joint case, pass the gland grommet over the semi-flexible cables leading from the joint case and firmly locate it in the terminal entry opening of the joint case. In the following order fit on locking plate, one gland spacer and a second locking plate. Finally secure this assembly of parts to the joint case with the retaining screws (See page S-13).

FITTING CONNECTORS

Fit the coaxial connectors as required to the appropriate main plates in the apparatus case and secure with circlips.



ASSEMBLY ENTRY FROM WITHIN THE JOINT CASE

PREPARATION OF SEMI-FLEXIBLE CABLE FOR JOINTING

Form the semi-flexible cables up to each respective air spaced tube and with the gauge jointing Number 2, positioned with the number 1 mark on the end of the inner conductor of the air spaced tube, mark the semi-flexible cable at number 4 position on the gauge.

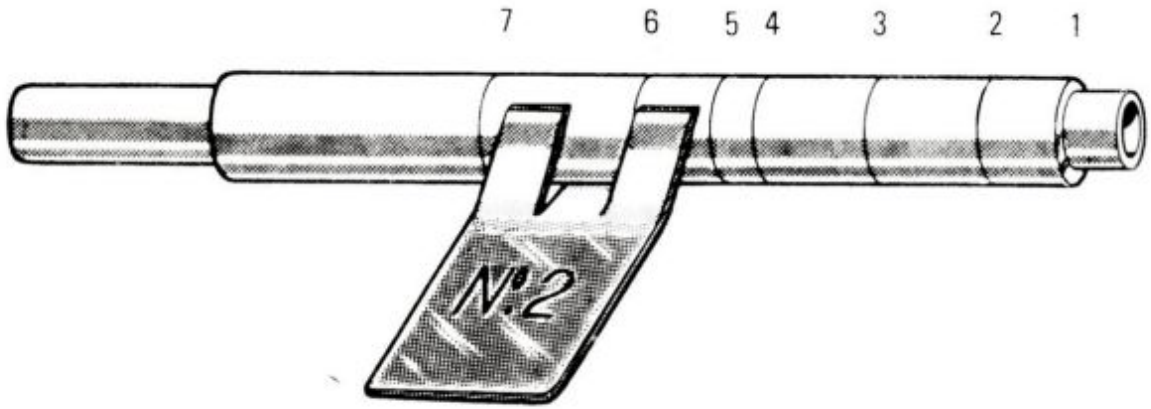
At this mark, cut with a sharp knife through the outer polyethylene sheath, the tinned stranded copper protection shield, the steel tapes, and remove surplus cable.

Postion the gauge jointing No. 2 with the number 1 mark at the edge of the outer polyethylene sheath and mark the outer conductor polyethylene insulation at the number 2 position and remove the insulation from that point.

FITTING SOLDERING RING

Fit a soldering ring over the outer conductor braid and insulation up to the outer sheath. (See page S-17.)

Using a steel scriber (N/S), comb the outer conductor braid into single strands and fold back over the soldering ring along the outer sheath.



GAUGE JOINTING NO. 2

REMOVAL OF DIELECTRIC

Position the gauge jointing No. 2 with the number 1 mark at the outer sheath and measure along the solid dielectric and mark at the Number 3 position on the gauge. Squeeze the area of Dielectric to be removed with long nose pliers, this will release the bond between the wire and the insulation and provide easier removal of the dielectric. Using the solid dielectric stripper (N/S) remove the solid dielectric to this mark in sections no longer than 6 mm. THIS OPERATION DEMANDS EXTREME CARE as the slightest score mark on the inner conductor will cause it to break off at that point, rendering the whole terminal set useless, for this reason A KNIFE MUST NOT be used to remove the solid dielectric from the inner conductor.

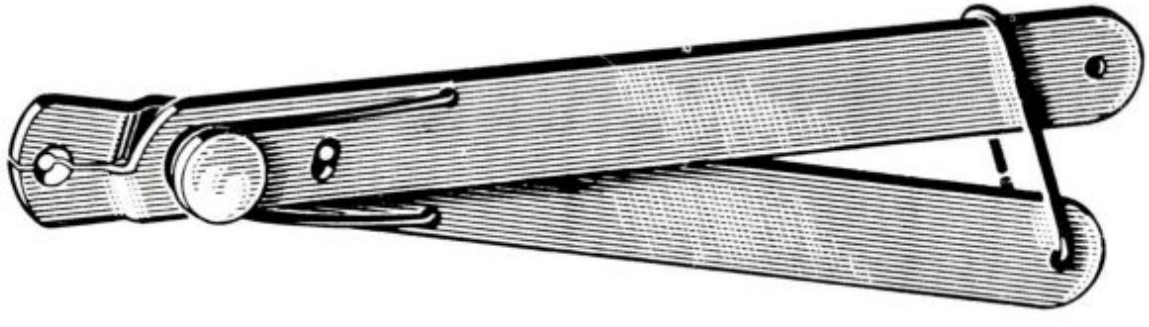
FITTING TEFLON SLEEVE

Fit a Teflon sleeve over the inner conductor and up to the conductor insulation.

Position the gauge jointing No. 2 with the number 1 mark at the outer sheath edge and score the inner conductor at the 4 mark, cut the inner conductor at that mark.

Cut and fit 35 mm of 12 mm clear heat shrinkable tube over the semi-flexible cable.

Prepare all other semi-flexible tubes the same way.



SOLID DIELECTRIC STRIPPER

JOINTING AIR SPACED TUBES TO SEMI-FLEXIBLE CABLES

Fit the inner conductor sleeve centrally over both inner conductors. Solder the sleeve to the inner conductors using 65/35 activated resin cored solder.

Fit the two sections of the split outer conductor sleeve over the inner conductor joint and lock into position with the spring clip.

Lay the copper braid of the semi-flexible cable back over the outer conductor sleeve then slide the soldering ring over the copper braid locking it to the outer conductor sleeve. Cut off the excess copper braid at the soldering ring. Solder the outer conductor at the soldering ring and through the two holes in the outer conductor sleeve to the soldering sleeve.

APPLYING HOT MELT IMPREGNATING TAPE

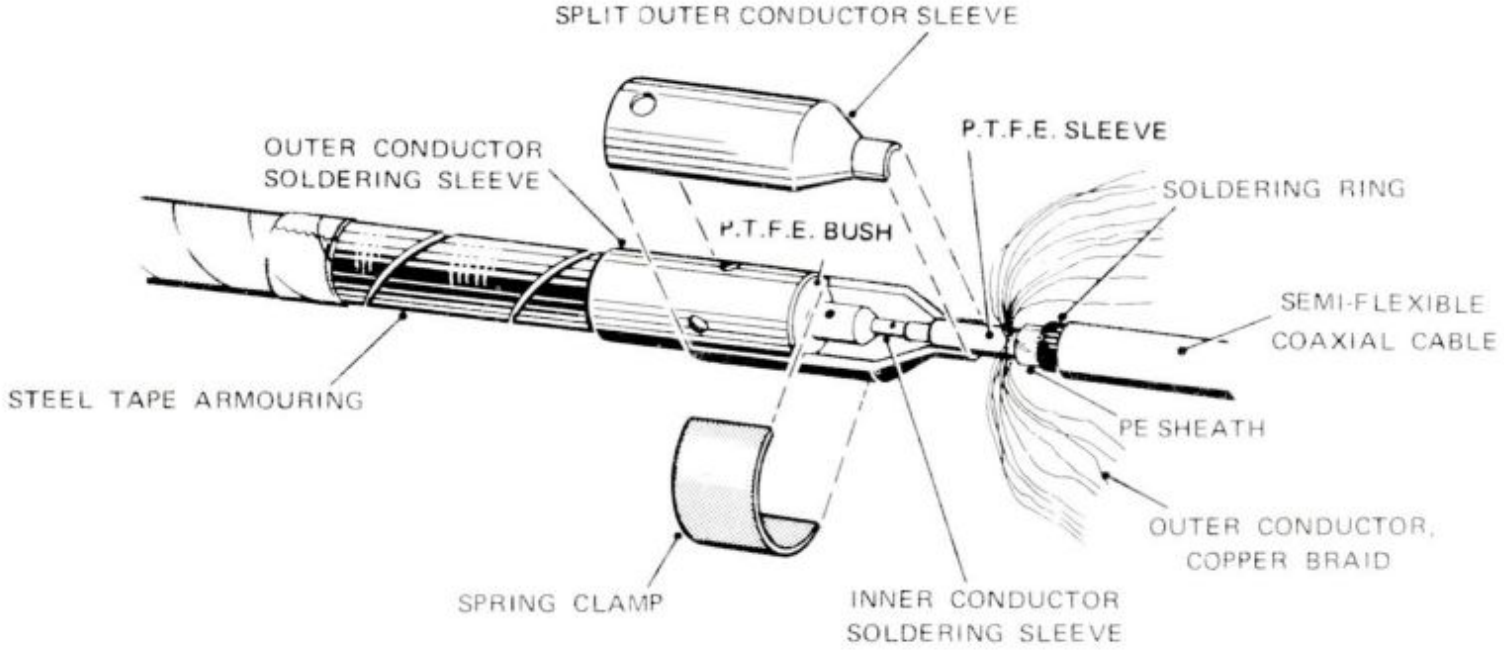
Cut and wrap a strip of hot melt impregnating tape 50 mm x 25 mm around the semi-flexible cable covering the outer conductor and up to the soldering ring. Slide the clear heat shrinkable tube over the hot melt impregnating tape and up to the outer conductor sleeve of the joint. Shrink the tube using a suitable hot air gun. The heat required to shrink the tube melts the impregnating tape which forms an air seal in the semi-flexible cable. Wrap each tube separately between the paper insulation of the air spaced tube and the outer sheath of the semi-flexible cable with P.V.C. non-adhesive tape (S.443/14) giving a 50% overlap. Secure the P.V.C. taped ends with cellulose tape.

OPENING A COMPLETED COAXIAL CONDUCTOR JOINT

Remove the non adhesive tape from the conductor joint.

Remove the spring clip and unsolder the split outer conductor sleeve from both the outer conductor soldering sleeve and the soldering ring. Push the copper braid back and remove the split outer conductor sleeve.

Unsolder the inner conductor sleeve allowing the inner conductor to part.



SEMI-FLEXIBLE TO TUBE COAXIAL JOINT

JOINTING LAYER, INTERSTICE AND CORE PAIRS

On some smaller coaxial cable all paper insulated pairs are directed into the apparatus case. In this situation the locking plate seal is fitted to either side of the through cable opening of the joint case.

When a through cable assembly is installed, insert the through cable assembly into the opening in the joint case reading clock or anti clock to match up with the cables being jointed. Fit the locking plate and securely tighten the retaining bolts.

JOINTING CONDUCTORS

The method of jointing the wires is by means of an A-MP Model MR-1 handtool for connector jointing (S.114/116) using number 60947-1 coloured red A-MP connectors (S.114/163). This tool crimps the wires and the connector between a set of dies and automatically cuts away excess wire giving a high quality joint.

THE CORE PAIRS, 1 AND 2 in the cable are the GPA pair and the Lineman's order wire respectively and are jointed to the first two pairs of the terminal set cable. The sequence of jointing those pairs is as follows:-

RED AND GREEN TAGGED CABLE	DESIGNATION	CABLE PAIR OF COAXIAL CABLE
White Wire	"A" side GPA pair	"A" side pair 1
Blue Wire	"B" side GPA pair	"B" side pair 1
White Wire	"A" side Lineman order wire	"A" side pair 2
Orange Wire	"B" side Lineman order wire	"B" side pair 2

LONG HAUL ORDER WIRES

The long haul order wires are allocated on core pairs three and four in the main cable and are jointed to the first two pairs in the through cable assembly.

TWO TUBE CABLE

For two tube coaxial cables pairs five, six and seven are jointed to pairs three, four and five in each of the cables in the terminal sets. Pairs six, seven and eight in each of the terminal set cables are spare pairs.

FOUR TUBE CABLE

For four and six tube coaxial cables, pairs five to ten inclusive are jointed to pairs three to eight in each cable of the terminal set.

All remaining pairs in the coaxial cables are required to be jointed to the through cable assembly.

Insert two Silica Gel bags (S.440/4) in the joint and double layer wrap the joint with 75 mm Kraft paper with a 50% overlap of paper.

FITTING JOINT ENCLOSURE AND SEALING

Fit the joint enclosures and seal with 35/65 wiping solder (S.4/1).

With the gas flow set in position 2 or 4 flash test left and right hand joints respectively. (Apply a pressure of 100 to 140 KPa.)

Cover the whole of the flange ring, the joint enclosure, and the exposed part of the cable with "Denso Tape", giving 50% overlap and building up any internal angles with "Denso" paste where necessary.

DESCRIPTION OF GAS ALARM AND FIELD ORDER WIRE SYSTEM

The gas pressure alarm system is incorporated in the design and manufacture of the housing. It consists of:-

(i) Contactor, pre-set to the required pressure of 62 kPa. The orange and blue wire leads are fitted with terminating lugs.

(ii) Pilot operated valve set to operate at 40 kPa for pressurising the cable at above ground control posts.

(iii) A gas pressure directional control valve for isolating or directing the flow of air to each of the cables or the cylindrical apparatus case.

VALVE READINGS

The five positions of the valve reading from left to right are indicated in diagrammatic form on the face plate of the switch. The flow of air for each position is:-

Position 1 - The housing, left hand and right hand joints are connected to the test point. With the valve in this position all sections of the system may be charged with, or discharged of air.

Position 2 - The housing and the right hand joint remain interconnected. The test point and the left cable are connected together. Air can be charged into or discharged from the left joint, therefore the left hand joint may be opened without any loss of air from the housing and the right hand joint.

Position 3 - This is the normal position of the switch on completion of work on the cable. The housing, the right and left hand joints are interconnected and the test point isolated. In this position the housing or the cable cannot be charged with or discharged of air.

Position 4 - The Housing and the left hand joints remain interconnected. The test point and the right hand cable are connected together for charging or discharging air from the right hand cable. The right hand joint may be opened without any loss of air from the housing and the left hand joint.

Position 5 - The right hand and left hand cables remain interconnected. The repeater housing and test point are connected and the housing can be opened without any loss of air from the cable.

OPENING HOUSING OR CABLE

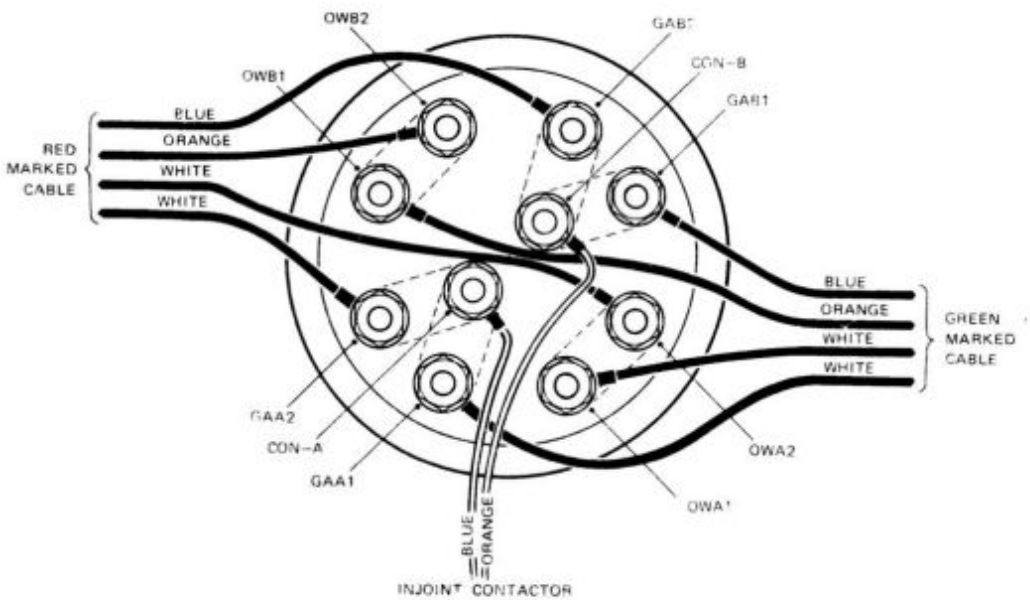
Turn the valve to the appropriate setting and remove the valve core from the valve holder.

CAUTION : THE CABLE OR THE HOUSING ASSEMBLY MUST NOT BE OPENED UNTIL THE AIR PRESSURE IS RELEASED THROUGH THE VALVE HOLDER.

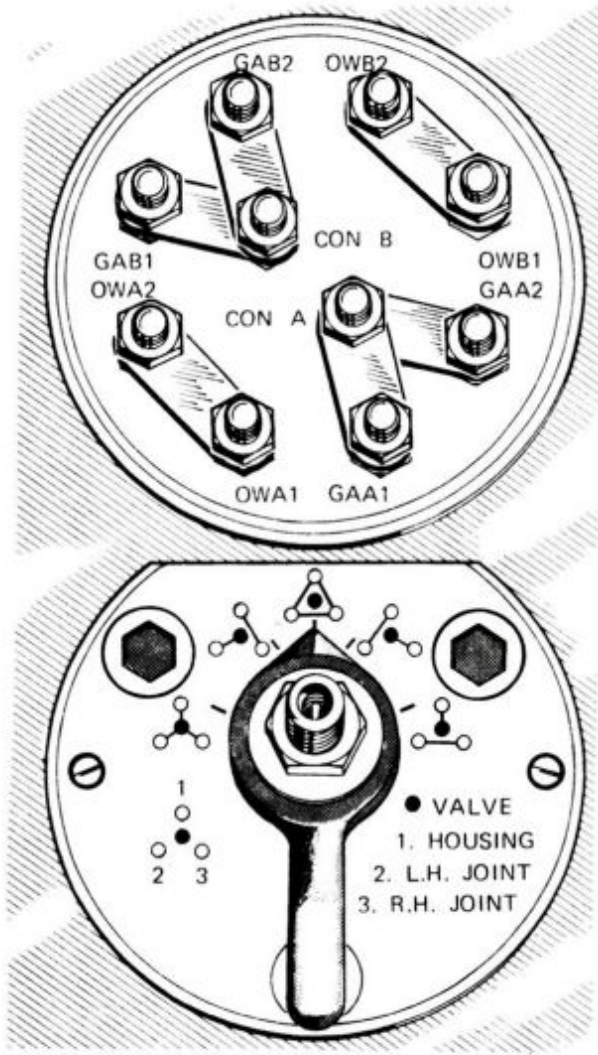
PREPARE AND INSTALL GAS ALARM AND FIELD ORDER WIRE SYSTEM

Remove the schrader valve from the cover, the Gas Pressure Control Cover Clamp and the Gas Pressure Control Cover from the joint case and close the air needle valve. The gas alarm terminal block fits into the joint case adjacent to the directional control valve. It is held in position with a circlip and sealed with an "O" ring. The terminal block may be removed by first releasing the air pressure from the apparatus case then firmly pushing the terminal block away from the retaining circlip. Remove the circlip from its groove with a pair of long nose pliers. Withdraw the terminal block from the joint case.

The gas pressure alarm and the field order wires of the terminal sets and the blue and orange wires of the contactor are terminated on the underside of the terminal block. The colour code for terminating the wires is shown below.



COLOUR CODE WIRE TO TERMINAL BLOCK



GAS ALARM TERMINAL BLOCK AND CONTROL VALVE

CABLE	WIRE COLOURS	TERMINAL
Green Tag Cable	White	GAA 1
	Blue	GAB 1
	White	OWA 1
	Orange	OWB 1
Red Tag Cable	White	GAA 2
	Blue	GAB 2
	White	OWA 2
	Orange	OWB 2
Contactor	Blue	CON A
	Orange	CON B

TERMINATIONS TO RED TAG, GREEN TAG CABLES AND INJOINT CONTACTOR ALARM (REAR VIEW)

ASSEMBLING TERMINAL BLOCK

To assemble, feed the wires back into the joint case. Ensure that the "O" ring is seated in the groove in the terminal block and press the terminal block into the joint case. Fit the circlip in position within the groove.

Open the air needle valve to 180°. Lubricate the "O" ring with petroleum jelly, fit the ring into position at the base of the gas pressure control cover. Secure the cover to the joint case by tightening the cover clamp to form an air tight seal. Replace the schrader valve on the GP control cover and tighten to seal.

ABOVE GROUND CONTROL POST

The above ground control post installations are described in Section T.

In situations where the above ground control post is not required fit the sealing nuts to the waterproof terminal and pilot valve connections, tighten them to eliminate any leakage of air.

For installation of the WATERPROOF CABLE TERMINAL or GAS TEST TERMINAL See Section T.

NOTE

When the above ground control post is installed, the cross connecting straps between the terminals in the waterproof terminal are left intact and the cross connecting straps on the terminal block in the joint case of the repeater housing are removed.

TERMINATING SUPERVISORY PAIRS ON THE PROTECTOR STRIP

The supervisory pairs consist of 6 pairs of polyethylene insulated conductors and are enclosed in polyethylene tube which is part of the terminal assembly. Before terminating, place conductors into the apparatus case then identify and mark each pair. As pair one and two in the joint side of the assembly were used for the G.P.A. Pair and Linemans Order wire, the third pair of the standard colour code now becomes the first pair in the protector strip cable. Identify this group of conductors as reading from 1 to 6 within the apparatus case.

RED AND GREEN MARKED CABLE

The RED marked cable enters the protector strip from the RIGHT hand side and the GREEN marked cable from the LEFT side of the strip.

The protector strip tags are numbered on the outer face of the protector strip and the wires terminated on the reverse side. Rotate the protector strip and remove the cover from the tags. Pass the conductors through their respective holes, allowing sufficient wire to terminate.

TWO TUBE COAXIAL CABLES

Where the housing has two tube coaxial cables, terminate pairs one, two and three or the red marked cable on tags one, two and three of the protector strip, and pairs one, two and three of the green marked cable on tags four, five and six of the protector strip. Using wire similar to that of the terminal set cables and of standard colour code strap both sides of tags one, two and three to tags four, five and six in that order.

Where the housing has two tube cables:

(i) Terminate pairs 1, 2 & 3 of the red marked cable to tags 1, 2 & 3 of the protector strip respectively.

(ii) Terminate pairs 1, 2 & 3 of the green marked cable to tags 4, 5 & 6 of the protector strip respectively.

(iii) Strap both sides of tags 1, 2 & 3 to tags 4, 5 & 6 respectively. Use wire which matches colour code and diameter of terminal set cables.)

CYLINDRICAL REPEATER HOUSING

FOUR AND SIX TUBE CABLES

Where the housing has four and six tube coaxial cables, terminate pairs one to six of the red marked cable to tags one to six of the protector strip and pairs one to six of the green marked cable to tags.seven to twelve of the protector strip. Using wire similar to that in the terminal set cable and the standard colour code strap both sides of tags one to six to tags seven to twelve on the arrestor strip.

NOTE: In all cases the cables in the terminal assembly are terminated on the inner tags and the pairs strapped on the outer tags of the protector strip.

REMOVING INSULATION

Cut each wire 5 mm longer than necessary to reach the tag position. With wire stripper (S.459/5) remove 12 mm of P.V.C. insulation from the end of each wire. Thread the bare wires through the holes in the respective tags up to the insulation and bend the wires at right angles. Solder the wire to the tag using 65/35 resin cored solder and cut off the excess wire.

Lay the wires flat along the protector strip and replace the protective cover.

RESPONSIBILITIES OF LINE STAFF

On completion of the installation of the Cylindrical Repeater Housing the lines staff are required to carry out the following procedure.

Fit the patch cord assembly (S.443/4) when required.

Install Siemens Button Arrestors (S.442/22) in the protector strip, as and when required.

Remove all wire ends, solder and any other foreign matter from the apparatus case.

SEALING HOUSING

Place the dust cover in position and see that the "O" ring grooves are free from moisture and dust, etc. Lightly lubricate the flat mating surfaces with petroleum jelly. Position the "O" rings in the grooves. Fit the lid into position and line up the holes with the holes in the apparatus case. With a 10 mm socket and torque wrench alternately tighten the high tensile bolts to 14 Nm.

CHECKING CROSS CONNECTING LINKS

Check that the cross connecting links are installed or removed as described earlier and the Gas Flow directional switch is in No. 3 Position. Position the "O" Ring and the Gas Pressure control cover and securely tighten the cover clamp bolt to 14 Nm.

NOTE:

It is the function of the Coaxial Patrolman or other Lines Staff as delegated by the responsible ENGINEER to open and close the repeater housing and the thermal environment manhole. He should remain in attendance whilst the repeater housing is open and on completion of work ensure that seals are free from gas leaks and the gas pressure alarm system is restored to normal.

ENGINEERING INSTRUCTION REFERENCES

E.I. LINES Cables	J 3930

GAS PRESSURE ALARM SYSTEMS

COAXIAL CABLE

Above Ground Control Post.
Waterproof Cable Terminal.
Gas Test Terminal.

Issue 1, 1976

GAS PRESSURE ALARM SYSTEM (CX)

GENERAL

The system is designed to protect the cable and coaxial repeater equipment from the entry of moisture. Contactor alarms are placed at intervals of 1.5 km (proposed 60 MHz repeater locations). The contactors are factory set and operate when the pressure falls to 60 kPa. Some contactors (S.421/66) are used inside the joint and repeater housings and are known as in-joint contactors. (For more information on Gas Pressure Alarm Systems see Section G).

Alarm circuits and control circuits on some systems are on core or layer pairs depending on the system used.

For all coaxial cable systems four VF pairs are required. These circuits are gas pressure alarm and order wire circuits.

Cable Type				Allocation
2 Tube	4 Tube	6 Tube or 8 Tube	12 Tube	
Interstitial QJ	Centre Unit Tw.	Centre Unit QT	Centre Unit QJ	
Pair 1	Pair 1	Pair 1	Pair 1	G.P.A.
Pair 2	Pair 2	Pair 2	Pair 2	Local O/W
Pairs 3 & 4	Pairs 3 & 4	Pairs 3 & 4	Pairs 3 & 4	Long Haul O/W

PAIR ALLOCATION FOR G.P.A. AND ORDER WIRES

GAS ALARM PAIR

Gas pressure alarm systems require one unloaded pair to connect the contactor alarm units back to the unattended station. This pair is only connected to the contactor and not jointed to the tail cables at repeater positions.

LOCAL ORDER WIRE

The local order wire (or field order wire) consists of a loaded pair connecting the testing station to a waterproof connecting box at each manhole above ground control post or to circular repeater housings where they are used.

It is provided for the joint use of Lines and Technical staff to enable them to communicate with each other from manholes with repeaters, G.P.A. contactors, main repeaters and terminal stations. Communication on local order wire extends only over a main repeater section.

LONG HAUL ORDER WIRE

A four wire order wire is used to inter-connect main stations. The pairs are loaded and are not connected to repeater tail cables, but are through connected at each repeater manhole.

EXCEPT IN CASES OF EMERGENCY, AIR PRESSURE MUST NEVER BE LEFT OFF A MAJOR TRUNK OR COAXIAL CABLE EXCEPT WHEN WORK IS ACTUALLY BEING PERFORMED ON THE CABLE.

SUPERVISORY PAIR REQUIREMENTS

Some systems require additional pairs for supervisory purposes. Typical requirements for supervisory pairs are:-

NAME	TYPE OF SYSTEM	PAIRS REQUIRED
S.T.C. (LG 12A)	12 MHz	4
S.T.C. (LG 12B)	12 MHz	NIL
SIEMENS	12 MHz + 60 MHz	NIL
N.E.C.	12 MHz + 60 MHz	2
T.M.C./Phillips	60 MHz	Possibly 1

GAS INJECTION

Inject dry air at a pressure of 105 kPa for all hard metal joint enclosures, this can be accomplished by:-

(i) Compressor Dehydrators.

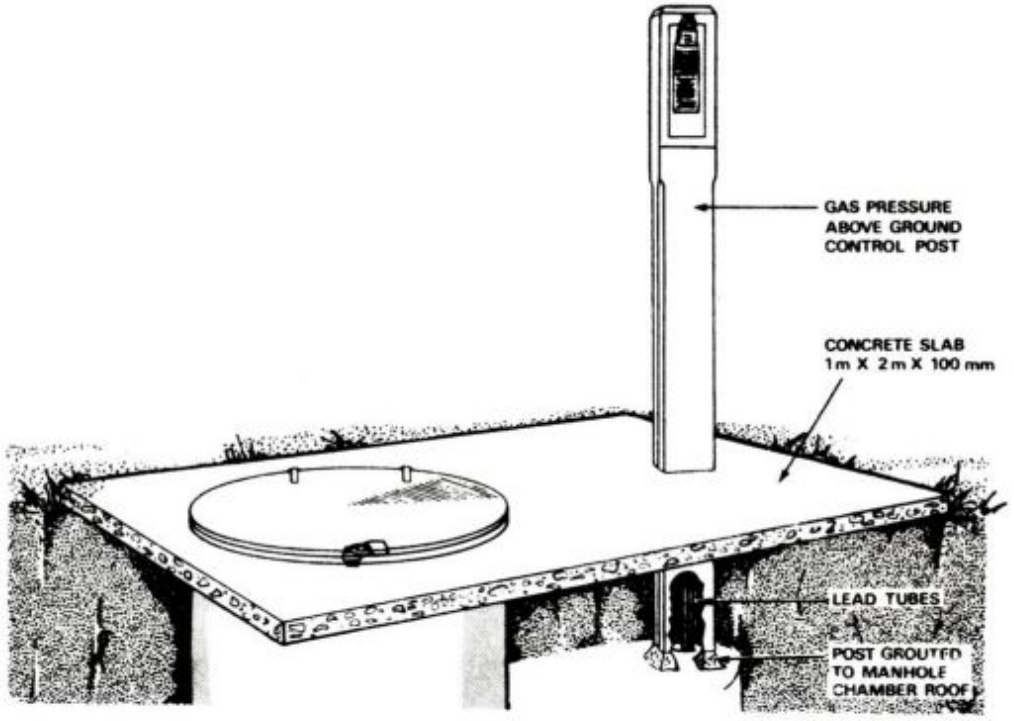
(ii) A bank of commercial dry air cylinders totalling a minimum of 25 m^3 of air.

Where air cylinders are used, inject air into the cable via a manifold assembly. A two stage contents alarm attached to the cylinder bank brings up the alarm when the cylinder bank first falls to 9 500 kPa and then at 7 000 kPa. Replace the cylinders as soon as possible after the second alarm, to minimise risk of moisture entry.

ABOVE GROUND CONTROL POST

GENERAL

The above ground control post (S.448/9) is used to house the Gas Test Terminal (S.421/1) and the Waterproof Cable Terminal (S.421/67). The control post has a security cover and is designed for use with underground cylindrical repeater housing installed on coaxial cables. It may however, be adapted as required for use on other cable installations.



ABOVE GROUND CONTROL POST

ABOVE GROUND CONTROL POST

INSTALLATION AT MANHOLES

At repeater housing locations where cylindrical manholes are installed, the post is grouted directly above the hole provided in the roof of the manhole chamber. This hole allows for three lead tubes from the gas test and waterproof cable terminals to enter the manhole (See figure on page T-5).

INSTALLATION WITHOUT MANHOLES

Where no manhole is provided bury the control post to a depth of 600 mm leaving 1.2 m above the ground. The post should be located near a fence or some fixed landmark. Place the three lead tubes (from the gas test and waterproof cable terminals to the cable joint enclosure to be monitored) in a P.V.C. conduit. Where the lead tubes are buried directly in the ground they should be protected by a polyethylene jacket.

TREAT MINOR CUTS AND ABRASIONS IMMEDIATELY. A MINOR SCRATCH TODAY CAN BECOME A MAJOR INJURY NEXT WEEK IF IT BECOMES INFECTED.

WATERPROOF CABLE TERMINAL

GENERAL

The waterproof cable terminal (S.421/67) is used mainly on all gas pressure cables fitted with in-joint contactor alarms. Its primary use is with Coaxial Cable and is designed for use with the above ground control post (it is secured to the post by two 8 x 25 mm stainless steel bolts). The cable terminal provides easy access for patrolmen to the lineman's order wire and other gas alarm contactor pairs.

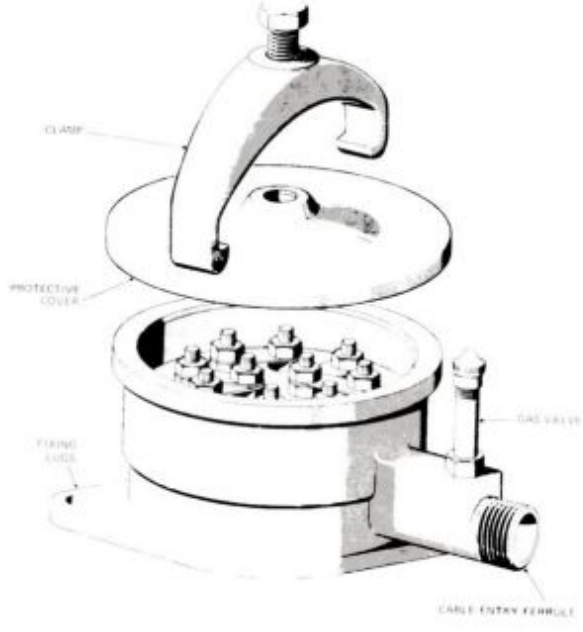
NOTE : When the terminal is installed in a manhole, it is attached to the wall by masonry anchors and two 8 x 25 mm diameter stainless steel bolts.

WATERPROOF SEAL

The clamp fixes the protective cover to the body and a rubber "O" ring situated in the groove in the cover provides a waterproof seal.

Two fixing lugs are fitted on the body of the housing and a gas test point valve on the cable entry is provided.

BE CONSTANTLY ON GUARD AGAINST AN ACCIDENT AND DO NOT COMMENCE A JOB UNTIL YOU ARE SURE THAT YOU CAN WORK IN SAFETY.



WATERPROOF CABLE TERMINAL

WATERPROOF CABLE TERMINAL

TERMINAL SET

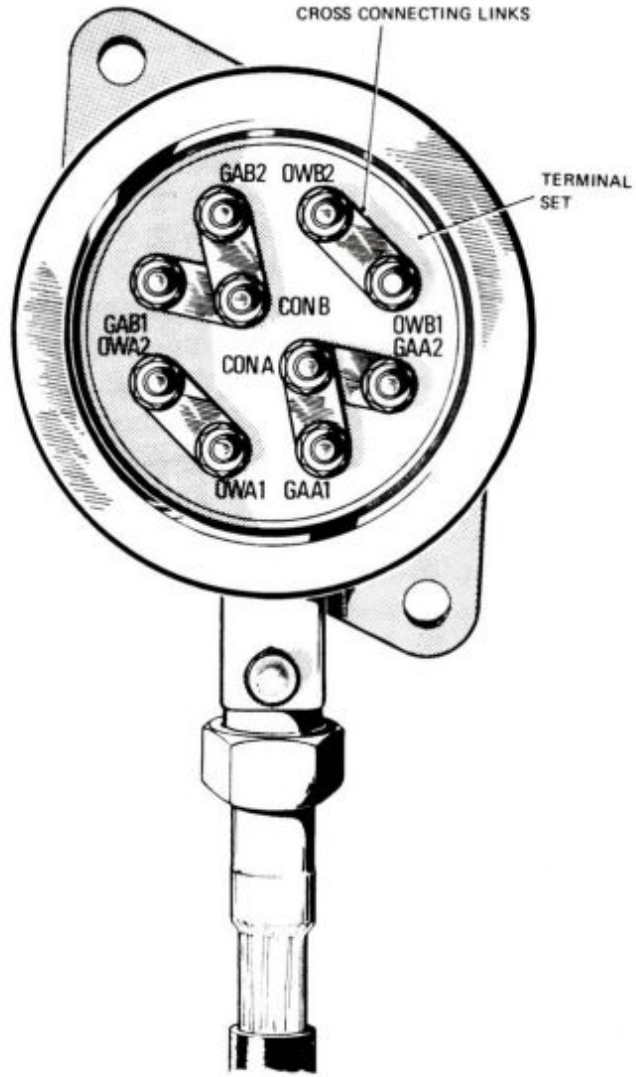
The identification of each terminal is engraved on the terminal set which is sealed in the body of the housing with a rubber "O" ring and securely located by a circlip. For personnel safety, this circlip is held captive when the rear face of the terminal set is subjected to cable air pressure.

PREPARING TUBE

Cut a suitable length of Lead Antimony Tube (S.421/35) to reach from the equipment recess of the control post to the correct outlet in the cylindrical repeater housing or the joint enclosure end cap ferrule.

Draw the wires listed on page T-12 into the lead tube allowing for 380 mm excess wire at the end to be fitted to the repeater housing and 310 mm at the end to be fitted to the waterproof terminal.

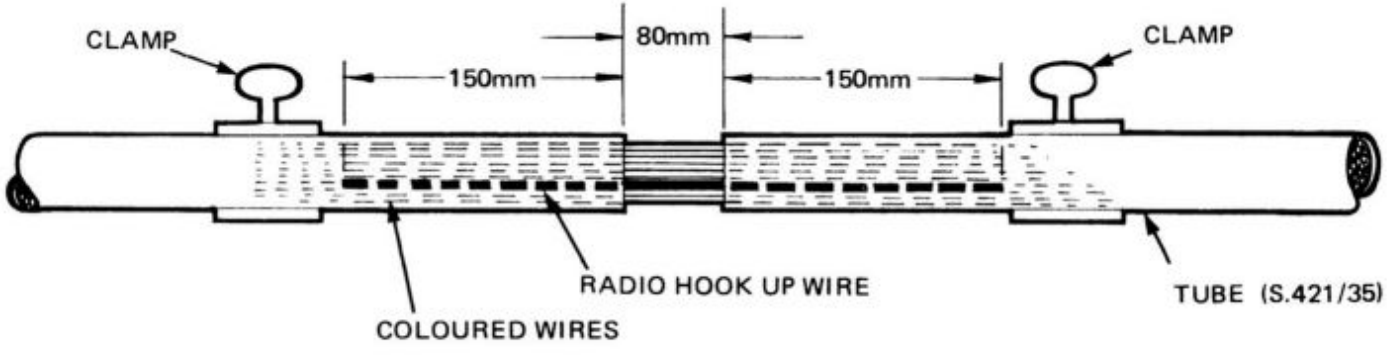
PLACE GUARDS AROUND ALL OPEN MANHOLES. JOINTING PITS, TRENCHES AND ANY OTHER OBSTRUCTIONS WHICH MIGHT ENDANGER THE SAFETY OF PEDESTRIAN OR VEHICULAR TRAFFIC.



TERMINAL SET

PREPARING SEAL

Measure 460 mm from the lead tube end which is to be terminated at the repeater housing or joint enclosure. Make a radial cut around the tube at this position, taking care not to cut the coloured wires. Separate the tube by 80 mm at this point and clamp in position. Insert a 380 mm length of black radio hook up wire (S.3/157), 150 mm into both ends of the tube. The purpose of this wire is to provide a restricted flow of gas through the epoxy seal thus allowing the waterproof terminal to slowly equalise at cable or system pressure. In the event of the lead tube being accidentally cut above ground level, the epoxy seal will prevent large quantities of gas discharging from the cable.



PREPARING TUBE FOR EPOXY SEAL

WATERPROOF CABLE TERMINAL

RESTRICTING EPOXY FLOW

Make a circumferential indentation 20 mm from each side of the opening by tapping the shaft of a 5 mm screwdriver with a pein hammer, against the lead. This groove should be deep enough to restict the flow of the epoxy resin into the lead tube while pouring the seal.

Slide a 20 x 150 mm lead slip sleeve over the lead tube; centrally position it over the opening and seal each end with 35/65 wiping solder. Wipe a 12.7 mm flange injector (S.421/9) onto the centre of the sleeve.

MAKING SEAL

With an Epoxy Injection Gun (N/S) force a mixture of 31 grams of Epicote 816 and 14 grams of Polymid 75 into the sleeve to form a gas seal (for mixing instructions see Page G-7). Remove and clean the injection gun, insert a Screw, Flange Valve Holder (S.421/16) and allow a curing period of ten days before installation. The total mixture of Epicote and Polymid (45 grams) is the correct quantity to complete one seal. Larger batches of resin can be prepared by increasing each part of the mixture in proportion to the number of seals required.

For this type of seal it is permissible to use an Epoxy Resin Pack (S.433/58) which consists of Epicote 818 and Polymid 75. This unit pack when mixed will provide sufficient quantity for six seals.

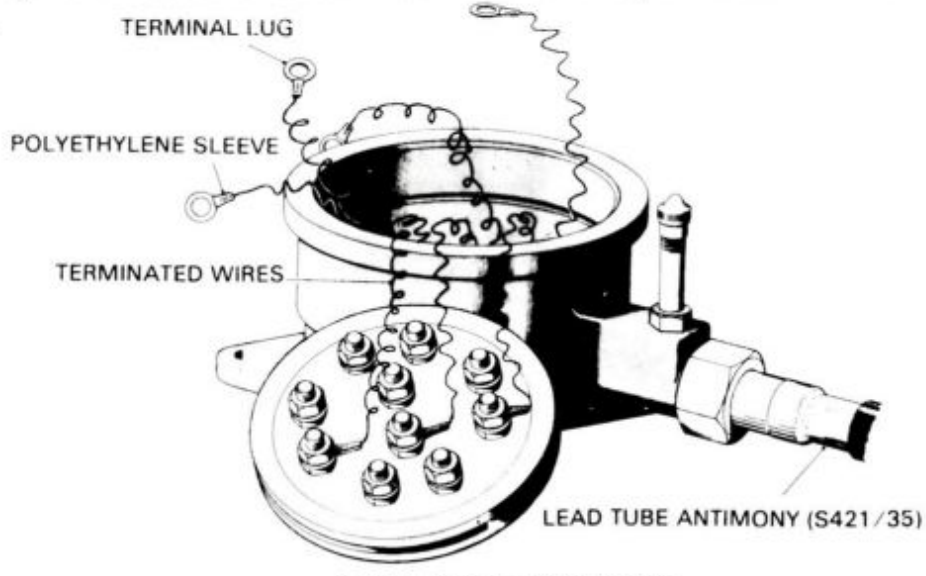
NOTE : When the lead tube is installed in the manhole, the epoxy seal is located adjacent to the joint protection sleeve of the cylindrical repeater housing. (See Page N-5.)

REMOVING TERMINAL SET

Remove the terminal set from the body by firmly pushing it away from the retaining circlip. With a pair of long nosed pliers carefully remove the circlip from its groove and withdraw the terminal set. Pass the wire through the centre of the nut and tail. Fit the lead antimony tube into the nut and tail and solder the lead tube to the tail using 65/35 activated resin core solder. Feed the wires into the body of the waterproof housing, then firmly tighten the nut to the body until a gas seal is achieved.

TERMINATING WIRE

Cut a 12 mm length of Orange Polyethylene Jointing Sleeve (S.433/102) and slip it over each wire to be terminated. Solder a Utilux Low Tension Terminal Lug no. 238 or similar to the end of each wire allowing enough slack wire for easy termination. Slide the orange polyethylene sleeve over the soldered portion of each lug to insulate it from other wires.



WIRE TERMINATIONS

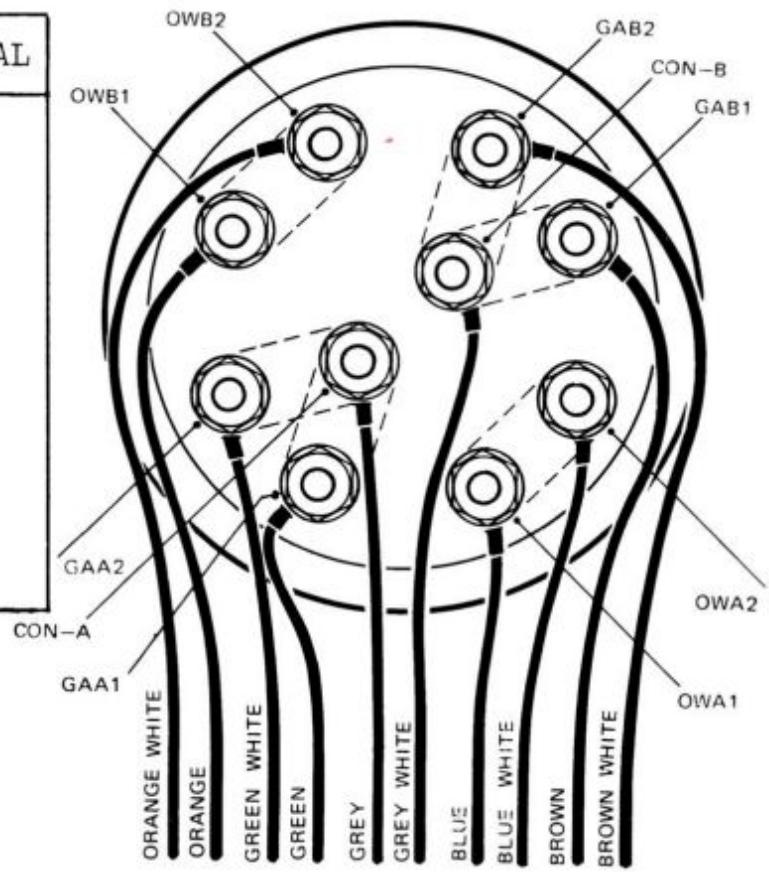
WATERPROOF CABLE TERMINAL

TERMINATING WIRE (cont'd)

Terminate the wires to the terminals shown below.

SERIAL	CABLE PAIR	WIRE	TERMINAL
3/351	Blue - Blue White	Blue Blue White	OWA 1 OWA 2
3/352	Orange - Orange White	Orange Orange White	OWB 1 OWB 2
3/353	Green - Green White	Green Green White	GAA 1 GAA 2
3/354	Brown - Brown White	Brown Brown White	GAB 1 GAB 2
3/355	Grey - Grey White	Grey Grey White	CON A CON B

WIRE IDENTIFICATION



TERMINATIONS TO REAR FACE OF TERMINAL SET

TAKE CARE TO AVOID DAMAGE TO PRIVATE PROPERTY.
REPORT ACCIDENTAL DAMAGE IMMEDIATELY.

RE-ASSEMBLING TERMINAL SET

Feed the wires back into the body; ensure that the "O" ring is seated in the groove in the terminal set; press the terminal set into the body then return the circlip to its groove. During installation, dismantling or assembling the terminal set, the schraeder valve must be removed from the gas valve stem. The purpose of this valve is to release the air pressure in the waterproof cable terminal which enables the circlip and the terminal set to be removed. The valve cannot be used to charge or discharge air into the gas pressure alarm system or take the air pressure reading of the cable. To seal the waterproof terminal replace schraeder valve, valve cap and ensure that the groove in the protection cover is dry and free from any foreign matter. Lightly lubricate the "O" ring and position it in the groove, place the protection cover and the clamp in position then tighten the locking screw to 15 Nm.

TERMINATING CABLE END OF WIRE

The wires at the end opposite the waterproof cable terminal are terminated either to a repeater housing (see Page T-14) or directly into a joint at a proposed future repeater point.

Where the waterproof cable terminal is installed at a joint select the correct end cap for the joint enclosure for the size of the coaxial cable (see drawing CL-1142, Sheet 8). Pass the wires through the ferrule in the end cap and ball wipe the lead antimony tube to the ferrule with 35/65 solder.

WATERPROOF CABLE TERMINAL

CONNECTING TERMINAL TO REPEATER HOUSING

Measure and cut the lead antimony tube to the required length. Unscrew the angle connector and insert the wires into the connector. Solder the tube to the connector using 65/35 resin cored solder and screw the connector to the housing.

REMOVING TERMINAL BLOCK

Remove the terminal block as described in Section S and bring the wires through the terminal block opening. Cut the wires to a suitable length to be terminated on the block and fit a 12 mm length of orange Polyethylene Jointing Sleeve (S.433/102) over each wire to be terminated. Strip 6 mm of insulation from each wire and solder a Utilux Low Tension Terminal Lug No. 238 or similar to each wire. Slide the orange polyethylene sleeve over the soldered part of each lug to insulate it from other wires.

Fit the terminal block to the joint case as described in Section S.

NOTE : When the above ground control point is installed the cross connecting straps between the terminals in the waterproof terminal are left intact and that the cross connecting straps on the terminal block in the joint case of the repeater housing are removed.

BEWARE OF LEAD POISONING - AFTER HANDLING LEAD OR LEAD COVERED CABLE, WASH YOUR HANDS AND FACE THOROUGHLY WITH SOAP AND WATER BEFORE EATING OR SMOKING.

SEQUENCE OF JOINTING WIRES

The sequence of jointing the wires in the repeater housing and joint enclosure is detailed in the following tables:-

COAXIAL CABLE PAIR	WIRE COLOUR	TERMINAL
PAIR 1 A SIDE	GREEN WHITE	GAA 2
B SIDE	BROWN WHITE	GAB 2
PAIR 2 A SIDE	BLUE WHITE	OWA 2
B SIDE	ORANGE WHITE	OWB 2

CABLE TO MAJOR TERMINAL

PAIR 1 A SIDE	GREEN	GAA 1
B SIDE	BROWN	GAB 1
PAIR 2 A SIDE	BLUE	OWA 1
B SIDE	ORANGE	OWB 1

CABLE TO MINOR TERMINAL

BLUE	GREY	CON A
ORANGE	GREY WHITE	CON B

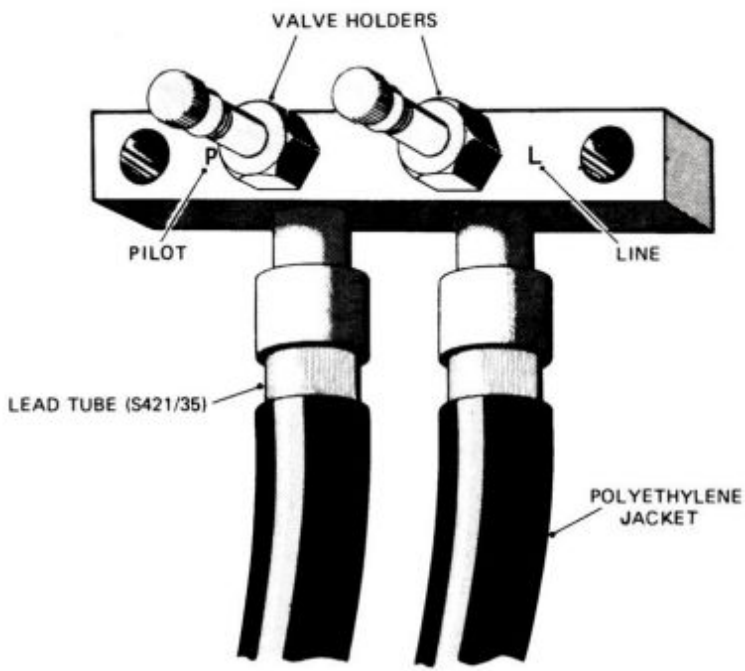
CONTACTOR

GAS TEST TERMINAL

GENERAL

The Gas Test Terminal (S.421/1) is used with the Above Ground Control Post (S.448/9).

The ferrules are fitted to the underside of the terminal and allow lead tubes (S.421/35) to be fitted and soldered with 65/35 activated resin cored solder. Two valve holders (S.421/25) screw into tapped holes on the front face of the terminal. The terminal is stamped with the letter "P" (Pilot) and letter "L" (Line), see figure. Two holes, 10 mm diameter, allow the terminal to be bolted to the equipment chamber of the gas pressure above ground control post by using 8 x 25 mm stainless steel bolts.



GAS TEST TERMINAL

PILOT OPERATED CHECK VALVE

The pilot operated check valve (S.421/68) is located in either the cylindrical repeater housing or the straight joint enclosure. These fittings enable cable air pressure to be read remotely from above the ground without the need to enter the underground manhole chamber. By the use of the pilot operated check valve, "live" air pressure lines are not extended above ground, where they are vulnerable to accidental damage or vandalism.

TO OPERATE CHECK VALVE

Apply a pressure of 140 kPa to the test point marked P on the gas test terminal, this will operate the check valve which will allow the cable line or system pressure to be extended above ground and appear at the test point marked L on the gas test terminal. The cable system static pressure can then be either recorded, increased or decreased.

INSTALLATION IN ABOVE GROUND JOINT POST

Place the lead tubes (S.421/35) through the above ground joint post and cut to the correct lengths. Solder the tubes to the two ferrules fitted under the terminal with 65/35 activated resin cored solder. The terminal can then be bolted to the equipment chamber of the above ground control post.

INSTALLATION TO REPEATER HOUSING

To connect the gas test terminal to the repeater housing, cut the lead tubes to the correct lengths, then unscrew the angled connectors. Solder the lead tubes into the connector using 65/35 resin cored solder. Screw the angle connectors onto the housing. The tube marked L on the gas terminal is screwed onto the left side pilot valve connection and the tube marked P on the gas terminal is screwed onto the right side pilot valve connection. This step connects the gas test terminal to the pilot valve which now becomes operative.

ENGINEERING INSTRUCTION REFERENCES

E.I. Lines Cables	P3511
	P3702
	P3703
	SY3905
	SY3906

CASH AWARDS

ARE PAID FOR GOOD IDEAS WHICH SAVE TIME, MONEY OR MATERIALS SEND YOURS NOW TO:

THE SECRETARY,
STAFF SUGGESTIONS BOARD,
TELECOM AUSTRALIA,
COMMUNICATIONS HOUSE,
199 WILLIAM STREET,
MELBOURNE, VIC, 3000.

Write a brief description of your idea include where possible, sketches photographs or a prototype sample, and post directly to the above address.

To avoid disappointment and waste of the Commission's time in investigating the suggestion make sure that your ideas are practical. Discuss them with your supervisory officers or if possible try them out before submitting the suggestion.

EXPLANATORY NOTES

The General Purpose (GP) cable pair identification set was introduced to line staff in July 1979. Summarised information regarding the description, operation and use was included in an instruction booklet and issued with the set. The information contained in the instruction booklet has been slightly amended and the presentation altered to enable inclusion of this information in the linemens handbook "LINES TESTING AND INSTRUMENTS".

Some pages have been replaced and new pages relating to location of power cables, have been included in sections JA and L.

Sections A and pages FE, JD and P have also been amended to replace those existing.

Section	What to do with your existing LINES TESTING AND INSTRUMENTS handbook
A	Replace existing Section
DF	Insert new section
FE	Replace existing page
JA	Replace and insert new pages
JD	Replace existing page
KF	Insert new section
L	Replace and insert new pages
P	Replace existing page
T	Insert new section