OVERHEAD LINES SECTION 4

1. GENERAL

Work on electrical assets shall be performed only by:

a. Electrical workers, apprentices or persons who have passed an approved training course appropriate to the activity being performed and whose competencies are current, or

b. An apprentice working in accordance with the provisions of their defined training requirements whose competencies are current.

When working on energised conductors, employees shall:

- Be appropriately trained and authorised for the purpose of the work.
- Make a safety assessment and ensure that the job can be performed safely whilst energised.
- Work on only one phase at a time and remain isolated and insulated from all other potentials.
- NOT rely upon conductor insulation for protection.
- Whenever possible, work from a position below the conductors.
- Use barriers when working adjacent to energised conductors or equipment that cannot be adequately insulated with cover-up materials.
- Wear appropriate insulated gloves and approved safety glasses.
- Wear approved overalls or work suit, and safety footwear.
- Cover all exposed conductors and conductive structures (e.g. stays, conductive poles, public lighting brackets, roofs, etc…) that are within reach.
- Be given appropriate first aid training at commencement, and thereafter subject to annual competency testing.
- Ensure the work is performed under dead conditions if the work cannot be performed safely whilst energised.
- Have an approved rescue device readily available at the site.

A person working on or within reach of live exposed apparatus may work alone in the following situations:

a. Testing and/or inspecting customer's premises.

b. Engaging in metering work as described in Section 5.

c. Routine switching of circuits.

d. Where a risk assessment has been carried out and procedures documented.

- In situations that are not described above, a person working on or within reach of live exposed apparatus shall be accompanied by a safety observer who is trained for the same class of work and has received appropriate first aid and rescue training at intervals not exceeding 12 months.

When working on or near de-energised lines and equipment, employees shall:

- Clearly identify and isolate the conductors to be worked on, including capacitor banks.
- Tag and lock where practicable, any isolation points.
- Identify the switching, isolation, disconnection and other precautions on an appropriate Access Authority.
- Treat all conductors as energised until proven de-energised, by an approved voltage tester that has been proven functional, and earth and/or bond all conductors in an approved manner.
- Avoid the risk of inadvertent contact with adjacent live conductors or electrical apparatus in the vicinity of the work site.
- Isolate and discharge as required, any capacitor bank in the circuit.
- Measures shall be taken to protect persons and apparatus from induction and/or inadvertent contact between new, not yet commissioned overhead conductors and existing live overhead line(s). This may include barriers, covers and earthing as appropriate.
- Where a newly constructed HV or LV UG circuit reaches the stage where it can be made alive by normal operating means, an appropriate Access Authority or clearance shall be raised to cover the circuit.

2. LOW VOLTAGE

8 most important steps

The following are the most important steps to ensure safety when working on live low voltage:

1	Make a safety assessment.	Ensure the job can be done safely alive. Plan your work – complete a JSA. Ensure that all necessary equipment is available. Complete the Safe to Climb test where necessary. Check the condition of your body belt/harness.
2	Arrange for a Safety Observer where required.	Use an observer who has received PTR, EWP escape and first aid training, and who has the skills and knowledge to undertake the task or work practice being observed.
3	Wear PPE.	Wear LV gloves, hard hat, issued overalls or work suit, safety glasses, and safety footwear.
4	Fasten your body belt/ harness.	As soon as you reach the head of the ladder or get into the EWP.
5	Ladder work.	Use an approved method to secure the ladder.
6	Tie handline with quick release knot.	Stow the handline in a temporary position (e.g. on step iron or arm brace). Shift the handline to the correct position (preferably above you), tying it with a quick release knot, leaving a tail (600mm minimum). Shift the handline as necessary during the course of the work.
7	Cover all conductors within reach.	Use mats or protective sleeving as required.
8	Check that you are not making a second point of contact.	Ensure you are not making a second point of contact by making a visual inspection. YOU MUST CHECK EVERY TIME: You change your working position. You work on a different conductor. You re-climb the pole (or ladder). You reposition the EWP.

Making LV dead

To prepare an LV line for de-energised work, employees shall:

- Identify the neutral.
- Establish the direction of supply.
- Where applicable isolate LV capacitors.
- Isolate all the conductors except the neutral.
- When using an LV hopper, ensure that during removal, the supply side of the hopper is disconnected first.
- Test that all conductors are de-energised.
- Prove the tester.
- Bond the conductors.
- Display warning signs.
- Issue EAP.
- Have an approved rescue device readily available at the worksite.

NOTE:

In-line breaks may be installed in midspan situations to create isolation points on a low voltage circuit. When selecting a position to install the break the following shall be considered:

- Installation must be a minimum of one secured span from the position of the intended work.
- They should be installed as close to the pole as possible to reduce conductor sway and sag.
- Approved insulating devices are to be used to create the in line break.

Paralleling low voltage circuits

Low Voltage lines are paralleled so that supply can be maintained to an area while work is in progress. It is usual to disconnect one of the sources of supply after the parallel is made.

When paralleling Low Voltage circuits employees shall:

- Identify both neutrals.
- Connect the neutrals together.
- Test for correct reading between an active of each circuit.
- Prove the tester on an active and neutral or two actives on the live circuit.
- Connect each pair of actives having no acceptable voltage difference.

NOTE: LV paralleling switches (isolators) may be closed with an operating stick without prior test.

Energising previously de-energised circuits

When energising previously de-energised circuits, employees shall first:

- Cancel any Access Authority on issue involving the circuit.
- Remove any earths/bonders.
- Remove any warning tags.
- Energise the circuit.
- Conduct NST, polarity and phase rotation tests where required.

3. HV LIVE LINE

General

- A visual inspection shall be conducted on the structure where work is to be performed and the structures on either side to identify potential hazards that might directly influence the safety of the work being performed.
- A tailgate session shall be held to identify any potential safety issues and to develop a job plan for implementation.
- Before commencing either Glove and Barrier or Live Line Hotstick work, appropriate devices shall be either enabled or suppressed to give the highest level of protection available.
- To enable additional materials to be raised to the work location a handline or suitable lifting device should be carried.
- Insulating Barriers shall be applied to all second points of contact within the work area. Two levels of insulation shall be applied to prevent phase to earth and/or phase to phase contact.
- Steel or metallic hoists shall not be used for high voltage live line work. Nylon webbing hoists shall only be used in conjunction with an approved insulating medium when straining from a conductive structure.
- Live line techniques shall be used at all times when working on electrical assets, unless those assets are isolated and proven dead (earthed) and covered by an appropriate Electrical Access Authority.
- The area directly below the immediate work area is considered the "Drop Zone". Where any conductor or live line equipment connected to live apparatus could become uncontrolled or drop into any sources of potential difference, then these sources shall be covered with insulating barriers.
- During all live line work, one member of the work team shall be appointed as the designated Safety Observer. The designated safety observer's role is to alert the work team to any potentially unsafe actions or lack of compliance with approved work practices, procedures or documentation. The safety observer shall be certificated for the type of work being observed.

- Before undertaking any live line task, a live line risk assessment shall be carried out. This risk assessment shall be a formalised and documented process. The risk assessment document shall contain a range of prompts to help the electrical worker consider a wide range of risk factors.
- Glove & Barrier work shall never be performed directly from a structure. Glove & Barrier work shall be performed from either an EWP fitted with a 50kV tested basket liner or from an approved insulated platform. The lineworker's belt / harness shall remain at the same potential as the lineworker, and prevented from contacting any component at a different potential to the lineworker.
- While Live Line work is in progress on a particular structure, no other work shall be performed on that structure or any adjoining structure. No Live High Voltage work can be conducted within an access permit area concurrently with any other line work, unless isolations are established and maintained through normal operating means and or live line techniques between the live structure / circuit and the access permit area.

Example: Where work is to be undertaken on a double circuit structure such as a 66kV pole with a 22kV subsidiary circuit and the top circuit conductors are under access permit while the subsidiary circuit remains alive, isolations between the two circuits are to be maintained using live line techniques. No other work parties are to be working on the circuit under access permit conditions at the same time unless an isolation is established on that circuit. (e.g. Bridges tied back or removed).

NOTE:
As the gap between an over/under crossing can be compromised, no live line work shall be carried out on the first adjacent poles of an over/under crossing where construction/maintenance work is being carried out concurrently.

- In line with relevant ESAA guidelines, auto-reclose equipment controlling a circuit on which live line work is to be performed shall be suppressed for the duration of the work unless specific and careful engineering and safety analysis indicates otherwise, and additional safeguards are considered to ensure that the work can be performed safely.
- Live line rules, practices, procedures, guidelines, insulated gear and equipment are all designed and intended to provide the primary safety protection for live line work. All persons working on live high

voltage lines must be aware of system protection capabilities and not under the false assumption that protection trip devices are failsafe in the event of an incident. System protection devices are used to provide additional safety aspects, however, depending on a range of factors, it should not be assumed that system protection devices will always operate to remove hazards, and may not operate in time frames to be of critical benefit.

- Adequate light must be available to perform Live Line tasks. This can be achieved by providing sufficient light so as to eliminate distractive shadows from the worksite.
- Conductive poles being lifted into live HV conductors shall be bonded to the lifting plant (prior to lifting) and the plant vehicle shall be earthed.
- Only hydraulic tools meeting the requirements contained in the ESV Live Line Minimum Rules document may be permitted to make contact with live apparatus. All live line persons undertaking tasks utilising hydraulic tools shall be instructed in these procedures.
- Any lineworker changing from glove and barrier method to stick method shall move outside the contact area, remove their insulating gloves and sleeves, and re-enter the work area observing the live line minimum approach distance appropriate for the live line stick method for the voltage concerned.
- The following combinations of live line Glove and Barrier and Stick methods are not permitted:
  - One lineworker carrying out stick work and one lineworker carrying out glove and barrier work from the same EWP.
  - One lineworker on a pole or structure carrying out Stick work and one lineworker on an Insulating platform carrying out Glove and Barrier work.
- Appropriate Live Line tools and equipment are essential for safe live line work. Any and all equipment used, created, manufactured for the purpose of live line work shall be designed, tested and approved specifically for live line work, capable of being safely used on energised high voltage conductors / apparatus.

Clearances & contact area

- 1 metre or closer to energised high voltage conductors is considered as the "Contact Area." Any body part or extension of the body (i.e. tools in the outstretched hand), which encroaches this dimension, is considered to be within the "Contact Area" and as such shall require Glove and Barrier techniques to be used.
- When persons are performing Glove and Barrier or Live Line Hotstick work from an EWP or approved insulated platform, all (LV and HV) conductors within 380mm of the basket or boom shall be covered when work is being performed, to prevent a second point of contact.

Live Lineworkers shall always observe the Minimum Approach Distances as outlined in the table below

LIVE LINE MINIMUM APPROACH DISTANCE (mm) up to 66kV			
Type of Work Plant	**Hot Stick**	**G&B**	
	22kV	**66kV**	**Up to 22kV**
Live Line Worker *(The use of covers should be considered when working to 380mm clearances for Hot Stick work up to 22kV)*	380mm	680mm	Contact wearing gloves & sleeves
Live Line EWP insulated section	380mm	680mm	Contact with covers
Live Line EWP & Mobile Plant non-insulated section *(to Un-covered conductors)*	1000mm	1000mm	1000mm
Live Line EWP & Mobile Plant non-insulated section *(to Covered conductors)*	380mm	680mm	380mm
Mobile Plant Load (i.e. Pole) *(Double insulated where the load is covered and the conductors are covered)*	380mm	680mm	380mm
Insulated Lifting Equipment *(to twice the voltage)*	Contact	Contact	Contact
Non-Insulated Lifting Equipment *(to Covered conductor)*	380mm	680mm	380mm
Non-Insulated Lifting Equipment *(to Uncovered conductor)*	380mm	680mm	1000mm
Phase to Phase distance *(Distance to be maintained between phases when moving conductors)*	450mm	900mm	450mm
Tool Insulation Distance *(Hand Sticks)*	450mm	900mm	450mm
EWP Basket Separation *(Utilising more than 1 EWP's working together)*	Where two EWP's are utilised for live line work, two phases may be worked on simultaneously provided that a minimum separation of 2 metres (air gap) is maintained between the baskets & booms of the EWP's is maintained at all times. No tools and/or equipment are to be passed between the EWP baskets while working in close proximity. Care shall be taken to ensure that the work of one person does not compromise the safety of another.		

Plant

- In all cases, plant and equipment such as EWP's, Cranes, Peru's, Task Trucks and any other plant items being used in close proximity to live HV conductors in connection with HV live line work shall be electrically connected to earth. This shall be achieved via a conductor from the vehicle chassis to a permanent or driven earth.

  NOTE: *The lowering of an earth chain is not an adequate means of earthing when undertaking HV Live Line work.*

- Plant items parked closer to each other than 6 metres shall be bonded together to a common earth system / electrode. If a 6 metre separation can be maintained between items of plant as well as the earth electrodes the items of plant should be separately earthed.

Plant that has control levers or remote controls that can be operated whilst standing on the ground shall not be used unless:

- The operator is standing on a mat that is electrically connected to the vehicle, or
- The operator shall be positioned on the vehicle, or
- The operator is 6 metres from the vehicle earth (in the case of remote controls) before operating any crane controls.
- The EWP should be slewed out of the Contact Area prior to raising or lowering materials.
- Only materials related to the immediate task being performed are permitted to be transported in the basket of the work platform.

Equipment

All live line rubber gloves, mats & hoses shall be inspected daily for:

- Pin holes, cuts, scratches, abrasions, ageing, corona cutting, or other mechanical damage.
- Rubber gloves shall be field air-tested before use to ensure their integrity as an insulating medium. If at any stage the electrical integrity is suspect the equipment shall be withdrawn for retesting or discarded.

- Only approved clothing shall be worn. All personal protective equipment shall be utilised including hard hat, eye protection and ear protection when required.
- All live line insulating equipment shall be electrically tested on a regular basis (as per table below) or where the integrity of such insulation is suspect.

PERSONAL EQUIPMENT	TEST INTERVALS
Insulating Gloves & Sleeves	6 months
Insulating blankets	12 months
Insulating line hoses, connectors covers	12 months
Conductor support equipment, insulating platforms & temporary dropout tools	12 months
Insulated jumpers	12 months
PLANT EQUIPMENT	**TEST INTERVALS**
Insulated EWP's	6 months
Insulated EWP basket liner	6 months
Insulated hoses	6 months

Conductors

- Conductors must be restrained in proper equipment designed for such use.
- Conductors shall only be placed or rested upon the work platform after an appropriate weight assessment has been conducted, and at no stage shall the safe working load of the work platform be exceeded.
- Only one conductor shall be placed on the basket at any time. Two forms of insulation shall be maintained at all times.

Weather

- Live line work should not be performed in unsuitable wet, windy and stormy weather conditions. Prior to commencing any Live Line task weather conditions for the day shall be considered. Weather conditions for the day may be unsuitable because of:

a. Electrical storm

b. Rain, fog, snow, mist, or sleet

c. Excessive wind velocity

d. Excessive heat

e. Excessive humidity

- If Live Line work is in progress and the weather conditions deteriorate to a point where it becomes unsafe to continue, the Live Line work shall be suspended. Where temperatures rise above a comfortable level the risk of heat stress and fatigue increases and as such Glove & Barrier work should be suspended.

Washing insulators on HV lines and equipment

- Employees required to wash HV insulators shall be trained and authorised to carry out this type of work.
- Only approved washing equipment shall be used and the equipment shall be used in accordance with approved procedures.
- Washing procedures shall include precautions which protect the worker from exposure to unsafe leakage currents and prevent insulator flashover.
- Water purity, water pressure, nozzle size and minimum permissible washing distance are related and shall be observed as specified in the procedure.
- The procedure shall also include independent precautions to protect the worker from exposure to unsafe leakage currents. Depending on the procedure, this may require working from an insulated platform, maintaining an earth on the nozzle of the washing gun or using an insulated washing gun.
- Water purity tests shall be made on the water supply daily when live washing and each time the water storage tank is refilled, regardless of whether the equipment is to be used for energised washing or not, water shall have a resistivity value of 2.5kΩcm or more.
- A pressure gauge shall be located at the pump of the washing equipment to indicate the water pressure. At no time shall this pressure exceed the manufacturers recommended ratings. Labels shall be provided on each unit specifying this rating.

- The insulator washing equipment shall be provided with hoses rated to withstand the maximum water pressure that the equipment is capable of producing at the pump.
- The washing gun shall be a pressure type, equipped with a spring-loaded trigger or other type of device, which will automatically shut off when released. The nozzle size shall be as specified in the approved washing procedure.
- All components of the insulator washing equipment shall be thoroughly inspected prior to each use. All hose connections, including the nozzle, shall be checked to ensure that they are securely fastened. Work shall not proceed until defects are corrected.
- The insulator washing trailer shall be earthed according to company specific procedures.
- The nozzle of an uninsulated washing gun should be bonded to the surface on which the operator stands to ensure that they remain at the same potential.
- Inspect insulators prior to washing. Generally, damaged, sparking or excessively noisy insulators should not be washed alive. In the case of transmission insulators, a small number of cracked or broken discs may be permissible subject to procedures.
- The water stream shall be at full pressure before being brought into contact with insulators and moved clear before being reduced.
- Dirty insulators may flashover if wetting is not controlled. The insulators should be washed in sections, ensuring that each section is clean before progressing to the next. Avoid wetting adjacent sections until the section being washed is clean.
- For pin and post type insulators, start from the base and work up. For suspension and strain construction, commence at the disc insulator closest to the conductor.
- High pressure washing is not permitted on certain equipment such as circuit breaker and oil switches due to the risk of water entry into the equipment.
- Polymeric insulators should not be washed with high pressure equipment.

Single person tasks

- All live line lineworkers undertaking single person aloft tasks shall be suitably instructed and authorised for this type of work.
- A single person aloft cannot perform any task that involves moving or displacing a conductor, or installation / removal of a hopper.

Allowable tasks by a single person aloft are as follows:

a. Install / Remove fault detection and recording equipment

b. Install / Remove insulating barriers / covers

c. Install / Remove vibration protection

d. Install / Remove bird covers

e. Install / Remove "D" loops (off load only / no circuit connection)

f. Install / Remove spreader ropes

g. Replacement of insulator ties (pre-form ties not allowed)

h. TVI rectification (limited to lubrication)

i. Tighten hardware (crossarms and insulators)

j. HV crossarm inspection

4. POLES, TOWERS AND STRUCTURES

General

When working on poles, towers or other structures, employees shall:

- Be suitably trained and authorised.
- Ensure poles, towers and structures are sound prior to commencing work.
- Inspect all assets to ensure that they are safe prior to climbing.
- As required, secure all structures to ensure employee and public safety.
- Report any asset, which could present an immediate danger.
- Raise or lower lightweight equipment and tools by means of a handline and canvas polebag, or other suitable container. Care should be taken by employees working overhead to prevent tools or material from falling.
- Avoid shock or out of balance loads on structures during work and install temporary stays when necessary.
- NOT rely upon cross-arm braces or other pole attachments to support an employee's weight.
- Wear an approved pole belt/harness.
- Use non-conductive taglines and handlines near energised lines and equipment.
- Not withstanding the fact that the electrical apparatus has been disconnected from all sources of supply, due regard shall be given to the possibility of inadvertent energisation from adjacent electrical apparatus, induction, lightning, static charges, or other means.
- When erecting poles, consideration shall be given to the weight of the pole which can vary for both wood, steel and concrete poles due to moisture content, age, type of wood, steel gauge and in the case of concrete poles the manufacturer. (See Table 1. Wood & Concrete Pole Data page 21).
- When erecting poles, the appropriate hole depth shall be achieved. (See Table 1. Wood & Concrete Pole Data on page 21).

Safe to climb test for poles

1	Conduct Visual Inspection	Look for: • Condemned pole markings • Disc height (1.5m above ground level)[1] • Rotting • Splitting • Termites • Rust stains, cracks and bulges on concrete poles • Crossarm, insulator and tie damage • Excessive leaning • Damage by vehicles [1] See page 22 for pole disc information
2	Conduct Push Test	**Where a pole has fittings to push against.** • Extend a ladder hard against a bracket, step iron or arm brace. Do not push against stays or a line of conductors other than slack services. See Figure 1 • Position ladder as high as possible on the pole. This will ensure that the maximum amount of stress is placed on the pole, especially at the butt, which is most important when testing for rot. • Ensure that all persons and vehicles are in safe positions, including the public. • Two persons push on the ladder, first gently and progressively increase the force. The ladder must be lifted clear of the ground to make an effective test. **Where a pole has no fittings to push against.** • Erect ladder fitted with 12mm handline as shown in Fig. 2. • Tie handline off to base of pole. • Test pole by pushing on ladder.
3	Discontinue Test	Immediately the pole shows signs of failure OR After the pole withstands the full force and proves to be sound

Make poles safe

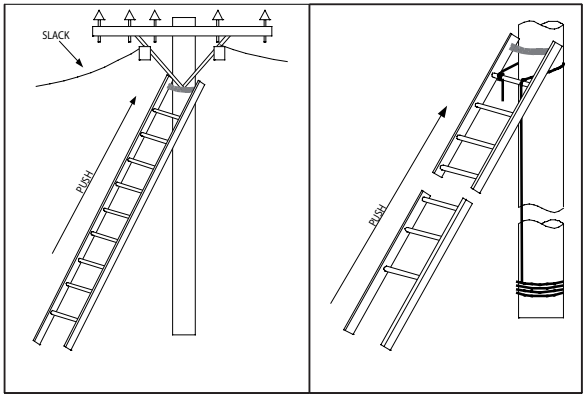


Figure 1 ***Figure 2***

4	Make Safe	Where a pole fails the Safe to Climb Test it must be made safe. **Secure the butt:** a) Drive 3 ground pins around the pole as shown in Figure 3. b) Lash pins and pole securely with 12mm rope c) Lash to an adjacent pole, (300mm maximum spacing) d) Lash to PERU if close enough **Support the pole:** a) With the PERU, keeping the winch rope high for maximum support, or; b) With 4 x 16mm rope stays. Push stays up with HV operating stick or set 4 temporary pikes to support the pole and fit stays from ladder. Tie to ground pins set at 90° apart.

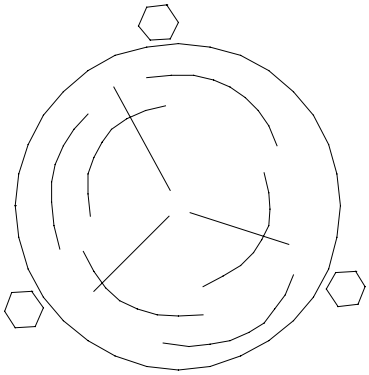


Figure 3

Pole weights & hole depths

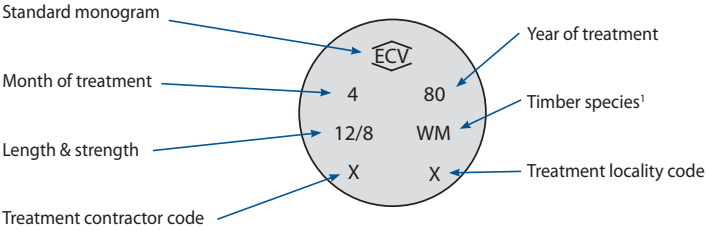
TABLE 1

Wood Poles	Approx. Weight (kg)	Depth (mts)
11/5	500 – 900	2.1
11/8	700 – 850	2.1
11/12	800 – 1600	2.1
12/5	600 – 750	2.2
12/8	800 – 950	2.2
12/12	1000 – 1200	2.2
12.5/5	850 – 1100	2.3
12.5/8	850 – 1100	2.3
12.5/12	1100 – 1200	2.3
13/5	800 – 1100	2.3
13/8	1000 – 1200	2.3
13/12	1200 – 1700	2.3
14/8	1100 – 1400	2.4
14/12	1200 – 2000	2.4
15.5/12	1400 – 1650	2.5
17/12	1700 – 1900	2.5
18/12	1800 – 2100	2.6
18.5/12	1800 – 2150	2.6
20/12	2100 – 2400	2.7

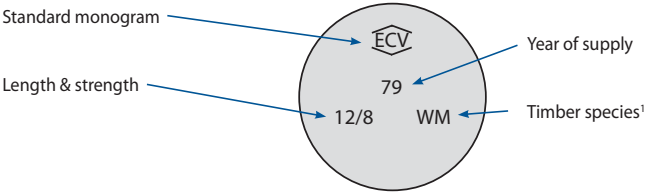
Concrete Poles	Approx. Weight (kg)	Depth (mts)
13/3	1400 – 1550	2.3
11/8	1500 – 1650	2.1
11/12	1900 – 2000	2.1
12/8	1750 – 1950	2.2
12/12	2100 – 2300	2.2
12.5/8	2200 – 2400 (Sub)	2.3
12.5/12	2250 – 2450	2.3
13/8	2000 – 2200	2.3
13/12	2300 – 2500	2.3
14/8	2200 – 2400	2.4
14/12	2600 – 2800	2.4
15.5/12	3100 – 3250	2.5
17/12	3300 – 3800	2.5
18/12	3500 – 4000	2.6

Pole identification discs

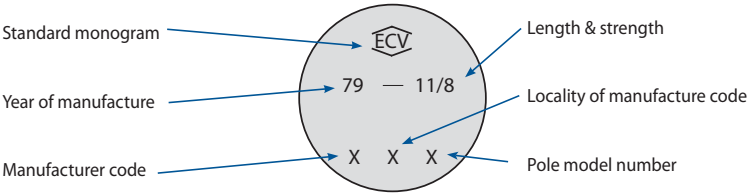
PRESSURE TREATED POLES



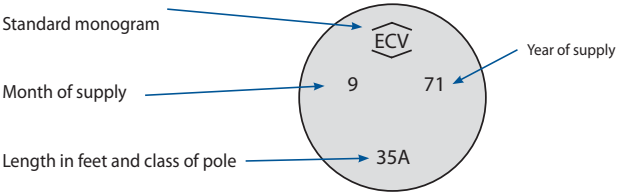
NON-PRESSURE TREATED POLES



SPUN CONCRETE POLES



EARLY IMPREIAL POLES



[1] See timber species codes listed on page 23.

Timber species commonly used for poles in Victoria

Class 1 (Mainly dressed but some natural round poles are used)		**Class 2** (Mainly natural round but some dressed poles are used)		**Class 3** (Mainly creosote but some CCA treated poles are used)	
Species	Code	Species	Code	Species	Code
Grey Box	GB	Blackbutt	B (Also BB)	Messmate	MS (Also MM)
Grey Gum	GG	Spotted Gum	SG	Silvertop Ash	MT (Also GG)
Grey Ironbark	GI	White Stringy-bark	WS (Also WSB)	Mountain Grey Gum	CG
Red Bloodwood	RW	Yellow Stringy-bark	YS (Also YSB)		
Red Ironbark	RI				
Tallowwood	TW			Radiata Pine *(Class 4)*	PR
White Mahogany	WM				
White Topped Box	QB				

Periods of use

Pre 1947	Metro – dressed Class 1 timbers. Other – mixture of dressed and natural round Class 1 & 2
1947 > 1956/57	Mainly natural round Class 2 (WS and YS) but some dressed Class 1 & 2
1956 > 1971	Wholly Class 3 timbers, creosote pressure treated. **NOTE**: In this period, the Mountain Grey Gum poles were identified GG, but they should not be confused with the highly durable Grey Gum which had been bought in the dressed condition and also in smaller numbers from 1972 to 1983 for pressure treatment. Gippsland region continued to use untreated white and yellow stringy-bark throughout this period and right up to 1976.
1972 > 1983	Creosote pressure treatment continued in this period. Poles treated were mainly Class 3 and some Class 1 & 2. Mountain Grey Gum were properly identified MT from the introduction of metric poles
Mid 1983	Dressed Class 1 poles only
1996	CCA treated poles introduced across Victoria

Multiple circuits

When working on structures with multiple circuits, ensure that:

- All personnel can identify the correct circuit to be worked on.
- Limits of approach are observed/maintained.
- Safety Observers are appointed as required.
- When relocating to another work position, reconfirm the circuit to be worked on each time.
- As part of the on site risk assessment, the work crew shall establish appropriate methods of communicating which circuit is to be worked on and of the intended method of action.
- When working on conductive structures with a circuit under Access Authority, cross-arms and conductors shall be bonded together by standard earthing techniques.

When undertaking work on 'dead' circuits with other circuits alive, (multiple circuits), employees shall adhere to the following access procedure.		
1	Identify the circuits to be worked on.	Assemble the work party at the foot of the structure and identify the circuit/s to be worked on.
2	Climb under continuous observation. (One person only).	Appoint an observer. Climb and STOP before getting within reach of the lowest HV conductor.
3	Use approved signals.	Indicate the conductors to be worked on by pointing across the body.
4	Obey signalled instructions.	Watch the observer who will: a) Signal 'all clear' in response to correct indication; or b) Signal 'recall' in response to incorrect indication.[1] After receiving 'all clear' continue to working position. Stop and again indicate the conductors to be worked on. [1] If an incorrect indication is made, the person climbing must return to the ground and recommence the procedure.
5	Do not touch the conductor/s until the second 'all clear' is received.	Watch the observer who will: a) Signal 'all clear' in response to correct indication; or b) Signal 'recall' in response to incorrect indication.

6	Climb in turn. (Other persons).	The person now established in their working position will act as safety observer. Each person climbing will then follow the procedure already described.
7	Follow the procedure every time.	Each employee must follow this procedure every time the structure is climbed. Be particularly alert when, after climbing a series of poles from one side (i.e. the road or line side), you climb the next pole from the opposite side. This reverses the relative positions of the live and dead conductors. See Figure 4.

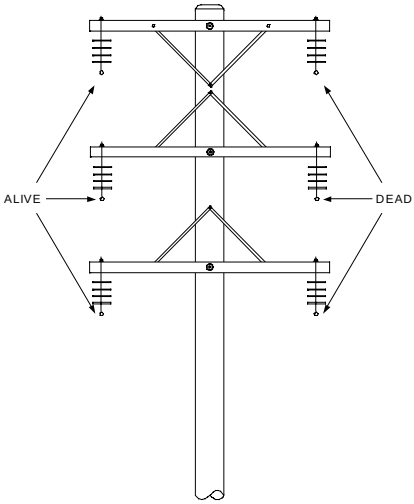


Figure 4

NOTE: The dead conductors illustrated on the right would be on the left of a person climbing from the far side.

8	Prevent all possibility of accidental contact.	Avoid moving a dead conductor in any way likely to cause contact with live conductors. Be aware of under and over-crossings as well as conductors attached to the same pole.

Pole type junction boxes

Pole Junction boxes are used to house the connection of cables. They contain no protective element such as a fuse and are generally located on poles where they are used as a junction point between bridging cables connected to LV mains and one or more service cables feeding a customers premises.

There are two different types of junction boxes:

'J' Type Junction Boxes

- This type of junction box consists of three terminal blocks contained in a one piece porcelain insulation housing. The porcelain has been found to crack or break easily when disturbed and due to the size of the box has minimal clearances.
- When working near to these junction boxes avoid disturbance to the leads and services to the box and wear full protective apparel, including safety glasses.
- Work on J type junction boxes **SHALL** be carried out under de-energised conditions only.

Isolating Type Junction Boxes

- This type of junction box is an isolating type, they are designed so that the services connected in the junction box can be easily isolated from the LV mains.
- The isolation is achieved by the disconnection of the bridging conductors from their terminals, which are then held in a disconnected position by means of nylon screws.

5. CONDUCTORS & STAYS

Conductor stringing

When stringing conductors, employees shall:

- Ensure conductors are kept under positive control by the use of adequate tension reels, guard structures, tie lines or other means.
- Ensure conductor pulling and tensioning lines, reels, load bearing hardware and other equipment are of adequate capacity, are periodically inspected for defects, and are operated in accordance with the manufacturer's instructions.
- Ensure overhead lines (other than insulated low voltage service lines) being erected, dismantled, or replaced, where there is any possibility of contact with, or induction from, adjacent live conductors, are earthed before work commences. They shall remain earthed until the work is completed.
- NOT position themselves on cross-arms while a conductor or pulling line is being moved by truck or stringing equipment.
- NOT position themselves inside the angle.

Conductor bridging

When carrying out LV conductor bridging, employees shall:

- Identify and tag neutrals.
- Confirm phasing and voltage prior to and after bridging.
- Establish direction of supply.
- Use approved hoppers to make or break load.
- Apply and remove hoppers using the line/load, load/line method.
- Clean conductors and apply jointing compound as appropriate.
- Use appropriate cover up and PPE.
- When connecting bridges, confirm that the hopper is correctly connected by conducting a "splash" test.
- Avoid contact between Line and Load conductors.

Conductor ties

Intermediate Tie

For intermediate and angles of deviation up to 3 degrees.

1. Halve the tie. Place centre at start point, (see Figure 5). Take 1½ turns around insulator, passing each tie end under the conductor
2. Make 3 turns around the conductor.
3. Pass ends of tie around insulator and under the conductor on the opposite side.
4. Make 8 turns.
5. Make 1 open turn, (approximately 20mm).
6. Make 5 turns.
7. Make 1 open turn.
8. Make 3 turns.
9. Cut off surplus tie wire.

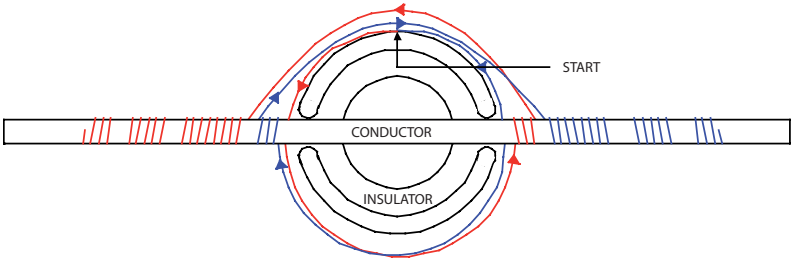


Figure 5

Angle Tie

For angles of deviation greater than 3 degrees.

1. Halve the tie. Place centre at start point, (see Figure 6). Bring ends of tie around insulator and under conductor on each side.
2. Make 2½ turns around the conductor.
3. Pass ends of tie around the back of the insulator and under the conductor.

4. Make 2 turns around the conductor.
5. Pass ends across the front of the insulator and under conductor.
6. Make 4 turns around the conductor.
7. Make 1 open turn, (Approx. 20mm).
8. Make 5 turns around the conductor.
9. Make one open turn.
10. Make 3 turns around the conductor.
11. Cut off surplus tie wire.

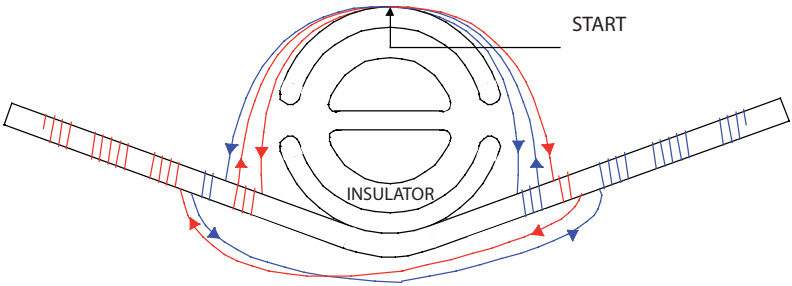


Figure 6

Fallen conductors

When dealing with fallen conductors, employees shall:

- Treat all conductors as alive until proven dead.
- Construct/erect visual warnings such as signs, flashing lights, barriers, ropes, etc.
- Issue verbal warnings to those present that the area is unsafe to approach.
- Where possible maintain a 6 metre clearance distance.
- Issue an appropriate Access Authority prior to handling.
- Notify emergency services as required to provide site security or assistance.

Conductor weight and tension

It is important to maintain an awareness of the weight of and tension in conductors to avoid shock and out of balance loads or overloading of equipment.

Conductor Tension - the following formula can be used to determine conductor tension where the supports are on similar levels. Reference should be made to Table 2 on page 33 for conductor weights.

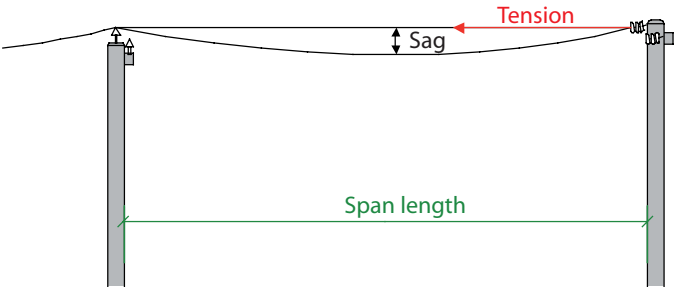
$$T = \frac{W \times S^2}{8 \times Sag} \text{ kg (for spans up to 300m)}$$

Where:

T = Tension in kg's

W = Weight of conductors per metre

S = Span length



SAMPLE CALCULATION

The following calculation determines the tension of a single conductor in a 60m span of 19/3.25 having a sag of 1.25m. The weight of the conductor is 0.433 kg/m

$$T = \frac{0.433 \times 602}{8 \times 1.25}$$

$$T = \frac{0.433 \times 3600}{10}$$

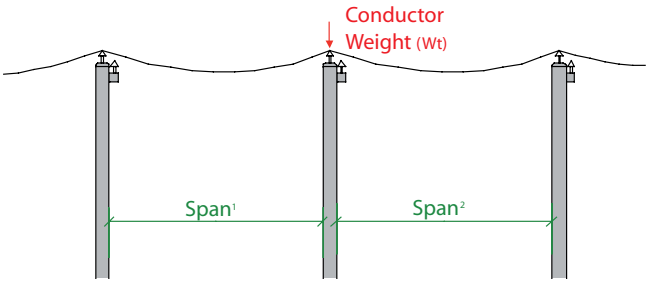
$$T = \frac{1558.8}{10}$$

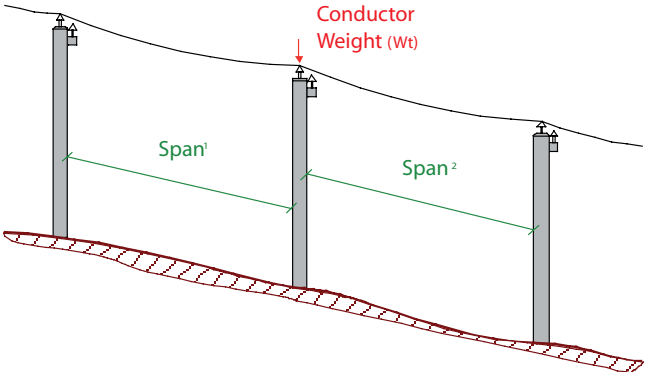
155.88kg or rounded to 156kg

Conductor Weight

The following formula can be used to determine conductor weight at a point as indicated in the diagrams below.

$$Wt = W \times \left(\frac{Span^{1} + Span^{2}}{2} \right)$$





SAMPLE CALCULATION

The following calculation determines the weight of a single 7/4.75 conductor in a situation where Span 1 = 80m and Span 2 = 70m.

$$Wt = W \left(\frac{Span\ 1 + Span\ 2}{2} \right)$$

$$Wt = .340 \left(\frac{80 + 70}{2} \right)$$

$$Wt = .340 \left(\frac{150}{2} \right)$$

$$Wt = .340 \times 75$$

$$Wt = 25.5\ kg$$

TABLE 2

Conductor[1]		
Type	**Stranding & Wire diameter mm**	**Linear Mass (kg/m)**
AAC	7/2.50	0.094
	7/3.00	0.135
	7/3.75	0.212
	7/4.75	0.340
	19/3.25	0.433
	19/3.75	0.578
	19/4.75	0.926
	37/3.75	1.130
ACSR	3/4/2.5	0.193
	6/1/2.5	0.119
	6/1/3.0	0.171
	6/1/3.75	0.268
	6/4.75, 7/1.60	0.404
GALV. STEEL	3/2.75	0.118
	7/2.00	0.177
	7/2.75	0.326
	19/2.00	0.483
	19/2.75	0.888
Cu	7/1.63 (7/.064)	0.130
	7/2.03 (7/.080)	0.204
	7/2.64 (7/1.04)	0.344
	19/2.11 (19/.083)	0.599
	19/2.57 (19/1.01)	0.887
CdCu	7/1.63 (7/.064)	0.130
	7/1.85 (7/.073)	0.171
	7/2.36 (7/.093	0.277
	7/2.87 (7/.113)	0.409
	19/2.26 (19/.089)	0.691
LVABC	2 X 25	0.20
	3 X 25	0.30
	4 X 25	0.40
	4 X 35	0.52
	4 X 95	1.35
	4 X 150	2.02

[1] Reference: ECV Drawing # VX9/7020/30 K

Aerial supervisory cable

The general function of Aerial Supervisory Cable is to protect and operate zone substations.

Aerial Supervisory Cable when running in parallel with overhead conductors is subject to induced voltages, which may be as high as 25kV as a result of a fault situation. The catenary wire is subject to the same induced voltage but as it is connected to earth at each sectionalising box the magnitude of this voltage would be expected to be less but still of sufficient magnitude to be treated with caution.

When working on poles supporting Aerial Supervisory Cable the following precautions shall be taken:

Wood poles dead work

When working on/near dead LV conductors and simultaneous contact can be made between those conductors and the catenary wire, either the catenary or the appropriate conductor shall be covered using LV mats or sleeving.

Wood poles live work

When working on/near live LV conductors within reach of supervisory cable, the exposed catenary shall be covered as well as all other conductors within reach to avoid a second point of contact.

Concrete poles dead work

If simultaneous contact can be made between the bare catenary wire and any dead conductor or the concrete pole, the catenary wire shall be bonded to the concrete pole. LV gloves shall be worn when making the bonder connection and the bonder must be removed at the completion of works.

Concrete poles live work

As for wood poles. Where work is undertaken on the catenary wire itself, the catenary shall be bonded to the concrete pole.

Disconnection of catenary from permanent earth

Any work involving the disconnection of catenary from the permanent earth at sectionalising poles, must not proceed until the catenary is earthed by means of temporary earths applied to both sides of the sectionalising pole.

Electrolysis cables

Traction electrolysis cables (also known as drainage bonds) are erected on distribution poles to enable underground metal structures such as water mains to be bonded to the rails of the electric Rail and Tram traction systems. By this they provide a return circuit for stray DC leakage currents produced by the traction systems, thereby reducing electrolytic corrosion of the underground structures.

The bond or connection is made in a pole mounted control box by either of two methods:

a. a diode which allows DC current to flow in only one direction from the underground asset to the rails or;

b. an electrical contactor that closes automatically when the DC voltage polarity between the rails and the underground asset is such that current would flow from the underground asset to the rails. These installations require an un-metered LV supply to the electrolysis equipment box and are quite rare.

Work on electrolysis cables

It is important that electrolysis cables are not earthed at any point other than the bonding point in the control box and therefore must not be earthed at the worksite unless the cable is isolated with the proper approval of the Rail or Tram Authority.

Although most electrolysis cables are insulated in the vicinity of each pole or structure to which they are attached, all such cables must be treated as live LV conductors. If work is to be carried out on live LV conductors adjacent to the electrolysis cable; an adequate number of LV mats must be applied to the cable on all poles on which work is to be carried out.

When working on electrolysis cables for the purpose of changing poles, if an electrolysis cable is not broken and earthed, it must be treated as "Live LV" and appropriate gloves and mats shall be used.

Continuity of electrolysis cable NOT BROKEN

Where the work being carried out is such that the continuity of electrolysis cables will not be broken, or the electrolysis cable will not contact or be contacted by any earthed apparatus (including the ground and other earthed conductors), isolation of the electrolysis cable is not necessary.

Continuity of electrolysis cable BROKEN

Where the work being carried out is such that the continuity of electrolysis cables be broken, and/or the electrolysis cables will be, or are likely to be earthed by contact with other earthed apparatus or conductors, the electrolysis cables must be isolated at the work site as follows:

a. Isolation of electrolysis cable must be preceded by notification to the relevant Rail or Tram authority who will advise the applicant whether it is in order to isolate the cable at the requested time.

b. Network Control and the relevant authority will co-ordinate the switching sequence.

c. Work party to ascertain whether the electrolysis box/es has an LV supply and where applicable isolate supply.

d. Apply LV hoppers across the suitable cable bridges on both sides of the work site. Open bridges and remove hoppers.

e. Apply earths or bond electrolysis cable to other earthed conductors.

Restoration

a. Remove earths or bonders from electrolysis cable.

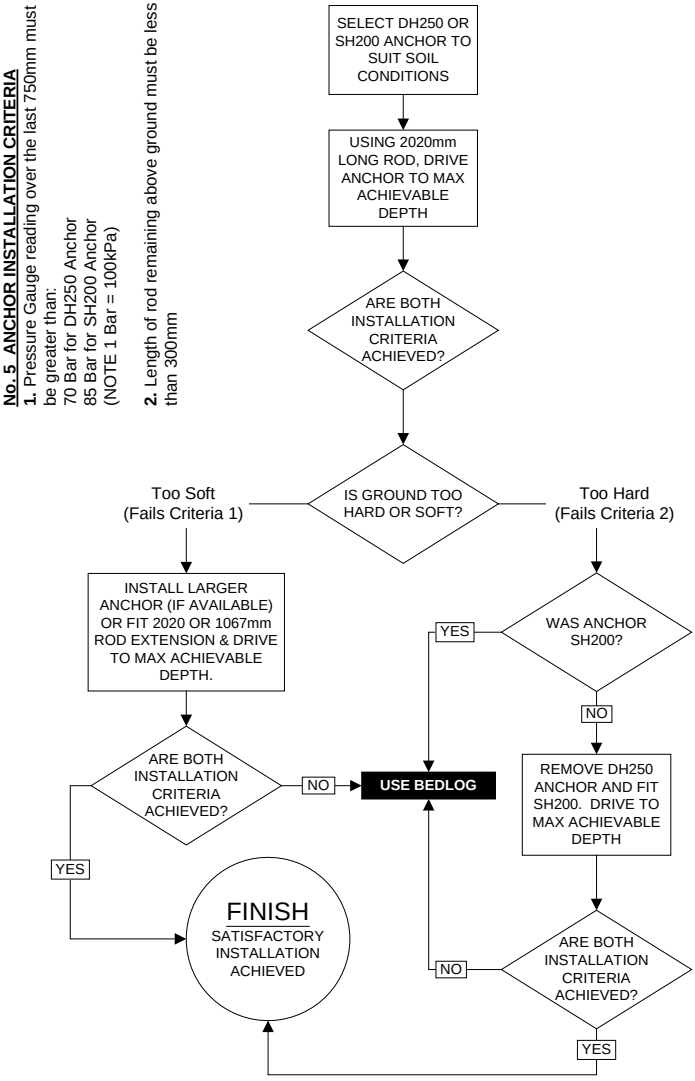
b. Apply LV hoppers across the electrolysis cable bridges on both sides of the work site. Close bridges and remove hoppers.

c. Restore LV supply where applicable.

d. Notify Network Control that electrolysis cable is restored.

Screw in anchors

Process Flow for No. 5 Screw in Anchor

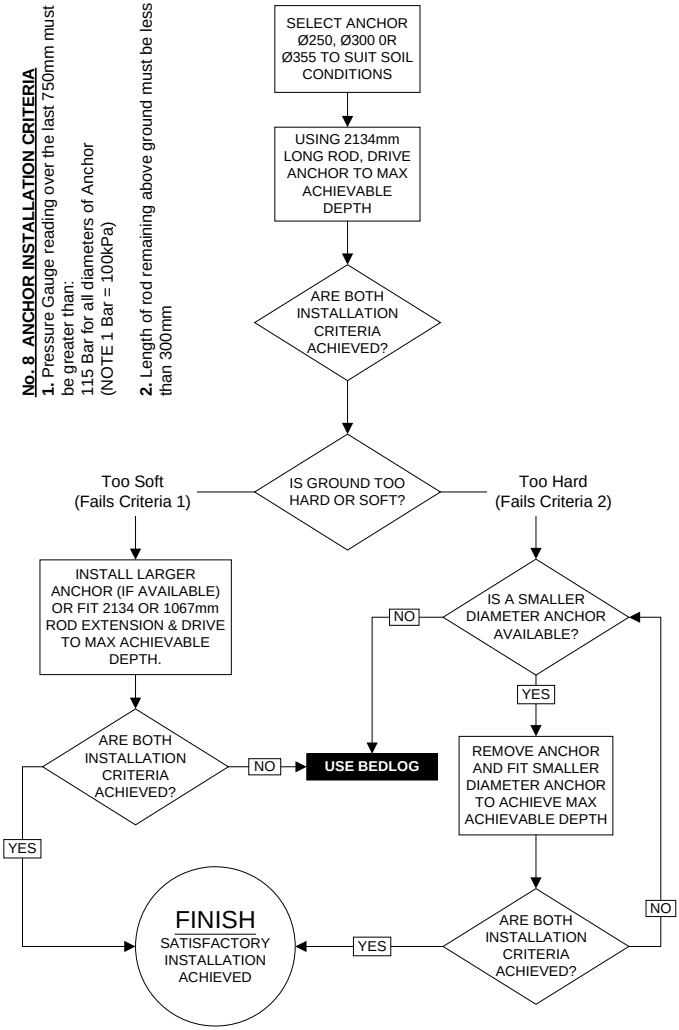


Process Flow for No. 8 Screw in Anchor

No. 8 ANCHOR INSTALLATION CRITERIA

1. Pressure Gauge reading over the last 750mm must be greater than:
115 Bar for all diameters of Anchor
(NOTE 1 Bar = 100kPa)

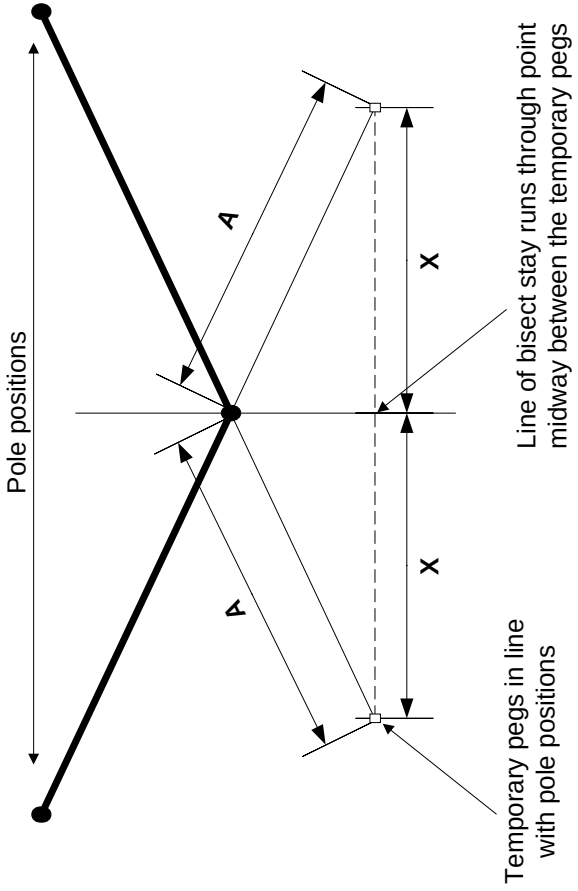
2. Length of rod remaining above ground must be less than 300mm



Stay holes

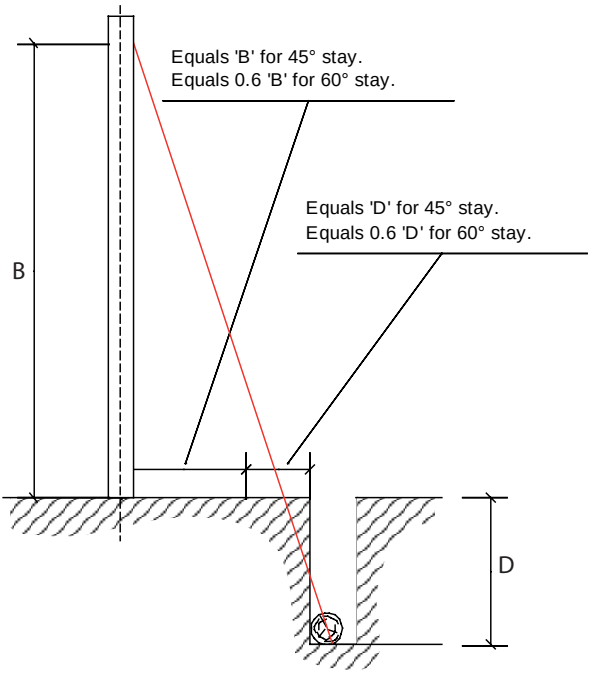
Determining the Stay line

Sight through line of poles for in-line stays or plot for bisect stays where A = A and X = X.



Calculating the Stay Hole Position

Plot distance of stay hole from pole.



6. PUBLIC LIGHTING

When working on public lighting, employees shall:

- Be appropriately trained and authorised for the purpose of the work.
- Treat lanterns, brackets, stays and hauling wires as alive at all times.
- Cover all conductors and fittings within reach that are not being worked upon.
- Only handle a hauling wire if standing upon an approved insulating medium (e.g. line workers mat).
- Test all lantern brackets and hauling wires to earth with an approved tester before commencing work, unless changing tubes or lamps from an approved and tested EWP.
- Disconnect the supply to a public light when the lantern bracket or hauling wire is found to be alive. The fault shall immediately be rectified or reported.
- Ensure unauthorised persons remain at least 2 metres from brackets and do not touch hauling wires or cable television systems.
- Ensure the safe disposal of mercury and sodium vapour lamps.
- Ensure the safe disposal of components containing either asbestos or PCB's.

Prior to the use of photoelectric (PE) cells, public lighting systems were controlled by a system known as the 'Cascade Control System' or more simply as the 'Switchwire' system. Street lights were connected to the switchwire and neutral and in effect the system used a series of contactors to energise the switchwire at each distribution substation.

The switchwire system is now obsolete and is being progressively removed from service, however in some parts of Victoria they are still functioning. Figure 7 shows the wiring arrangements for the Master PE Control Switch & Contactor Box, Figure 8 shows the wiring arrangements for a Contactor box and Figure 9 shows a schematic representation of the Cascade system.

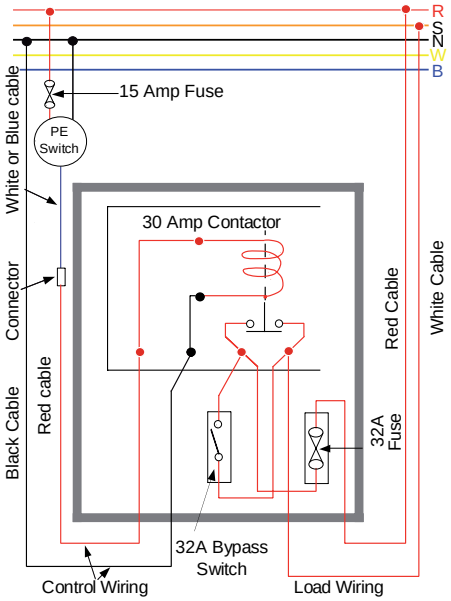


Figure 7

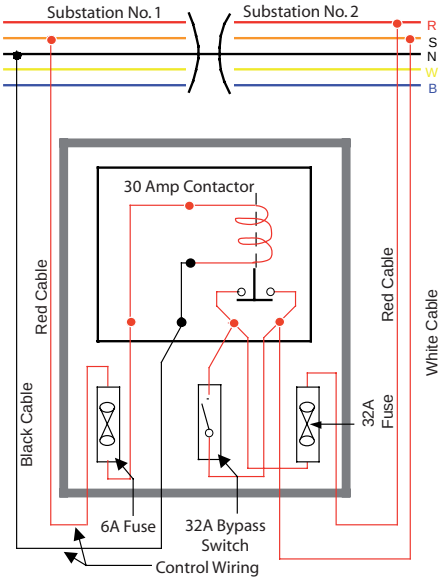


Figure 8

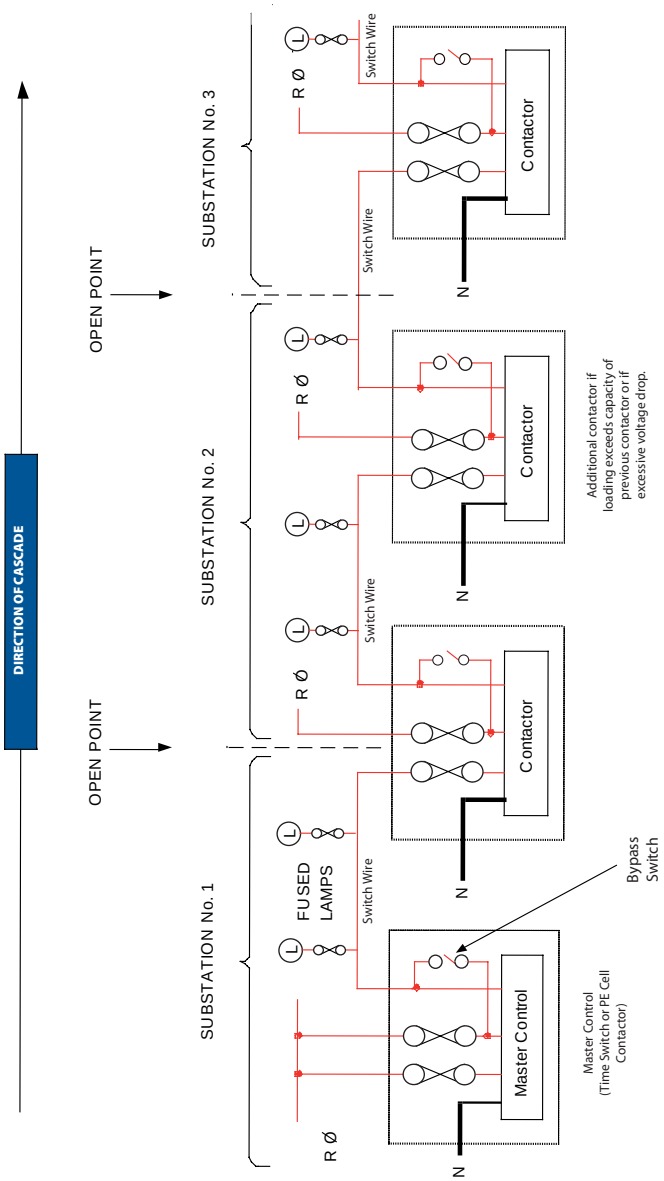

DIRECTION OF CASCADE
OPEN POINT
OPEN POINT
SUBSTATION No. 1
SUBSTATION No. 2
SUBSTATION No. 3
FUSED LAMPS
Switch Wire
Switch Wire
Switch Wire
R Ø
R Ø
R Ø
N
N
N
Master Control
Contactor
Contactor
Contactor
Master Control (Time Switch or PE Cell Contactor)
Bypass Switch
Additional contactor if loading exceeds capacity of previous contactor or if excessive voltage drop.

Figure 9

7. TREE TRIMMING

Generally, vegetation management is to be undertaken by approved specialists. The information below relates to required tree trimming under fault conditions:

- When trimming trees, the appropriate worksite traffic management is to be employed for protection of the public and the work group.
- Only authorised live line persons are permitted to clear tree limbs overhanging live high voltage conductors.
- When using chainsaws or brushcutters, the operator is to consider the hazards associated with its use, including environmental (weather, terrain, light, etc.) and electrical conditions, and the proximity of other persons. Such considerations should be noted on the job site assessment.
- Appropriate PPE shall be worn at all times.
- Instructed or authorised persons may clear tree limbs overhanging live low voltage conductors provided the movement of limbs being cut can be controlled.

8. OPTICAL FIBRE CABLE

With the introduction of Optical Fibre Cables, (OFC) in the Telecommunication networks it is important to understand the risks involved with working with and handling OFC.

OFC is used to transmit communications and video signals over long distances with very little loss of signal. These signals are pulses of high frequency light.

OFC is generally a round black, grey or blue polyethylene covered cable with multiple bundles of fine glass fibres in the core of the cable. OFC can consist of 12, 24, 36 and 60 fibre strands.

Self supporting cable has an outer Aramid yarn layer covered by a second polyethylene sheath for self supporting strength.

See Figure 10 next page.

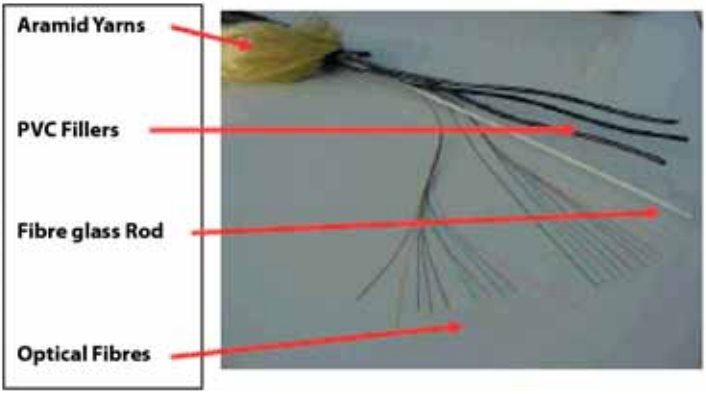


Figure 10

Hazards

Glass Fibre Hazard

If the glass fibres are exposed there is the risk of tiny fragments of glass causing a severe injury. This could occur with a new cable or with a damaged cable that has been in service. Broken fragments could penetrate the skin or inadvertently come in contact with your eyes causing a serious injury.

Always wear gloves & safety glasses when working with OFC!

Laser Light Hazard

The fibres carry pulses of light generated by a laser. This light is invisible to the human eye and can cause damage to the eye if looked into.

Do not look into the fibres at the end of OFC as severe damage to the eyes can occur!

Working with optic fibre cable

Handling OFC

When working with Fibre Optic cable care must be taken to prevent damage to the fibres as OFC repairs are time consuming and very costly.

The fibres may be damaged by:

- Bending the cable past its minimum bending radius.
- Crush damage if the cable is strained incorrectly.
- Crush damage if cable is driven over.
- Pinch damage if weight is placed unevenly on the cable.

Bending Radius

Care must be taken not to exceed the minimum bending radius. The minimum bending radius of the cable will be specified by the manufacturer. This is measured as shown in Figure 11.

A simple template can be made to indicate the bending radius of the cable to indicate if the bend is too tight.

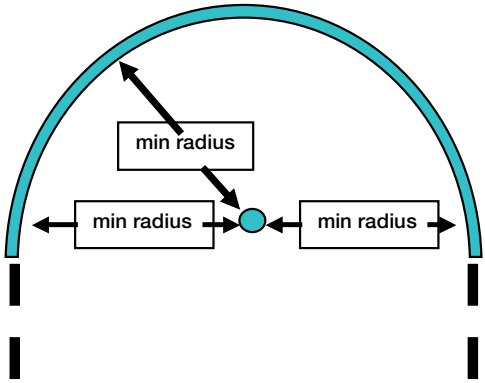


Figure 11

Straining Optic Fibre Cable

When straining cable the only acceptable method is to use a helical termination placed over structural rods.

Crescent clamps, comealongs or rope snodders are not to be used in any instance, as these will crush the cable causing severe internal damage to the fibres.

Pulling OFC cable away from poles

When it is required to pull the OFC away from a pole, ie during a pole changeover; tie the rope over a structural rod as this will prevent pinch damage to the cable.

Temporary support of OFC at adjacent poles

When handling OFC, shock loading must be avoided as this can result in pinching and/or breaking of the optic fibres at the adjacent support structure clamps.

It may be necessary to support the cable at these adjacent structures to ensure no damage occurs. Do this by securing the cable with a temporary termination wrap-on (over the top of a structure rod) at the adjacent poles. This will spread the load over the cable and remove the tension at the support clamp.

Maintenance

Damage prevention - Intermediate Pole Changes

- Secure the cable with temporary termination wrap-ons (over the top of a structure rod) at the adjacent poles.
- Carefully lower or move the cable away from the pole using a rope tied over a structure rod.

Damage prevention - Termination Pole Changes

- Take up the strain using temporary support method on the adjacent pole.
- Then let back the cable slowly.
- Avoid shock loading and maintain the minimum bending radius or more as the cable is being lowered.

Damage prevention – Strain Pole Changes

- Take up the strain across the cable using a winch device.
- Apply wrap-ons only over a structure rod for tensioning.
- Handle the cable in such a way so as not to bend the cable past the minimum bending radius. This includes the cable and jointing box assembly.

Faults

When responding to a fault where an OFC is damaged:

- Under no circumstances look into the fibres of the cable.
- Contact the report/control room and advise of:
  - Specific location
  - Damage to OFC
  - OFC owner if known
- If the cable needs to be cut to make the site safe, cut and apply heatshrink caps to the two ends of the cable.
- Roll up cable ensuring not to exceed the bending radius of the cable and secure.

9. RAILWAY CONDUCTOR / CABLE CROSSINGS

Overhead crossing design pre-approval

Design plans for the particular site demonstrating compliance with the relevant Railway Authority requirements shall be submitted to and approved by the Railway Authority prior to commencement of programmed work.

Access to railway property

Access arrangements with the relevant Railway Operator are essential prior to entering railway property or carrying out work in the immediate vicinity of railway infrastructure, particularly relating to the provision of appropriate safety requirements.

Overhead conductor construction conditions

- Overhead crossings must be constructed to an approved design plan for the particular site.
- Overhead lines and supporting structures shall be erected clear of all railway structures, drains, access roads, signalling/communications equipment, overhead masts and buildings.
- Crossings shall be terminated at each end of the span with strain type insulators and for this purpose the supporting structures (poles) shall be a strained construction design.
- Where stays are on railway property, their position shall be approved by the Railways Engineer.
- Splices or joins shall not be made in conductors of spans crossing railway lands and tracks.
- If, in a fault or emergency situation, a sleeve or join is made in a conductor crossing Railway land, a fault follow up is to be raised to replace the repaired conductor.
- No current carrying connection of any kind shall be made to any portion of a crossing span which is under tension.
- Crossarms not fitted to the top of the pole, shall be fitted to that side of the pole which is farthest from the railway tracks. The use of "Offset Crossarms" is not permitted.
- Conductor stringing activities shall stop and conductors are to be secured during the passage of trains in the vicinity of work.

- Construction crews shall as far as practicable, leave the Railway Authorities property in the condition it was prior to the installation of the overhead crossing.
- For transmission line crossings, the type of structure (steel towers) is to be specified in the approved design plans.

Underground cables

Special conditions apply to bores crossing under the railway lines as specified by the Railway Authority, and the construction of bores shall not proceed without authorisation by the Railway Authority. These conditions are necessary to ensure that the integrity of the railway tracks is maintained.

10. STRINGING CONDUCTORS BELOW & ADJACENT TO LIVE CIRCUITS

General

Where cricital supplies could be affected or network integrity is at risk it may be required to string new and/or replacement conductors below or adjacent to live circuits.

Planning & communication

Conductor stringing below or adjacent to live conductors can involve a number of different situations and can be completed using a variety of works practice methods. It is vital that correct planning and adequate safety precautions are put in place before the job commences to remove any risks that may occur during the completion of the job.

When evaluating the safe completion of conductor stringing where conductors are to be run below live conductors, it is important to ensure that the line of sight between the stringing points at each pole does not infringe on the Safe Approach Distances (SADs) to the live conductors above, (see Figure 12)

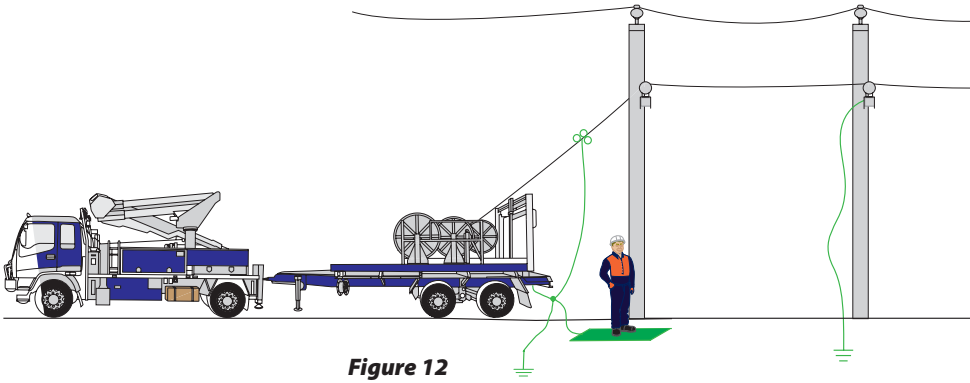


Figure 12

As with all conductor stringing jobs, effective communication (visual and sound) is a vital part of ensuring the safe completion of the job. TMRs, Flot channel, hand-held 2 way radios, mobile phones and the most effective positioning of persons and equipment for line of sight are mandatory considerations.

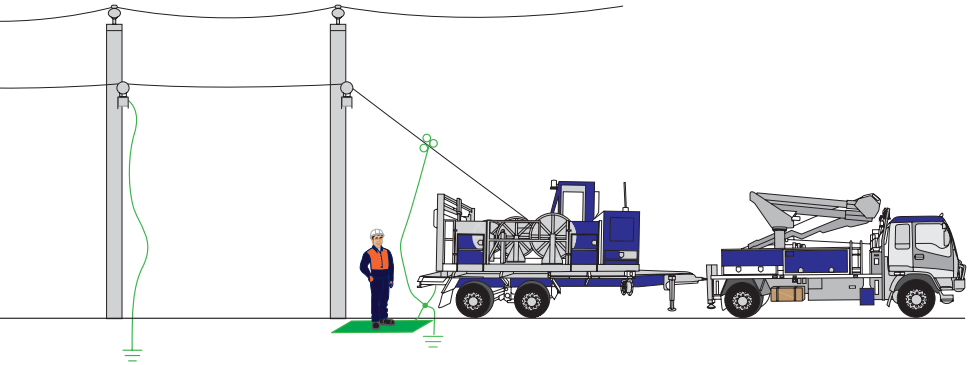
The utilisation of experienced personnel at key locations or tasks is also of vital importance. Where line of sight is not obtainable for key personnel or equipment, consideration is to be given to the posting of Safety Observers who can facilitate effective reporting, updates or equipment functionality confirmation.

Electrical hazards

To prevent electric shock either via accidental contact or induction it is vital that operational earthing is in place during this type of work.

The installation of earth rollers one span from each end of the run is the most effective manner of achieving this. Earth rollers are installed one span from each end to allow the conductors to be hung, sagged and terminated whilst still at earth potential. These poles would then be tied in last to ensure effective electrical protection.

Induction should also be considered when operating plant or equipment. In this regard, operators shall ensure they are protected from step and touch potential when operating plant and equipment or managing the cables as part of the run.



Precautions for this could include earthing the plant or equipment, using personal separation such as an HV mat, the use of equipotential mats bonded to conductors and drum supports, or using ropes to manoeuvre or pull cables.

Suppression of auto-reclose shall also be enabled whenever this type of work is performed.

Re-conductoring methods

Where the stringing involves utilising the pull in - pull out method, it is important to consider the quality and condition of the conductor or rope that is being used. Some older type conductors are prone to breaking and this may cause a flicking hazard.

Where the conductor is deteriorated or deemed too small to pull in the new conductor, rope may be pulled through using the existing conductor and then the rope utilised for the new conductor pull. It is also important to be aware of the straining capabilities of the pull through conductor/rope as it may not be capable of withstanding the full sag while straining the new conductor. Where this occurs, pulling of the new cable right through to the straining device or for three rolls on the recovery unit drum are effective solutions.

Consideration can also be given to using other methods to assist with safety and increasing clearances such as lowering the rollers down the pole and lifting conductors to the final position once sagging has been completed.

Equipment

The use of the correct equipment plays a vital role in safe and effective conductor stringing. It is important to utilise equipment that is sufficiently rated and capable of completing the job safely. The utilisation of correct equipment reduces manual handling, limits the risk of damage to plant, equipment and materials and includes the following:

- Correct sized and appropriate rollers.
- Cable Recovery Units
- Cable trailers (with operational drum brakes)
- Cable stockings
- Ropes
- Come-alongs
- Correct sized Lug – Alls
- Equalizer blocks
- Chains, strops, blocks and rollers for hanging on poles and below xarms.
- Equipotential mats
- Earth rollers