High Voltage Live Work Manual

Prepared by
Field Practices
Safety and Health
Corporate Services and Company Secretary
## STAKEHOLDERS

The following positions must be consulted if an update or review is required:

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## NOTIFICATION LIST

The following positions must be notified of any authorised change:

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* Must be the Process Owner and is the person assigned authority and responsibility for managing the whole process, end-to-end, which may extend across more than one division and/or functions, in order to deliver agreed business results.

** This person will have the power to grant the process owner the authority and responsibility to manage the process from end to end.

*** Frequency period is dependent upon circumstances—maximum is 5 years from last issue, review, or revision whichever is the latest. If left blank, the default will be 1 year unless otherwise specified.
Important Notice to Users

The High Voltage Live Work Manual has been developed for use by Horizon Power workers’ and Service Providers engaged to perform High Voltage (HV) Live works on Horizon Power Electrical Networks.

The manual is issued as a controlled document by Horizon Power to Horizon Power employees’ and Service Providers on the condition that it will only be used whilst undertaking HV Live works on Horizon Power electricity distribution network.

HV Live work will only be performed by individuals who are appropriately trained, authorised and qualified in accordance with accepted standards within Horizon Power. This Manual is not intended, and should not in any way be relied upon, as a substitute for such training.

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1. Scope

The High Voltage Live Work Manual has been compiled as a standard work technique document and as reference resource, to assists work parties who are conducting High Voltage (HV) Live Work techniques for all voltages up to and including 33kV.

The techniques described within the manual have been designed and developed for the performance of HV Live Work on all types of pole and cross-arm structures, steel, timber, concrete and synthetic, utilising Insulating Stick and Glove & Barrier methods. All standards and techniques in the manual are designed to ensure the safety of the work party, the public and the security of distribution assets.

It is the responsibility of the work party involved in HV Live Work to be fully conversant with all aspects and techniques of this manual and any subsequent amendments.

The Glove and Barrier techniques in this manual have been developed in conjunction with live line workers and the Australian Standards for working on live HV using the Glove and Barrier method.

All techniques in this manual include the roles and responsibilities of the HV Live Worker with the expectation to maintain current competencies and to create and manage a safe working environment at all times.

The preceding HV Live Work techniques and work instructions in this manual must be adhered to at all times.
2. Definitions

Apparatus
HV conductors, cables, associated hardware, and pole-mounted plant that is capable of being energised, or is already energised.

Approved
Approved in writing by Horizon Power.

Approved Work Technique
A documented work technique which meets the requirements of this manual has been approved by Horizon Power.

Authorised
Authorised in writing by Horizon Power, or an authorised person.

Brush Contact
Brush contact is defined as inadvertent momentary contact with insulating barriers covering energised conductors or equipment.

Circuit
A set of conductors and associated hardware and insulation, which together form a single electrical connection and which when faulted, are normally switched automatically from the system as a single entity.

Contact Area
The area within one metre of the nearest energised high voltage apparatus, whilst carrying out Glove and Barrier work.

Dead
Apparatus which is isolated, tested and at earth potential.

De-Energised
Disconnected from all sources of supply but not necessarily isolated, earthed or de-commissioned.

Drop Zone
The area below the immediate work position where a conductor or HV Live Work equipment connected to live apparatus could become uncontrolled and dropped during the work process. All sources of potential difference in the drop zone area capable of being reached, or which are, or could be at a different potential to the component being worked on shall be covered with approved insulating barriers.
Earthed

Electrically connected to the general mass of earth, by means of earthing conductors of an approved type, so that any electrical energy in the system is discharged in a manner that will prevent dangerous rises of potential and will affectively actuate the appropriate protective devices of the system.

Formal Appreciation

Means a person has attended a training course conducted by an RTO (Registered Training Organisation) for a period of time to gain a good understanding of the relevant subject matter work tasks.

High Voltage

A voltage greater than 1000 volts ac.

HV Live Worker

A HV Live worker who, by way of training and the demonstration of competency in all aspects of HV Live Work.

Insulated Elevating Work Platform (EWP)

An approved and tested insulated aerial device fitted with an approved and tested insulating liner to the inside of the basket.

Insulating Barrier

A barrier of rigid or flexible insulating material specifically designed, approved and tested for use as a line cover, insulator cover, expulsion drop out fuse cover, crossarm cover, and termination cover, or as a cover for similar live equipment.

Insulating Gloves and Sleeves

Insulating gloves and sleeves specially designed, approved and tested to a rated voltage being worked on.

Protective Outers

Leather protective outer gloves to be worn over the top of insulated gloves.

Insulating Pole Platform

A platform of insulating material specially designed, approved and tested for use with the HV Live Glove & Barrier method.

Live

Apparatus which is connected to a source of electrical supply and having a potential difference between conductors, to earth, or which is subject to hazardous induced or capacitive voltages.
Live Work Equipment

All approved Live Work tools, rope, insulating equipment and other equipment used for HV Live Work.

Live Glove & Barrier Method

A work method for HV Live Work using insulated and rated rubber gloves, sleeves and barriers.

Live Stick (also called a Hot Stick)

A stick of insulating material specifically designed, approved and tested for use in physically bridging the distance between the HV Live Worker and energised apparatus, between the energised apparatus and earth, between adjacent phases, and to enable physical loads to be taken or tools to be applied to the stick.

Live Stick Method

A method of performing HV Live Work using tools and equipment attached to Live Sticks with the HV Live Worker maintaining the safe approach distance (SAD's) from energised apparatus.

Live Work

All work performed on apparatus capable of being energised without implementing the full protective practice of isolating, proving de-energised and earthing at the worksite.

Safe Approach Distance (SAD)

The safe approach distance which a HV Live Worker can safely approach energised apparatus with their body or plant and equipment.

Minimum Tool Insulating Distance

The distance that insulating material, stick or rope, is subjected to contacting energised conductors. This distance shall be measured between the metal end fitting at the conductor end of the insulating material and the metal end fitting or hand mark, where provided, at the opposite end of the insulating material. When HV Live Sticks consist of sections joined with metal couplings, the insulating distance shall be the total of each of the lengths of insulating material which have not been bridged out by the metal couplings.

Other Cable Systems

Telecommunications cables, pay television cable, control cables, aerial earthed cables, electrolysis drainage cables.

Rated Voltage

The manufacturers recommended maximum voltage which shall be applied to the specified equipment.
Safety Observer

Person or persons whose job role is to alert workers aloft of any potentially unsafe actions or omissions of the approved work method. The person shall be authorised to carry out the work being observed and have the authority to stop work if required. The observer must always be in a position to observe the work being done and to suspend work if it is not possible to observer live activities. This role can be rotated between team members to assist in alleviating fatigue etc.

Safe Working Load (SWL)

The safe maximum load (in kilograms or Kilo newtons) which shall be applied to the specified equipment, apparatus or hardware.

Tested

Apparatus which has been tested in accordance with the relevant standard.

Test Voltage

The voltage which shall be applied to the specified equipment for the purpose of periodic electrical testing.

Work Area

The working area within normal body reaches of the working position.

Working Voltage

The maximum voltage which shall be applied to the specified equipment while conducting actual fieldwork. This voltage is 5 kV less than the test and rated voltage.

Note: Throughout this manual the word “shall” or “must” is to be interpreted as mandatory and the word “Should” is advisory or discretionary.
3. Concepts

3.1. Glove & Barrier Method

- The Live Glove & Barrier method is based on the principle that the HV Live Worker always maintains a minimum of two (2) independent levels of insulation to prevent phase to earth and phase to phase contact.

This is achieved by:

- Wearing properly rated and tested insulating gloves and sleeves, rated for the voltage being worked on.
- Always working from an insulated elevating work platform (EWP) or pole mounted insulating platform.
- Never directly from a ladder, pole or structure.

Additional protection for the HV Live Worker is provided by using insulating barriers where applicable.

An insulated and rated basket liner fitted in the elevating work platform, and the network protection system (auto-recloser) being set to single shot to give the HV Live Worker another level of protection.

3.2. Stick Method

- The Stick method is based on the principle that the HV Live Worker always maintains a safe approach distance from any energised apparatus while performing work using tools and equipment fitted to insulated sticks.

The Stick method may be carried out from:

- A pole or structure.
- A work platform attached to a pole or structure.
- The basket of an insulated elevating work platform.

**Note:** A work platform insulated for the voltage worked on shall be used for steel or concrete poles or structures.
3.3. Combination Glove & Barrier and Stick Methods

When HV Live Work is to be accomplished through a combination of Glove & Barrier and Stick methods, the work shall be limited to situations where the safety margins are not decreased by introducing Insulated sticks into the contact area.

- The HV Live Worker carrying out Live Glove & Barrier work within the contact area shall wear insulating gloves and sleeves and these shall not be removed until outside the contact area.
- Any HV Live Worker changing from Stick to Glove & Barrier method must be trained and competent for both methods.
- The worker shall advise the observer of their intention to change methods.

When HV stick work is required the HV Live Worker will:

- Move out of contact area.
- Discuss with team their intention and record on JRA.
- Apply appropriate techniques.

All relevant Safe Approach Distances (SAD) must be maintained at all times dependant on techniques used.

The following combinations of Live Glove & Barrier and Stick methods are not permitted:

- HV Live Workers carrying out Live Stick work and HV Live Workers carrying out Glove & Barrier work from the same insulated elevating work platform (EWP).
- HV Live Workers on a pole or structure carrying out Stick work and HV Live Workers on an insulating platform carrying out Glove & Barrier work.
- HV Live Workers carrying out Stick work from an insulated EWP and HV Live Workers carrying out Glove & Barrier work from another insulated EWP where the distance between the two EWP’s is less than 2.0 metres.

3.4. Combining of G&B work procedures

It may be a requirement to combine various Glove and Barrier techniques to allow specific tasks to be completed.

When HV Live Work is to be accomplished through a combination of techniques, the work must be limited to situations where the safety margins are not decreased.

- Such combinations must be agreed to by all team members and documented in the onsite risk assessment.
- The combination must be agreed to at the start of the job and must not be implemented in an unplanned manner during the work process.
- If it is found that during the task that a change in HV Live Work techniques is required, all work must stop and a suitable technique chosen to carry on with the task.
- This must be agreed on by all members of the team and documented in the onsite risk assessment.
4. Safety Rules

4.1. Safety Observer

During all HV Live Work, one member of the work party shall be appointed as the designated Safety Observer. The designated Safety Observer’s role is to alert the work party to any potentially unsafe actions, lack of compliance with approved work practices, techniques or documentation.

The designated Safety Observer shall:

- Be trained and authorised for the HV Live Work task being performed.
- Be appointed prior to any member of the team going aloft.
- Be positively identified to each member of the HV Live Work team.
- Be identified on the Job Risk Assessment form.
- Be positioned at a suitable location before work starts, to observe the work being performed.
- Be aware of how the task will progress and any changes made during the task.
- Have the authority to suspend the work at any time.
- Maintain effective and immediate communication with the work party at all times.
- Must not perform any other task whilst HV Live Work is in progress.
- Suspend all work in the event of having to leave the site or significantly change position until they have returned, reached new location, or have been replaced.

Note: When HV Live Work is being carried out using two (2) EWP’s, then a trained and authorised safety observer must be appointed for each EWP.

The designated Safety Observer’s role may be rotated between members of the work party, for example to reduce fatigue.

If the safety observer role is rotated during the work task, the new safety observer must be noted on the JRA.

During a work task the designated Safety Observer’s view is impaired by some obstruction, they must communicate this to the team aloft carrying out the work task, and may for short periods transfer the role to a HV Live Worker of the team working aloft.

When this occurs it shall be conscientiously communicated so that all members of the work party are aware at all times who is performing the role of the Safety Observer.

The Designated Safety Observer shall not undertake any tasks other than observing the work in progress.

The designated Safety Observer should be stationed at ground level unless another position provides greater viewing benefit to provide a holistic and broad view of the work.
4.2. Safe Approach Distances

4.2.1 Safe Approach Distances for the HV Live Workers

The Safe Approach Distances for the Stick method is based on the phase to ground Voltage Surge Distances plus an allowance of 300mm for inadvertent movement.

The Safe Approach Distances for the Glove & Barrier method is based on the phase to ground Voltage Surge Distances and are to the uninsulated parts of the body.

**Note:** Contact with electrical apparatus during Glove & Barrier work is allowable wearing approved tested and rated gloves and sleeves.

**Table 1:** provides recommended Safe Approach Distances for Instructed and / or Authorised HV Live Workers with Auto Reclose OFF.

<table>
<thead>
<tr>
<th>System Voltage (kV)</th>
<th>Stick</th>
<th>G&amp;B to Body</th>
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<tbody>
<tr>
<td>11</td>
<td>350mm</td>
<td>50mm</td>
</tr>
<tr>
<td>22</td>
<td>400mm</td>
<td>100mm</td>
</tr>
<tr>
<td>33</td>
<td>450mm</td>
<td>150mm</td>
</tr>
<tr>
<td>66</td>
<td>600mm</td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>710mm</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>810mm</td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>910mm</td>
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</tbody>
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**Note:** The Glove & Barrier clearances in Table 1 refer to the clearances from the un-insulated parts of the body.

4.2.2 Safe Approach Distances for Mobile Plant

**Table 2** provides recommended Safe Approach Distances for Mobile Plant Operated by an Instructed and / or Authorised Person with the use of a Safety Observer with the Auto Reclose OFF.

The Safe Approach Distances for **un-insulated** portions of mobile plant is based on the phase to ground Voltage Surge Distances plus an allowance of **1 metre** for inadvertent movement.
Table 2: Safe Approach Distances for Mobile Plant
Auto Reclose OFF

<table>
<thead>
<tr>
<th>System voltage phase to phase</th>
<th>LV Up to 1000v</th>
<th>11kV 22kV 33kV</th>
<th>66kV</th>
<th>132kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Un-insulated portions to un-insulated conductor</td>
<td>300mm</td>
<td>1200mm</td>
<td>1400mm</td>
<td>1800mm</td>
</tr>
<tr>
<td>Un-insulated portions to insulated conductor</td>
<td>150mm</td>
<td>400mm</td>
<td>1400mm</td>
<td>1800mm</td>
</tr>
<tr>
<td>Insulated portions to un-insulated conductor</td>
<td>150mm</td>
<td>150mm</td>
<td>1000mm</td>
<td>1200mm</td>
</tr>
<tr>
<td>Insulated portions to insulated conductor</td>
<td>Physical Separation</td>
<td>150mm</td>
<td>350mm</td>
<td>450mm</td>
</tr>
</tbody>
</table>

- Mobile plant being used in accordance with Table 2 shall be operated under the direction of an authorised HV Live Worker.
- Distances contained in Table 2 shall not be reduced at any time.
- If at any time prior to or during a task, that the relevant SAD distances cannot be maintained, the task shall not be performed.
- When one EWP is utilised for HV Live Work, only one phase at a time may be worked on.
- Both persons in a EWP basket must wear gloves and sleeves rated for the voltage being worked on when working Glove & Barrier method.

**Note:** When two (2) EWP’s are utilised for HV Live Work a separation of two (2) metres must be maintained at all times except when the work is being performed on the same phase / potential.
Glove & Barrier techniques up to and including 33 kV requires subsidiary circuits to be covered with insulating barriers rated for the voltage being worked on.

For Stick technique above 33 kV subsidiary circuits need only be covered with insulating barriers to their applicable voltage rating.

No tools and / or equipment shall 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, for example, encroaching on the clearance space of another person.

4.3. Protective Clothing

Protective clothing must meet the minimum PPE requirements. It must cover the body from wrist to ankle, and include approved eye protection, safety hardhat, appropriately rated and tested insulating gloves, sleeves and approved safety footwear shall be worn during all HV Live Work.

No exposed personal jewellery shall be worn during HV Live Work. Other items such as mobile phones and pagers shall not be carried during HV Live Work as they may cause distractions and reduce concentration.

Long hair shall be securely fixed and confined close to the head.

**Note:** Under NO circumstances shall any jewellery, exposed piercings or metallic objects be worn during HV Live Work tasks, Long hair shall also be tied back securely.
4.4. Incident Reporting

A HV Live Work accident / incident are defined as any of the following events:

- Electric shock or other serious injury received by any member of the work party or general public.
- A flashover at, or close to, the work site irrespective of its cause.
- Complete or partial breakdown of any insulating tool or equipment irrespective of whether or not flashover occurred.
- The electrical or mechanical failures of any HV Live Work equipment which did, or could have the potential to, cause an accident.

The Formal Leader must be notified of any accident / incident as soon as possible after the appropriate attention has been given to the safety of personnel and property.

The Formal Leader shall ensure that the appropriate person or persons complete the Hazard / Incident Reporting & Investigation form.

To assist in the accurate assessment of the contributing factors leading to an accident / incident all equipment and plant at the worksite shall not be moved except where permission has been granted because they pose an ongoing risk to safety, personnel or property.

4.5. Isolation from Structures and other Work Parties / Sites

Glove & Barrier work shall never be performed directly from a structure. Glove & Barrier work shall be performed from either a EWP fitted with a 50kV tested basket liner or from an approved insulated platform.

The HV Live Workers harness shall remain at the same potential as the HV Live Worker, and prevented from contacting any component at a different potential to the HV Live Worker.

While HV Live Work is in progress on a particular structure, no other work shall be performed on that structure or any adjacent structure.

No HV Live 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.
- HV Live Work techniques are used between the de-energised lines and / or apparatus and the access permit area.

4.6. Suspension of Work

If it becomes necessary to suspend work the circuit shall be left in a safe condition and the Network controller informed.
5. Job Planning

5.1. General

Whenever power line work is being planned, the ability to readily interrupt or alter the network to enable work to be performed under shutdown conditions shall be considered as well as doing the work by HV Live Work methods.

The specific nature of the assets being worked upon and the proximity of other assets that may impose higher risks shall be considered, e.g. surge arresters on transformers, cable heads poles or intermediate structures. A risk assessment shall determine if HV Live Work on these structures can be carried out safely.

5.2. Job Risk Assessment

Before the commencement of any work the job risk assessment (JRA) shall be completed, and all crew members must participate and sign on to the JRA.

When controlling hazards the hierarchy of controls – elimination, substitution, engineering controls, isolation, and administration, PPE, in their order of priority shall always be considered.

As part of the JRA process, a site briefing shall be facilitated by the team leader with all of the work party members to establish the following:

- Review the job to be undertaken, including the work to be done, how the work is to be carried out, the techniques to be used, and the role of each member of the work party.
- This ensures that their role is understood and that each member is capable of undertaking the assigned function.
- Identify potential work hazards on the site including:
  - The terrain and safe vehicle set up.
  - The structure to which work is to be carried out.
  - Checking condition of all the adjacent structures.
  - The conductors in the spans either side of the structure on which work is to be carried out.
  - The integrity of the insulators of the structure on which work is to be carried out.
  - Clearances to potential hazards.
- Discuss the hazards and be satisfied that all foreseeable risks have been controlled and documented.
- If the hazards cannot be effectively controlled, the work activity must not take place until additional controls are implemented.
- Re-visit job risk assessment if scope of work changes or new hazard is introduced during the HV Live Work process.
5.3. Work Site Set up

With all G&B work setting the work site up is an important factor in achieving a safe work site for all HV Live Workers.

The dot points below, when applicable to work package, give a guide to what must be checked before any HV Live Work can be carried out on the network.

- Work site needs to be cordoned / barricaded off to prevent access by unauthorised personal and members of the public during HV Live Work task.
- Determine the loads exerted on the HV live work equipment when performing the work task.
- Calculate and record all conductor lifts on the JRA.
- Ensure that the SWL of the equipment, crane and EWP is not exceeded.
- Check all cranes and EWP’s to be used have an effective vehicle earth.
- Conductor tension increase when moving or relocating conductors with the HV Live Work equipment.
- Do not place undue strain on adjacent ties or terminations.
- The insulating section(s) of the EWP boom must be inspected and cleaned prior to use.
- Where possible, the EWP should be positioned so that all work areas can be accessed safely.
- EWP should, where possible, be set up so that the work task can be completed from one site set up, though the proximity of LV conductor clearances must be considered.
- EWPs and plant must always maintain the required SAD from conductors and other live apparatus.
- To prevent unintentional movement under the work area a drop zone is to be established, agreed and maintained by the HV Live Work team.
- Before use clean, wipe down, and inspect all equipment that is to be used.
- Items that are subject to periodic testing i.e. insulating gloves, insulating covers and mats must be checked before use.
- All insulated equipment, including EWP boom and bucket liner, must be checked to ensure they are within test date period and suitable for the voltage being worked on.
- Prior to work commencing a visual inspection must be performed on the structure to be worked on.
- Checks must include conductors and equipment, and adjacent structures.
5.3.1 Weather

HV Live Work shall not be performed in adverse weather conditions or where the wind velocity exceeds 45km/h.

Prior to commencing any HV Live Work task weather conditions for the day shall be considered and only performed when there is adequate light. Weather conditions for the day may be unsuitable because of:

- Electrical storm.
- Rain, fog, snow, mist, or sleet.
- Excessive wind velocity.
- Excessive heat.
- Excessive humidity.
- Dust storms.

When employees are exposed to thermal stress, decisions about whether it is safe to work shall be taken through consultation and agreement between the team leader and work crew.

In making such a decision, consideration shall be given to provision of PPE, fluid availability, rest breaks and task rotation.

If HV Live Work is in progress and the weather conditions deteriorate to a point where it becomes unsafe to continue, the HV Live Work shall be suspended.
5.3.2 Wind Velocity – International Beaufort scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Wind Strength</th>
<th>Indicator</th>
<th>Wind Velocity km/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Calm</td>
<td>Smoke rises vertically</td>
<td>0 – 1</td>
</tr>
<tr>
<td>1</td>
<td>Light air</td>
<td>Smoke rises almost vertically, motion of air barely detectable</td>
<td>2 - 6</td>
</tr>
<tr>
<td>2</td>
<td>Light breeze</td>
<td>Trees and foliage occasionally in motion direction of wind detectable by feeling</td>
<td>7 - 12</td>
</tr>
<tr>
<td>3</td>
<td>Gentle breeze</td>
<td>Tree and shrub foliage hums, surface water ripples, and flags in motion</td>
<td>13 – 18</td>
</tr>
<tr>
<td>4</td>
<td>Moderate breeze</td>
<td>Tree and branches in motion, flags flutter</td>
<td>19 – 25</td>
</tr>
<tr>
<td>5</td>
<td>Fresh breeze</td>
<td>Trees and branches in motion, surface water covered with small waves, wind feels unpleasant</td>
<td>26 - 35</td>
</tr>
<tr>
<td>6</td>
<td>Strong breeze</td>
<td>Wind howls, lighter trees in motion, surface water covered with rolling waves and very choppy</td>
<td>36 - 45</td>
</tr>
<tr>
<td>7</td>
<td>Moderate gale</td>
<td>Wind bends trees, surface water covered with chopping and rolling waves</td>
<td>46 – 54</td>
</tr>
<tr>
<td>8</td>
<td>Fresh gale</td>
<td>Wind bends trees and breaks of small branches and twigs, wind is very audible, walking in the wind is difficult</td>
<td>55 – 65</td>
</tr>
<tr>
<td>9</td>
<td>Strong gale</td>
<td>Wind overturns lighter objects, lifts roofing tiles, breaks branches and small trees, walking is difficult</td>
<td>66 – 77</td>
</tr>
<tr>
<td>10</td>
<td>Whole gale</td>
<td>Wind breaks and uproots grown trees</td>
<td>78 – 90</td>
</tr>
<tr>
<td>11</td>
<td>Storm</td>
<td>Causes extensive damage to forest and buildings, knocks down pedestrians</td>
<td>91 – 104</td>
</tr>
<tr>
<td>12</td>
<td>Hurricane</td>
<td>Causes extensive destruction, knocks down roofs and chimneys, moves heavy objects</td>
<td>Greater than 104</td>
</tr>
</tbody>
</table>

5.4. Network Access

The auto-reclose function of equipment controlling the section of the circuit on which HV Live Work is to be performed shall be disabled to single shot reclose, for the duration of the work.

The site specific risk assessment shall be completed prior to commencing any HV Live Work task to ensure all the appropriate auto-reclose facilities are identified and are disabled, confirm with HPCC.

Prior to HV Live Work commencing at any work site, ensure that approval, via a permit, (VA) vicinity authority, has been obtained from the Network controller (HPCC) for the circuit being worked on, and the permit is cancelled on completion of the work.
Where more than one work team is working on the same circuit the Network controller (HPCC) shall ensure that all teams are clear of the circuit before the auto-reclose function is returned to normal.

5.5. Communication

Each work party shall establish and maintain a reliable on-site two-way communication link with Network control (HPCC).

5.6. Public Safety

All members of the public shall be kept clear of the work site while HV Live Work is in progress. The team shall ensure that the worksite is appropriately barricaded and signed. Additionally the Safety Observer will be vigilant of any potential public access to the worksite.

5.7. De-energised Circuits

HV Live Work techniques may be used to work on a circuit that is de-energised provided that all the circuit is confirmed as de-energised and work is undertaken, and all HV Live Work techniques are observed as though the circuit is energised.

5.8. Development of New Techniques

New HV Live Work techniques shall only be implemented after completing the following implementation process:

- Document the intended technique.
- Conduct a risk assessment and document.
- Trial the technique in a de-energised situation.
- Submitting the technique for approval by Horizon Powers’ Field Capabilities Improvement Group.
- Including the intended technique in this HV Live Work Manual as a standard work technique.
- Appropriate training in the technique.

5.9. Cable Termination Boxes

Some pole top cable terminations are in the form of insulating compound filled containers. The insulation may be pitch, gel or other insulating material.

The work party are reminded of the following restrictions regarding HV Live Work when working on high voltage structures with these cable termination boxes:

- No HV Live Work shall be carried out on the same structure as these boxes.
- Because of the explosive failures of these boxes, how close you perform work to these boxes on other structures will be subject to a risk assessment of the task planned.
- Work shall be performed under access permit, or in a de-energised state using HV Live Work techniques.
Purposely blank
6. Equipment

6.1. Care, Maintenance and Testing

General

The proper inspection, cleaning and maintenance of HV Live Work equipment is an integral part of the HV Live Workers duties.

Well-maintained equipment will result in extended equipment life, and will ensure that the safety of the HV Live Worker is not compromised.

Only HV Live Work equipment, which has been designed, tested, rated and approved for work on energised HV apparatus, shall be used.

HV Live Work equipment, insulating equipment and ropes shall not be:

- Stored with other non HV Live Work equipment.
- Placed directly onto the ground, an equipment rack or ground sheet must be used.
- Or stored near greases, oil based substances or chemicals.

All HV Live Work equipment shall be cleaned and maintained at intervals not exceeding seven days when used within the seven day period.

- Only equipment which has been used in the preceding seven day period needs to be cleaned and maintained.
- Any equipment which is suspected of being defective shall be withdrawn from service for detailed inspection and testing.
- Defective equipment which has been withdrawn from service shall be clearly tagged defective.
- The equipment shall be subjected to an appropriate test prior to being returned to service.

Electrical Testing

On completion of electrical tests, each piece of equipment is given a unique identification number. This number lasts for the life of the piece of equipment and accurate records kept of the equipment with regard to due test dates.

Each piece of equipment will have clearly marked on its surface the next due test date. It is the HV Live Workers responsibility to ensure the equipment being used is within its prescribed test date.

All HV Live Work equipment must be in date for use and audit purposes.

Safe Working Loads of Equipment

Horizon Power’s HV Live Work equipment is manufactured by an approved supplier of purpose built HV Live Work equipment.

In all instances the manufacturers SWLs must not be exceeded. Where SWL are prescribed in this manual, they must be adhered to at all times.
6.2. Personal Protective Equipment

**Insulating Gloves**: are made from Type 1 rubber and are available in a range of hand sizes and classes. All insulating gloves are manufactured using two colours of rubber. The inside and outside colours are different to facilitate the detection of damage to the glove. Cotton gloves may be worn under the insulating gloves for a more comfortable fit and the absorption of perspiration.

**Glove Protectors**: are worn over the insulating glove to keep the glove free of contaminants and to provide mechanical protection to the glove.

Appropriate length protectors shall be selected for the rating of each glove.

**Insulating Sleeves**: are made from Type 1 rubber and are available in a range of lengths and classes. They may also be curved at the elbow. The curves greatly reduce Live Worker fatigue. All insulating sleeves are manufactured using two colours of rubber. The inside and outside colours are different, to facilitate the detection of damage to the sleeve.

**Sleeve Harness**: is secured to each insulating sleeve with two threaded buttons.
6.2.1 Care and Maintenance of Insulating Gloves and Sleeves

General

Pure talcum powder should be applied to the inside surface of dry insulating gloves and sleeves after cleaning or prior to use. If storage is required for a lengthy period, the inside and outside surfaces of insulating gloves and sleeves should be powdered. Insulating gloves and sleeves shall always be stored with the bead on the outside, never inside out.

Gloves and sleeves shall not be folded or compressed during storage, this may result in stress within the rubber.

To protect insulating gloves and sleeves from mechanical and chemical damage they shall be transported and stored in their respective storage bags and kept within an appropriate personal kit bag. They should not be subjected to crushing or creasing due to other objects being laid upon them.

Leather protector gloves shall be worn over insulating gloves at all times. Leather protector gloves, which have been heavily contaminated by any oil based substances, can damage rubber insulating gloves. Discard or change gloves when the risk of contamination occurs.

Prior to Use

Gloves and sleeves shall be inspected both inside and out for pin holes, cuts, scratches, abrasions, ageing, corona cutting or other mechanical damage. Gloves shall be inflated and tested for air leakage. Sleeves are tested by running a hand down the inside of the sleeve stretching the sleeve with the fingers. If any underlying colour shows through, the item shall be repaired or replaced in accordance with ASTM F496.

Repairs to the glove shall only be carried out in the gauntlet area of the glove, and no more than three repairs made to an individual glove or sleeve.

Weekly

Insulating gloves and sleeves shall be cleaned using a cleanser, which does not cause the material to deteriorate or reduce its insulating qualities. Rinse the insulating gloves and sleeves with clean water to remove any excess cleanser and then place them in a position for drying, e.g. rack which shall not cause stressing of the material. Gloves and sleeves will be inspected for cuts, scratches or punctures.
6.2.2 Frequency testing of Gloves and Sleeves

<table>
<thead>
<tr>
<th></th>
<th>Tested</th>
<th>Working</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>15 kV</td>
<td>6 Months</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>25 kV</td>
<td>6 Months</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>35 kV</td>
<td>6 Months</td>
</tr>
</tbody>
</table>

6.3. Insulating Barriers

Insulating barriers are specifically designed, approved and tested for use as line covers, insulator covers, dropout covers, crossarm covers and dead end covers. They are designed to protect the HV Live Workers in the event of inadvertent contact with energised conductors / apparatus.

Insulating barriers are manufactured from either rigid or flexible material.

HV Live Workers shall not purposely make contact with an insulating barrier except with rated insulating gloves or a HV sticks.

Rigid Barriers

Are generally manufactured from Acrylonitrile Butadiene Styrene (ABS) plastic or high-density polyethylene and are available in a wide variety of configurations. Rigid barriers are rated by categories.

<table>
<thead>
<tr>
<th>Category</th>
<th>Phase to Phase Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25kV</td>
</tr>
<tr>
<td>2</td>
<td>34.5kV</td>
</tr>
<tr>
<td>3</td>
<td>46kV</td>
</tr>
</tbody>
</table>
Conductor cover

A category 1, it is 1.5 metres in length and it’s designed to insulate the conductor. They are available with or without the grip-all adaptor and they are designed to interlock with similar type insulator covers, they are applied by hand or with grip-all stick.

Insulator cover

Category 1 it is designed to cover a pin / post insulator and can be interlocked with the conductor covers to provide total coverage of live HV, they usually come in two sizes, 150mm and 225mm, they also have a grip-all stick adaptor and can be applied with a grip-all stick or by hand.

Cross arm Cover

Designed to fit over a crossarm and is slotted so it may slide around the pin insulator stork just below the insulator. This provides protection preventing the tie wire contacting the crossarm when untlying or tying in conductors utilising stick method. Installation may be with a grip-all stick.
Line Hose
A straight line conventional rubber hose in class 2 and 3. These covers totally enclose the conductor and may be joined together with the use of a separate insulated joiner.

<table>
<thead>
<tr>
<th>Class</th>
<th>Type of Barrier</th>
<th>Rated Voltage Phase to Phase</th>
<th>Working Voltage Phase to Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Flexible Hose (straight line)</td>
<td>20kV</td>
<td>15kV</td>
</tr>
<tr>
<td>3</td>
<td>Flexible Hose (straight line)</td>
<td>30kV</td>
<td>25kV</td>
</tr>
<tr>
<td>3</td>
<td>Pole Covers</td>
<td>30kV</td>
<td>25kV</td>
</tr>
<tr>
<td>4</td>
<td>Hose Couplers</td>
<td>40kV</td>
<td>35kV</td>
</tr>
<tr>
<td>4</td>
<td>Flexible Insulating Mats</td>
<td>40kV</td>
<td>35kV</td>
</tr>
<tr>
<td>4</td>
<td>Flexible Hose (extended lip)</td>
<td>40kV</td>
<td>35kV</td>
</tr>
</tbody>
</table>

Figure 1: Line Hose Connector
Figure 2: Insulating Mat - Eyelet Style

Line Hose Connector
Designed to join together non-connector end line rubber hoses, they come in class 2, 3 and 4. With the use of the joiner and the line hoses, conductors are easily covered providing an excellent covering system.

Insulating Mat - Eyelet style
Flat and generally square in shape with reinforced eyelets, which are used for securing purposes. They are available in Classes 2 and 4. The mat is effective in covering bulky line hardware items such as isolators and disc insulator assemblies. Used in conjunction with other flexible or ridged covers provide excellent covering system.
Insulating Mat - Slotted style

These are identical to the eyelet style, except for a slot running from one side to the centre of the mat. This slot is to improve and simplify application to various electrical apparatus. They are available in Classes 2 and 4. Used in conjunction with other flexible or ridged covers provide excellent cover to line hardware.

Pole covers

Designed to insulate a section of pole and are available with either a 225 mm or 300 mm diameter and range between .6 m to 1.8 m in length. Two or more covers may be applied to the pole for pole installations.

Insulated Mat Pins (Pegs)

Used to secure insulating mats to line hardware, they are also used for a variety of other purposes. They are available in 240 mm and 340 mm sizes.
6.3.1 Care and Maintenance of Rigid and Flexible Insulating Barriers

General

Rigid insulating barriers shall be inspected for scratches, gouges, splits or discolouration. They shall always be stored in a manner such that they do not become distorted or subjected to mechanical stress.

Flexible insulating barriers shall be inspected for holes, tears, cuts, and indications of corona cutting or chemical deterioration. Swelling, softening, hardening, stickiness or elasticity may indicate deterioration caused by chemical reaction.

They shall always be stored in a manner such that they do not become creased or compressed.

Tape shall never be used to secure or mark insulating barriers as the adhesive may react chemically with the material.

When mats are to be stored for long periods of time they should be dusted with talc powder so as to prevent them sticking together.

Prior to Use

Rigid barriers shall be inspected prior to use for any fractures, splits or cracks. Flexible barriers shall be inspected prior to use for cuts, tears or punctures.

Weekly

Insulating barriers shall be cleaned using a cleanser, which does not cause the material to deteriorate or reduce its insulating qualities. Rinse the insulating barriers with clean water to remove any excess cleaner. Rigid and flexible barriers shall be inspected during cleaning for any fractures, splits, cracks, cuts, tears or punctures.
6.4. Conductor Support Equipment

For the safe working loads of the equipment detailed in this section refer to manufacturers design data particularly usage configurations.

### Safe Working Loads of Equipment

<table>
<thead>
<tr>
<th>Description of Equipment</th>
<th>Chance</th>
<th>Hastings</th>
</tr>
</thead>
<tbody>
<tr>
<td>63mm wire tong saddle with extension</td>
<td>360kg</td>
<td>360kg</td>
</tr>
<tr>
<td>63mm wire tong saddle without extension</td>
<td>450kg</td>
<td>450kg</td>
</tr>
<tr>
<td>38mm wire tong saddle with extension</td>
<td>360kg</td>
<td>360kg</td>
</tr>
<tr>
<td>38mm wire tong saddle without extension</td>
<td>450kg</td>
<td>450kg</td>
</tr>
<tr>
<td>snubbing bracket</td>
<td>450kg</td>
<td></td>
</tr>
<tr>
<td>lever lift long epoxiglass</td>
<td>450kg</td>
<td>450kg</td>
</tr>
<tr>
<td>lever lift short aluminium base</td>
<td>450kg</td>
<td></td>
</tr>
<tr>
<td>conductor support crossarm mounted</td>
<td>68kg</td>
<td>68kg</td>
</tr>
<tr>
<td>conductor support pole mounted</td>
<td>136kg</td>
<td>136kg</td>
</tr>
<tr>
<td>extension arm 1800mm (two wire holders)</td>
<td>136kg</td>
<td>136kg</td>
</tr>
<tr>
<td>spiral link stick</td>
<td>1500kg</td>
<td>900kg</td>
</tr>
<tr>
<td>hoist link stick</td>
<td>1800kg</td>
<td>1800kg</td>
</tr>
<tr>
<td>rachet hoist</td>
<td>750 / 1500 kg</td>
<td></td>
</tr>
<tr>
<td>glove and barrier auxiliary arm double braced</td>
<td>204kg</td>
<td></td>
</tr>
<tr>
<td>glove and barrier auxiliary arm single braced</td>
<td>68kg</td>
<td></td>
</tr>
<tr>
<td>chain / wheel tightner for saddle</td>
<td>1100kg</td>
<td>1100kg</td>
</tr>
<tr>
<td>extension chain for pole saddles 450mm</td>
<td>1100kg</td>
<td>1100kg</td>
</tr>
<tr>
<td>c-type wire holders</td>
<td>68kg</td>
<td>68kg</td>
</tr>
<tr>
<td>fork type wire holders</td>
<td>68kg</td>
<td>68kg</td>
</tr>
<tr>
<td>roller wire holders</td>
<td>90kg</td>
<td>136kg</td>
</tr>
<tr>
<td>rope blocks double sheave</td>
<td>1500kg</td>
<td>900kg</td>
</tr>
<tr>
<td>rope blocks triple sheave</td>
<td>1500kg</td>
<td>900kg</td>
</tr>
</tbody>
</table>
38 mm and 63 mm Wire Tong Saddles

Attached to the pole and are used to support either a 38 mm or 63 mm wire tong stick. The wire tong is clamped in a barrel attached to the saddle.

Wire Tong Saddle Extension

When additional clearance from the structure is required a saddle extension may be fitted between the saddle and the barrel. This does provide more clearance between the wire tong and the structure but reduces the SWL of the saddle.

Snubbing Bracket

Attached to the pole and is used as an anchor point for hand or tackle ropes.
Lever Lifts

Attached to the pole using a chain tightener and used in conjunction with a wire tong stick, lifting tackle and snubbing bracket to raise, lower or move a conductor clear of a structure to a temporary position.

Glove & Barrier Auxiliary Arm

Arms are used to support the conductors, and to facilitate the replacement of insulators, poles or crossarms.

Two 63 mm wire tong saddles are used to mount the auxiliary arm mast to the pole. One or two braces will be used depending on the rig requirement. Line deviation is not permitted when using this rig. SWL Balanced 270kg, Unbalanced 68kg.

Fork Type Wire Holder

They are fitted in the upright position on the crossarm of the auxiliary arm.

C-Type Wire Holder
They are fitted in the suspended position on the crossarm of the auxiliary arm.

Insulator

Used to insulate the wire holder from the alloy bangle attached to the auxiliary crossarm and shall be used on 33 kV and 22 kV systems at all times and on 11 kV systems where conductors are to be left for prolonged periods.

Pole Mounted Temporary Conductor Support

Used to temporarily support conductors during maintenance and is attached to the pole via a chain tightener or ratchet strap. Two sizes are available 1.2 m and a 750 mm.

SWL 68kg per wire holder (Max of two)

Crossarm Mounted Temporary Conductor Support

Is used for temporarily reposition the conductor on the crossarm for maintenance purposes. It may be fitted to a maximum size crossarm 150 mm x 150 mm and is an alternative to double insulating the conductor.
Extension Arm Cross-arm Mounted

Is used for temporarily reposition the conductor clear of the existing arm or structure. The 1800 mm arm will accommodate two wire holders, SWL 68kg per wire holder.

Wire Tongs

Both 38 mm and 63 mm wire tongs are combined with other support equipment to create a temporary rig, which enables the relocation, and support of conductors temporarily for maintenance purposes. SWL Compression 681kg, Tension 1136kg.

75 mm Lifting Sticks

Are used with temporary crossarm and Au’s to support and relocate conductors for maintenance purposes.

Temporary Parking Bar (Hanger)

Used for supporting the end of temporary hoppers prior to energising.

Strain Link Stick

Used in a various situations. However its primary use is to insulate strap hoists or ropes from anchor points on poles or structures.
Figure 1: Roller Link Stick  

Figure 2: Spiral Link Stick

**Roller Link Stick**

Is used to spread and hold conductors apart in mid-span when erecting or relocating poles. The stick can be applied to the conductor from a structure then slid along the conductor to the desired position.

**Spiral Link Stick**

These are used to insulate strap hoists, or ropes from anchor points on structures. It can also be used as the insulating medium for applying ropes to conductors and for an insulating medium for the winch rope of a crane.
6.4.1 Care and Maintenance of Wire Tong Saddles/ AU's/ Temporary Cross-arms

Prior to Use

- Wire tong saddles, lever lifts / Au’s and snubbing brackets shall be examined for signs of cracking, excessive wear or any other visible damage prior to use.
- The equipment shall be lubricated such that all moving parts run free.
- Saddle barrels shall be wiped with a silicone impregnated cloth prior to use to remove any dirt or grime.
- Temporary crossarms shall be examined for signs of cracking/splintering or any visible damage prior to use.

6.5. Insulated Hand Tools

Universal Sticks

Universal sticks are designed for use as handles for the attachment of a variety of tools and equipment. They are usually 0.75 to 3 m in length with a diameter of 32 mm and are normally provided with a spline anchorage on each end.

Grip-All Clamp Sticks

Grip-all sticks are primarily designed for installing and removing Live Line clamps and rigid insulating covers.
Wire Holding Stick

May be used on or around energised conductors for forming, bending and positioning loops and for holding conductors during splicing operations. The head of the tool may be positioned at three different angles to aid in handling conductors. The clamping mechanism can also be adjusted to fit varying size conductors.

Conductor Cutters - Ratchet Type

They are fitted with a cutter head which is designed to cut aluminium, copper and single steel strand ACSR. The cutter head assembly is replaceable. This tool is often used in conjunction with the wire holding stick.
Wire Cutters - Light Duty

Wire Cutters are side cutters fitted to insulating handles and are used for cutting tie wire or small gauge single wire. Pliers may also be fitted to insulating handles.

Grease Tube Holding Stick

Are used to hold a tube of grease for lubrication of switchgear, ball and socket connections etc.

6.5.1 Care and Maintenance of Insulating Sticks

General

Tools and equipment, which are constructed of fibreglass - reinforced plastic rod, shall be cleaned by:

- Wiping down the entire stick surface with methylated spirits or a similar cleanser.
- The application of a thin coat of silicone oil or a wipe with a silicone cloth to the entire stick surface.

Insulating sticks shall be inspected for signs of overstressing prior to use. This type of damage is evident by distorted or cracked parts, bent rivets or bolts.

Metal parts shall be checked for excessive wear and other visible damage.

Insulating sticks and wire tongs that have lost their gloss or have been damaged can easily be refurbished with a plug repair kit and gloss restorer.

Prior to Use

Wipe with a silicone impregnated cloth prior to use and inspected for loose or broken fittings, cracks or fractures.

Weekly

Insulating sticks shall be inspected for signs of overstressing, and wiped down with methylated spirits or a similar cleanser; followed by the application of a thin coat of silicone oil to the entire stick surface.

6.5.2 Universal and Grip-All Accessories

A large number of tool fittings are available to facilitate the maintenance of line hardware.

The fittings are easily fitted to the universal stick via a rising run and thumbscrew or via a ring applicator to grip-all sticks.
6.5.3 Frequency Testing for Insulated Sticks

<table>
<thead>
<tr>
<th>INSULATING STICKS EPOXIGLASS UNI-CELLULAR FOAM FILLED</th>
<th>Test Standard ASTM F11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separation of Test Electrodes</td>
<td>Test Voltage</td>
</tr>
<tr>
<td>300mm</td>
<td>45kV</td>
</tr>
</tbody>
</table>

6.6. Ropes

Only synthetic rope and mechanical properties not inferior to polypropylene rope manufactured to the Australian Standard AS 4142.2 shall be used for HV Live Work.

![Synthetic Rope](image)

Figure 1: Synthetic Rope

All ropes used for HV Live Work shall be used within their safe working load for the tension or mass to be supported.

12 mm diameter is the minimum size rope used for HV Live Work.

As a guide the following formula may be used to calculate the SWL of a synthetic rope.

\[ SWL = D^2 \times 2 \quad Where \ D = \text{Rope diameter} \]

For a more accurate determination of the safe working load of a rope, a rope specification table supplied by rope manufacturers should be consulted.

When it is necessary to attach ropes to energised conductors, a rated insulating medium shall be fitted between the rope and the conductor.

Ropes used in HV Live Work may be used in the following configurations.
Side Rope

Is a minimum 16 mm rope connecting the head of a support stick or a conductor to a suitable existing or temporary ground anchor. This rope is controlled at the ground anchor by a tackle / strap hoist.

Spreader Rope

Spreader rope connecting a conductor directly to a suitable existing or temporary ground anchor.

Spreader Rope

Is a rope connecting a conductor directly to a suitable existing or temporary ground anchor.

Endless Hauling / Hand lines

12 mm polypropylene rope.

6.7. Strain / Tensioning

Tackle Block

Shall be reeved with polypropylene rope. The block assembly hook shall be fitted with appropriate safety device, i.e. safety latch / mousing, and a SWL 1690kg.
Strap hoists

Strap Hoists are suitable for either Stick or Glove & Barrier methods. Strap hoists are fitted with rings on all latches hooks and control levers to facilitate ease of positioning and operation when using the Stick method.

The operation of the hoist is via the insulated / nonconductive handle.

Strap hoists shall only be used in series with an insulating link stick.

The safe working load of the hoist shall be predetermined to ensure it is adequate for the task.

SWL 750 single / 1500kg double reeved.

6.8. Bridging Tools

Temporary Expulsion Dropout

Provides fuse protection during HV Live Work maintenance and is installed onto the line using a grip-all clamp stick, as well as Glove & Barrier method. The fuse carrier shall always be closed or opened with the aid of an insulating stick.

Temporary Expulsion Dropout with Arc Chute

Temporary means of energising and de-energising apparatus and circuits under load conditions.
**Temporary Bypass Jumper - Stick Application**

Used with Glove & Barrier or Stick methods. Check table below for current capacity.

**Temporary Bypass Jumper - Hand Application**

Used with Glove & Barrier methods. Check table below for current capacity.

**Temporary Conductor Bus (HZ)**

Attached to a cross-arm and is used to connect temporary hoppers to provide a bypass to permanent bridging or switchgear.

**Load Pickup Tool**

Attached across an open circuit and used to energise conductors / circuits under load. This tool has load make capacity only of 250 amperes and rated to 15kV.
In Line Isolators

Are used on overhead circuits in mid-span to create open points. All inline isolators must be fitted with an arc chute.

The blade can be opened or closed at loads up to 250 amperes at 15 kV.

Bridging cable is available in a number of configurations. The specification is stamped into the cable at 1200 mm intervals.

It is the HV Live Workers responsibility to ensure the correct cable is used by identifying the voltage rating and ampere rating of the temporary bypass cable.

<table>
<thead>
<tr>
<th>Cable Size (AWG)</th>
<th>15kV</th>
<th>25kV</th>
<th>35kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/0</td>
<td>260</td>
<td>260</td>
<td>260</td>
</tr>
<tr>
<td>2/0</td>
<td>300</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>4/0</td>
<td>400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.9. Ladders

Ladders used by HV Live Workers shall be non-conductive, either fibreglass or timber. See FI 3.5 Portable Ladders, for further information

6.10. Mobile Plant

6.10.1 Elevating Work Platforms (EWP's)

Elevating Work Platforms used in the performance of HV Live Work shall comply with the requirements of AS 1418.10 - Elevating Work Platforms and in addition shall have:

**An insulating section in the upper boom with a minimum rating of 66kV.**

- An approved insulating liner rated at 50 kV fitted into the basket for Glove & Barrier work.
- EWP's shall be earthed at all times during HV Live Work Tasks.

Escape devices installed to the basket of the EWP shall be positioned for easy access. The release mechanism shall be able to be operated when wearing HV Insulating Gloves.

Anchor points for the fall arresters shall also have easy access in order to release the lanyard from the basket quickly in case of emergency exit.

Fibreglass EWP baskets are reinforced with metal rods. To avoid any inadvertent phase to phase or phase to earth paths the relevant safe approach distances shall be maintained from the EWP basket and all second points of contact.

Additionally it is imperative that the care and maintenance program ensures that there are no exposed sections of reinforcing fastening screws etc. through damaged sections.
The insulated section of the EWP boom must never be bypassed by any uninsulated medium.

**Working on Separate Phases from EWP's**

When two EWP’s are utilised for HV Live Work, separate phases may be worked simultaneously provided that a minimum separation of two (2) metres air gap between the baskets and booms of the EWP’s is maintained.

**Leakage Detection**

Check leakage at the start and during tasks when performing HV Live Work from fully insulated EWP’s.

**Wind Loading**

EWP’s shall not be operated in constant wind velocities above 45 km/h or 40 km/h when using a Gin Pole to lift live conductors during HV Live Work. Refer to section 5.3.1 of this manual for wind velocities.

**6.10.2 Care and Maintenance of EWP’s**

**General**

Whenever any work is performed on a EWP which could affect the insulating components, the EWP shall be electrically tested before being returned to service.

The EWP shall have a permanent earthing point installed to the chassis.

**Prior to use**

All insulating components shall be visually inspected and wiped clean with a silicone impregnated cloth.

Particular attention should be given to:

- Fibreglass covers that protect greasing points.
- The covers that protect the bucket swivelling mechanisms.
- Mounting point for any lifting devices that may be attached to the basket.
- When the lifting jib is not installed, a nylon plug is to be placed in the housing for the lifting jib so as to prevent any energised conductors or loops entering the housing.
- The base of the mounting for the jib shall also have a permanent nylon plug installed.
- The insulating section of the boom.
- Any covers that protect hydraulic hose connections shall be intact.
- The boom and basket shall retain a gloss which causes water to bead.
Weekly

- The EWP boom and basket is to be washed with soapy water and rinsed. Where needed, a polish is to be applied to maintain water beading on the boom and basket.
- The tray of the vehicle is to be kept clear of debris or line hardware. The turret controls shall be accessible with the boom in all positions.
- All hydraulic connections shall be checked for oil leaks.
- Any damage to fibreglass is to be repaired so as to prevent the ingress of water through the glass fibres, which would weaken the structure mechanically as well as the electrical insulation.

6.10.3 Other Plant

The chassis of mobile plant shall be bonded to a priority earth or driven electrode whilst working within 2 metres of energised conductors. Additional plant working on the same structure or within 6 metres of the earth shall be bonded or earthed either directly or via the common earth connection.

Plant items that have control levers or remote controls that may be operated whilst standing on the ground shall not be used unless:

- The operator is standing on an equipotential mat that is electrically bonded to the vehicle.
- The operator shall be positioned on the vehicle.

The plant should be inspected for hydraulic leaks. The plant shall be in such operating condition that it allows for smooth controlled movement of suspended loads.

Only experienced, trained and authorised operators who have been briefed as to the task and are familiar with the plant shall be utilised for the task.

Operators shall have demonstrated their competence with a Supplementary Assessment for Crane Drivers.

Training of operators shall include practical and theoretical evaluation of the following:

- Installation and removal of poles through or near live high voltage conductors.
- Operating characteristics of the crane.
- Installation/removal of pole mounted equipment.
- Care and maintenance of pole insulating covers.

6.10.4 Frequency Testing of EWP’s

<table>
<thead>
<tr>
<th>Elevating Work Platform, Basket Liner and Hydraulic Hoses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Standard AS 1418- Part 10, ANSI / SIA A92.2</td>
</tr>
<tr>
<td>Test Intervals</td>
</tr>
<tr>
<td>6 Months</td>
</tr>
</tbody>
</table>
6.11. Hydraulic Tools

If a hydraulic tool system is fitted to the elevating work platform upper boom, the hoses connected to the hydraulic tools shall be of insulating material and the oil used shall be electrically non-conductive, tested and approved. Connection points for the hydraulic hoses shall not protrude so as to foul easily on pole hardware or conductors.

6.11.1 Using Hydraulic Tools in Direct Contact with Live HV Apparatus

Only hydraulic tools connected to the hydraulic tool outlets of an Elevating Work Platform (EWP) meeting the minimum requirements of this section may be permitted to make direct contact with live HV apparatus up to and including 132 kV.

All HV Live Workers undertaking tasks where hydraulic equipment is to be used in direct contact with live apparatus shall be instructed in these procedures.

Hydraulic Tools

The hydraulic tools approved for use are low pressure up to 2000 psi /140bar

- Hydraulic drills, impact wrenches.
- Conductor crimping equipment.
- Hydraulic cutters.

Individual hydraulic tools selected must automatically release in the event of a malfunction or oil pressure loss.

Tool Operating Requirements

The system hydraulic configuration, pressure and hydraulic fluid flow rates from the EWP shall match the system requirements of the hydraulic tools being used as per manufacturers specifications.

The hydraulic fluid reservoir shall be fitted with an approved hydraulic fluid moisture filter, e.g. filter type “Velcon” or equivalent, to ensure no moisture is transferred to the hydraulic fluid system. The hydraulic fluid moisture filter should be mounted between the hydraulic pump and main control valve.

The hydraulic hoses connecting the hydraulic tool from the EWP outlet shall be of an approved electrically insulating type and shall be of a minimum length of 1 metre not exceeding 3m.

Low Pressure Hose

The current Australian, IEC or SAE standards for hydraulic hoses do not make provision for suitably flexible non-conductive hose at the expected working pressures of 2250 PSI. This pressure requires hoses with a double synthetic braided construction.

Hydraulic hoses shall meet the electrical performance of category 100R6 in Australian standard 3791 (1991) or current equivalent.
Hydraulic hoses shall meet the rupture performance of category 100R7 in Australian standard 3791 (1991) or current equivalent.

Hoses that have been identified as meeting these requirements are:

- Goodyear Saflex.
- Nelphi Rubber Products B098.

EWP vehicles must have a verification card or similar to indicate to users that the hydraulic system oil and hoses have undergone and passed the appropriate tests as outlined in this manual.

It is recommended that hydraulic equipment / tools be assigned to a specific vehicle and not interchanged between vehicles so as to not mix oil types, and reduce the risk of cross oil contamination.

**Cleaning**

Any hydraulic fluid spilled during the use of hydraulic tools shall be cleaned before the tool is to be used again on another job. An oil spill kit shall always be available.

Hydraulic hoses must be cleaned with an approved HV Live Work cleaner.

**Flame Retardant Hydraulic Fluids**

Flame retardant hydraulic fluids shall not be used, as most are water based.

**Vacuum Exclusion Valves**

Vacuum exclusion valves shall be fitted to the hydraulic circuit of all EWP’s with a reach greater than 11 metres.

**Hydraulic Oil Shutdown System**

EWP’s shall be fitted with an automatic hydraulic oil shutdown system to the hydraulic tool line to ensure that hydraulic fluid will immediately cease to flow in case of hose rupture or hydraulic leak.
### 6.12. Summary of Testing and Inspection Intervals

The following table sets out a summary of the testing and inspection intervals for Live Work tools and equipment:

<table>
<thead>
<tr>
<th>ITEM FOR TESTING</th>
<th>INTERVAL IN MONTHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber Gloves and Sleeve</td>
<td>6</td>
</tr>
<tr>
<td>Rubber Line Hoses</td>
<td>6</td>
</tr>
<tr>
<td>HV Rubber Mats</td>
<td>6</td>
</tr>
<tr>
<td>Rubber Hoods</td>
<td>6</td>
</tr>
<tr>
<td>Rubber Cross arm Covers</td>
<td>6</td>
</tr>
<tr>
<td>HV Bypass Jumpers</td>
<td>6</td>
</tr>
<tr>
<td>Polymeric Insulators</td>
<td>6</td>
</tr>
<tr>
<td>Fibre Glass Sticks / Component Based Tools</td>
<td>6</td>
</tr>
<tr>
<td>EWP</td>
<td>6</td>
</tr>
<tr>
<td>Hydraulic Hoses</td>
<td>6</td>
</tr>
<tr>
<td>Gin Pole</td>
<td>6</td>
</tr>
<tr>
<td>Glove and Barrier EWP Liner</td>
<td>6</td>
</tr>
<tr>
<td>Rigid Conductor Cover</td>
<td>6</td>
</tr>
<tr>
<td>Rigid Insulator Cover</td>
<td>6</td>
</tr>
<tr>
<td>Polyethylene Cross Arm Covers</td>
<td>6</td>
</tr>
<tr>
<td>Polyethylene Hoods</td>
<td>6</td>
</tr>
<tr>
<td>Polyethylene Line Hoses</td>
<td>6</td>
</tr>
<tr>
<td>Pole Covers</td>
<td>6</td>
</tr>
</tbody>
</table>
7. Techniques

The principle of a technique based manual is to describe the philosophy and in certain instances outline specific step by step instructions to perform the underlying core skills which come together to complete a HV Live Work maintenance task.

For example, the replacement of an intermediate cross arm requires the skills of installing insulating barriers and setting up an appropriate rig to support the conductors to allow the replacement of the cross arm. These two skills are the core requirement to complete the HV Live Work intermediate cross-arm replacement, irrespective of the specific construction standards. As the HV Live Work maintenance task becomes more complex a wider range of skills will be required.

These skills are directly documented as techniques in this manual, which in turn establish the technique based manual. The advantage of this system is that while construction standards and hardware/apparatus changes will be infinite, the core skills and techniques will remain constant for the foreseeable future.

7.1. Applying insulating barriers / covers and mats

Purpose

This technique describes the application and use of temporary insulating covers on overhead distribution lines up to 33 kV.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- The task must be completed from an insulated EWP.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
Technique

- Only work on one potential at a time.
- Do not position yourself between bare phases.
- Maintain air gap from your body.
- Always cover the nearest and lowest conductor first.
- Where flexible insulating covers or mats without an interlocking system have to be overlapped or joined, then ensure the overlap or join provides adequate insulation, by ensuring an overlap of at least 150 mm.
- Double insulation can be achieved by hose to mat, mat to mat and mat to cover.
- Covering must be installed and secured in such a way to prevent them from being dislodged.
- Confirm that all second points of contact within reach are covered.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, hoses and mats, ensure enough equipment to cover liveconductors and second points of contact within reach.</td>
</tr>
<tr>
<td>Personal</td>
<td>HV Live workers</td>
</tr>
<tr>
<td></td>
<td>• 1+ in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
</tbody>
</table>
7.1.1 Untying and retying conductors

Purpose

This technique describes how to untie and retie conductors on overhead distribution lines up to 33kV.

Figure 1: Untying a conductor

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Before untying or retying, the conductor must be securely held with a downward force either by hand or link stick and tag line.
- Conductor can also be secured in the conductor trap holder of the lifting device.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
- When untying conductors be aware that you maybe altering the conductor loadings on adjacent structures.

Technique

- Before removing the old tie, the conductor must be securely held with a downward force by hand or link stick and HV Live Line rope or secured in the conductor trap of the lifting device.
- When removing the old tie the end must be controlled and the tie coiled into a small ball or cut into small lengths whilst being uncoiled, do not drop cuttings from EWP.
- Use the most suitable displacement procedure for the configuration being worked on to raise / displace the conductor.
Re-tying conductor

- Check conductor loads when relocating conductors back on to the insulator and monitor adjacent poles and equipment.
- Cover all second points of contact within reach.
- Ensure the conductor tie is prepared for application before going aloft, this can be achieved by halving the coil.
- Wrap the tie around the insulator one complete rotation ensuring the coils are facing down and out.
- Complete the tie, ensuring the coil of the tie is safely maintained at all times, keep it as short as possible to avoid breaching second points of contact.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
<tr>
<td>3</td>
<td>HV ties</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Personal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2+</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
<tr>
<td>3</td>
<td>HV ties</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Personal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2+</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>
7.1.2 Trimming trees near live HV conductors

Purpose

This technique describes how to trim trees near overhead distribution lines up to 33 kV.

![Figure 1: Trees near power lines](image)

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- For SADs and vegetation clearances see Network Instruction Manual 10.6 Vegetation Management Work.
- The EWP should be positioned so that any falling vegetation does not fall upon the cab, the EWP, or any public property such as vehicles and roofs.
- You must not attempt to lift vegetation using the boom or bucket of the EWP.
- Keep all members of the public clear of the worksite while tree trimming is in progress.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique

- If any branches are within the SAD cover the conductors using insulated covers, be careful of conductor sag with the extra weight when covers are fitted, or move the conductor to achieve SAD between conductor and vegetation. Pruning must commence from the tips of the branch and work back towards the trunk of the tree.
- Pruning above conductors must be carried out using feathering techniques the maximum cut length of 300 mm.
- The Vegetation Management Manual is a good source of reference for cutting trees around HV lines, see CS10 # 2369295
- Vegetation must also be cleared from around Horizon Power’s poles, stay wires and attachments.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
<th>Personal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Insulated stick long reach chainsaw or insulated stick mounted manual saw</td>
<td>HV Live workers</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
<td>• 2 in the EWP</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
<td>• 1 Safety Observer</td>
</tr>
</tbody>
</table>
7.1.3 Fit Line Splices, Armour Rods, Bird Diverters and Spiral Vibration Dampers

**Purpose**

This technique describes the fitting of line splices, bird diverters and spiral vibration dampers to overhead distribution lines up to 33 kV.

![Figure 1: Fitting of a line splice](image)

**Parameters**

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- The conductor to be worked on must be visually inspected, from below and above, for excessive damage such as broken strands.
- If the damage found is deemed to be excessive, the work task must not commence.
- When applying repair line splices maintain full control at all times to avoid flick back into the HV Live Worker.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

**Technique**

- Cover all adjacent phases, circuits and second points of contact.
- Confirm the area of conductor where the equipment is to be fitted is suitably prepared.
- When installing line splices and vibration dampers as a single person task, a cable tie can be used to ensure that the end of the preform is controlled at all times.
- Hold one half of the preform securely against the conductor whilst wrapping the other half of the preform along the conductor.
- Complete by wrapping the other end of the preform along the conductor.
• Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
<tr>
<td>Personal</td>
<td>HV Live workers</td>
</tr>
<tr>
<td>2+</td>
<td>• 1 in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
</tbody>
</table>
7.2. Installing temporary bypass jumpers

Purpose

This technique describes how to bridge overhead distribution lines up to 33 kV to enable the temporary bypassing of electrical current. This allows for the replacement, removal or joining of electrical conductors or apparatus.

![Figure 1: Fitting a temporary by-pass jumper](image)

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Check that the current rating of the bypass tools and equipment has a current rating adequate for the feeder load.
- Establishing the feeder load using a HV ammeter, before and after work task.
- Temporary conductor supports or insulating covers / barriers must be used so that the temporary bypass jumper does not contact any second point of contact.
- Two layers of insulation are required where contact cannot be avoided between any second points of contact, double cover.
- Never use temporary bypass jumpers to make and break load current or energise / de-energise a circuit, but can be used under no load situation.
- The temporary bypass jumper must only be used to bypass existing conductors to maintain continuity of supply.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
Technique (installation)

- Check and record the load current using an HV ammeter.
- Check that the temporary bypass jumper current and voltage rating is adequate.
- Cover all second points of contact within reach.
- Clean conductors thoroughly where the temporary bypass jumper connections will be made.
- Install insulated hanger if required, and visually confirm the temporary bypass jumper will be bridging the same phase.
- Check bypass jumper is securely attached to insulated hanger, then make your first connection, then remove bypass jumper from insulated hanger and make your second connection.
- Check the temporary bypass jumper is firmly attached to the temporary conductor support.
- A second layer of insulation need to be added to the bypass jumper if it is likely to come into contact with a second point of contact.
- Check the temporary bypass jumper is sharing the load before removing permanent bridging.

**Note:** The bypass jumper conductor size must be equal or greater than size conductor being worked on.

Technique (removal)

- Confirm all insulated mats and covers are still in place and secure, resecure if required.
- Check load current in the temporary bypass jumper using an HV ammeter.
- Reconnect the conductor or apparatus using approved connection method ensuring connections are clean.
- Measure the current in the conductor or apparatus and confirm the current is at least 50% value of the bypass jumper reading.
- Install insulated hanger, if required.
- Remove the temporary bypass jumper, ensuring that the first connection to be removed is held clear or parked on the insulated hanger until the second connection has been removed.
- Re-check load current is still at acceptable level.
- Remove all covers, temporary conductor supports and insulated hanger, if applicable.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.
## Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+</td>
<td>Temporary Bypass Jumper(s), the amount will depend on the work task</td>
</tr>
<tr>
<td>1+</td>
<td>Temporary Conductor Support</td>
</tr>
<tr>
<td>1+</td>
<td>Insulated Hanger</td>
</tr>
<tr>
<td>1</td>
<td>HV Ammeter</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

### Personal

- 3 HV Live workers
  - 2 in the EWP
  - 1 Safety Observer
7.2.1 Making and breaking bridges and taps (PG clamps)

Purpose

The technique describes how to make and break bridges and taps (PG clamps) on overhead distribution lines up to 33kV to de-energise / re-energise the supply.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Load current must be measured using HV ammeter and recorded.
- Isolation of circuits should only be undertaken with no load on the conductor.
- Bridges and taps must not be broken if the load current is greater than 2A.
- The energising and de-energising of overhead conductors may only be performed under the instruction of a switching program.
- When disconnecting, do not exceed the maximum length of open wire conductor respective to the working voltage.
- Maximum length of unloaded open aerial lines that can be energised or de-energised by operating open wire taps and bridges is 1.6 km.
- When reconnecting the open wire conductor the maximum length that can be energised will be determined by the line of sight the HV Live Worker can physically see along the line.
- Where the whole length of the conductor cannot be seen then a TDO fuse must be used.
- If load current cannot be removed then suitably rated load make and break devices are to be installed to control potential arc flash hazards.
- Always cover all second points of contact within reach.
- Only work on one potential at a time.

**Technique (breaking bridges)**

- Check the conductor electrical load with an HV ammeter and record result.
- Permanent bonds must not be broken if the load exceeds 2A.
- Inspect the permanent bridges for signs of damage, if damage is found on the bridge, it must be risk assessed to determine the actions to be taken before proceeding with the work.
- Cover all second points of contact within reach.
- Draw or photograph a phasing diagram and mark each bridge to identify which phase it came off, this will ensure you have the correct length of conductor for re-installation.
- Disconnect from the energised conductor, if the conductor is to be totally removed hold the bridge firmly and cut conductor away from both ends of attachment.
- Remove conductor and stow safely for re-installation. If the conductor is to be tied back – shape and fold the conductor back on to itself, and secure using PG clamps or rated cable ties.
- Remove the covering if the bridge break is for a sustained period.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

**Technique (making bridges)**

- Confirm that all safety requirements, equipment checks, switching programs and permits have been checked and are in place.
- Bridges must not be installed under load conditions.
- Cover all second points of contact within reach.
- Conductor contact points must be cleaned before connecting to conductor.
- For conductors which have been removed, using approved connections, connect the bridge to the de-energised conductor and, holding the bridge securely, connect to the energised conductor.
- For conductors that have been tied back, release the bridge while holding securely then connect to the energised conductor using approved connections.
- Remove covers and mats.
- Clean, wipe down and stow away all equipment.
- Where taps are used to break and make the connection, the above no load checks must be completed.
## Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
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<tr>
<td>1+</td>
<td>Temporary Bypass Jumpers, if required</td>
</tr>
<tr>
<td>1+</td>
<td>P G Clamps / Cable Ties</td>
</tr>
<tr>
<td>1</td>
<td>HV Ammeter</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
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### Personal

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</tr>
<tr>
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<td>• 1 Safety Observer</td>
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7.2.2 Energise overhead mains with a TDO fuse

Purpose

This technique gives detailed instructions on how to energise overhead distribution lines, up to 22 kV, with a TDO fuse.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- The TDO fuse is used to energise overhead mains to prove that no fault conditions exist before the connection is made.
- The maximum size fuse that can be fitted into the unit is 25 A.
- TDO must not be used on 33 kV systems.
- All TDO fuse units must be rated for the voltage being worked on.
- Never operate a drop-out device by using the gloved hand, only use an insulated operating stick.
- As in any G&B work always connect the temporary bypass jumper to the de-energised part of the circuit first, this limits the time spent handling an energised temporary bypass jumper.
- The energising and de-energising of overhead conductors may only be performed under the instruction of a switching program.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
Technique

- Clean the conductor and connect the TDO fuse unit onto the overhead line, ensuring the TDO fuse is open / removed.
- Connect the temporary bypass jumper between the tee bar of the TDO fuse and the point of supply.
- For a three phase system repeat steps above for the other two phases.
- The fuse barrel or barrels can now be installed and closed using an insulated operating stick to energising the circuit in accordance with the switching program.
- Ensure correct rated HV fuse are used.

**Note:** If the HV fuse operates during switching operations, the reason for the fault must be determined

- The connection / connections between the overhead line and the point of supply can now be made.
- Check load readings using a HV ammeter and confirm with HPCC.
- Open the TDO, then remove temporary bypass jumpers and TDO units.
- Remove covers.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

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<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
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<tr>
<td>1+</td>
<td>Temporary Drop Out Fuse Unit(s) (TDO)</td>
</tr>
<tr>
<td>1+</td>
<td>Temporary Bypass Jumper</td>
</tr>
<tr>
<td>1</td>
<td>HV Ammeter</td>
</tr>
<tr>
<td></td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment</td>
</tr>
<tr>
<td>Variable</td>
<td>to cover live conductors and second points of contact within</td>
</tr>
<tr>
<td></td>
<td>reach.</td>
</tr>
<tr>
<td></td>
<td><strong>Personal</strong></td>
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<td>• 2 in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
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</table>
7.2.3 Change HV fuses unit(s)

Purpose

This technique gives detailed instructions on how to change HV fuses and fuse units, up to 22 kV, with a TDO.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- TDO fuses must be used when changing HV fuses so that the supply can be maintained and protection still provided.
- TDO fuse units are not to be used on 33kV.
- All TDO fuse units must be rated for the voltage being worked on.
- The maximum size fuse that can be fitted into the unit is 25 A.
- Do not operate a TDO by the gloved hand only. An insulated operating stick must be used.
- The TDO fuse must never be used to make or break load current when changing HV fuses or fuse units.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique

- Check the feeder load current using an HV ammeter and record result.
- Check that the temporary bypass jumper current and voltage rating is adequate.
- Cover all second points of contact within reach.
- Secure existing expulsion drop-out fuse unit with a cable tie.
- Clean the conductor and connect the TDO fuse unit onto the overhead line, ensuring the drop-out fuse is open.
- Connect temporary bypass jumper between the tee bar of the TDO fuse unit and the other side of the HV fuse.
- The fuse barrel can be closed using an insulated operating stick.
- Measure the load current in the temporary bypass jumper and confirm the load is being shared prior to commencing work task.
- The HV fuse or fuse unit can now be replaced.

**Technique (removal)**
- Ensure that the expulsion drop-out fuse of the new unit has been loaded with correct fuse rating and secured with a cable tie.
- Check and measure load current with HV ammeter.
- Open the fuse on the TDO fuse.
- Remove temporary bypass jumper.
- Remove TDO fuse unit.
- Remove cable tie from new fuse unit.
- Remove covers and mats.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

**Resources**

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<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
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<tbody>
<tr>
<td>1+</td>
<td>Temporary Drop Out Fuse Unit (TDO): rated and tested</td>
</tr>
<tr>
<td>1+</td>
<td>Temporary Bypass Jumper: rated and tested</td>
</tr>
<tr>
<td>1</td>
<td>HV Ammeter</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
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**Personal**

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<th>Amount</th>
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<td>- 1 Safety Observer</td>
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</table>
7.2.4 Installing inline isolators

Purpose

This technique describes the installation of inline isolator links using helical dead-ends. Inline isolators are installed to isolate sections of the network allowing work to be carried out under EAPs.

Figure 1: Inline isolator

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Inline isolators leads must have a valid test date which must not expire during the period that they are installed.
- Inline isolators must be inspected for operation and damage prior to each use.
- They must be stored and transported in a manner which ensures the equipment is not exposed to excess moisture, dust, abrasion or any other deteriorating effects.
- When fitting the inline isolator, ensure that the link opens towards the de-energised side.
- Electrical load current must be measured and not exceed 200A, record the result.
- When using dead end wraps they must be new and in good condition, never re-use old dead end wraps.
- Lockable come alongs can also be utilised.
- The assembly components can be constructed on the line if weight is a problem.
- The maximum time an inline isolator can be installed is 90 days.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
Technique (installation)

- Inline isolators must be installed as close as possible to the pole / cross-arm to prevent excess conductor movement.
- Inline isolators must be installed in a staggered configuration to prevent the blades from breaching the phase-to-phase clearances when in the open position.
- Inline isolators must be installed with the blade open toward the de-energised side, load side.
- For three-phase systems, if the SAD cannot be maintained, ensure all second points of contact within reach are covered.
- Suspend the isolator on the conductor using the opposing hooks, ensuring the blade opens towards the de-energised side, load side.
- Clean the connection point on the conductor.
- Wind up the turnbuckle ratchet to achieve conductor tension.
- Apply integrated jumpers to the conductor as close as possible to both of the dead-end eyes and ensure connections are tight, ensure conductor is cleaned.
- Confirm the blade is closed and secure with a cable tie.
- Confirm load current in the integrated jumper is sharing the load prior to work task commencing.
- Cut conductor between last insulating skirts, bend back section of conductor.
- Secure tails using cable ties back along conductor being careful not to birdcage conductor.
- Remove securing cable tie from isolator blade, if SAD cannot be maintained, cover isolator with insulating mat ensuring second points of contact are insulated before installing isolators on adjacent phase.
- Repeat above procedure for all phases.
- Remove mats and covers from the overhead distribution lines.

Note: Once isolators are operational, they can only be opened or closed

Technique (removal)

- If SAD cannot be maintained, ensure second points of contact are insulated before removing isolators on adjacent phases.
- Inspect inline isolators for integrity of connections and confirm blades are closed.
- Secure isolator blades with cable ties.
- Apply the compression sleeve to the short side conductor tail and crimp.
- Tension up additional slack in conductor to allow crimping tool access.
- Control all conductor tails when inserting conductor into tension joint, and then crimp ensuring the correct crimping dyes are selected.
- Release tension on conductor using ratchet or turnbuckle.
- Check electrical load is being shared and in within acceptable range as per pre work task readings.
- Remove integrated jumpers and secure to isolator.
- With the isolator suspended on the conductor using the opposing hooks, the preformed dead-end can be removed.
- Remove isolator from the conductor.
- Repeat for all phases.
- Remove mats and covers from the overhead distribution line.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

**Resources**

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<th>Amount</th>
<th>Minimum Equipment Required</th>
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<tr>
<td>3</td>
<td>Inline Isolators within current test date and tagged</td>
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<tr>
<td>6</td>
<td>New dead ends for appropriate size of conductor</td>
</tr>
<tr>
<td>3</td>
<td>Tension crimps for appropriate size of conductor</td>
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<tr>
<td>1</td>
<td>HV Ammeter</td>
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<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
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<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
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**Personal**

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<th>Amount</th>
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<td></td>
<td>- 1 Safety Observer</td>
</tr>
</tbody>
</table>
7.2.5 De-energise-Re-energise u/g cables connected to 22kV overhead system

Purpose

This technique describes how to de-energise and energise U/G cables on voltages up to 33 kV.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- No work can be carried out on poles that have old style cast iron cable termination boxes.
- Where possible, the underground cable must be isolated from all sources of load.
- The cable to be de-energised/energised must be less than 1.0 km in length.
- De-energising/energising an underground cable must only be performed under the instruction of a switching program and under the direct supervision of a switching operator.
- A TDO must be used to re-energise the cable and de-energise a cable where transformer windings are connected, transformer windings are classed as load when picking up applied voltage.
- Temporary bypass jumpers are only classed as single insulated.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique (de-energise cable no load)

- Confirm there is no load current present with an HV ammeter.
- Cover conductors and all second points of contact within reach.
- Check that the switching operator is witnessing the operations and that the disconnection is okay to go ahead.
- Remove bridges to the cable box.
- Disconnect the conductor, if the conductor is to be totally removed, hold and secure firmly.
- Cut conductor away from both ends of attachment, remove the conductor and store safely ready for re-connection.
- If the conductor is to be tied back, shape and fold the conductor back and secure to the overhead conductor that it is connected to, use either PG clamps or rated cable ties.
- Repeat for all phases.
- Remove covers and barriers.
- Clean, wipe down and stow away all equipment.

**Technique (energise cable with a TDO)**

- Install TDO fuse units to the overhead conductor, ensuring the fuse is not installed and open position.
- Ensure the TDO fuse is fitted with a maximum 25 A fuse element.
- Install temporary bypass jumper between the TDO fuse on the load side, and the underground cable dropper leads, leaving enough tail to connect to the main line.
- Repeat above steps for all phases.
- Check that the switching operator is witnessing the operations and that the cable is ready to energise.
- Using an insulated operating stick, install all three fuses.
- Using an insulated operating stick, close each TDO fuse on all phases.
- Connect each permanent bridge to the respective overhead conductor and underground cable in turn on all phases.
- Using an insulated operating stick, open all three fuses.
- Remove the temporary bypass jumper and TDO fuse from all phases.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

**Note:** Where underground cables are connected to the overhead conductors through a rated switch, the switch should be used to de-energise and re-energise the cable. The live work component of the task is the reconnection and disconnection of the bridging cable.
### Resources

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<th>Amount</th>
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<tbody>
<tr>
<td>3</td>
<td>TDO fuse units, tested and in date</td>
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<tr>
<td>3</td>
<td>Temporary bypass jumpers</td>
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7.2.6 Fit and remove temporary polymeric insulator with turnbuckle

Purpose

This technique describes how to install polymeric insulators into conductors to make temporary points of isolation on distribution poles, up to 33 kV.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- The polymeric insulator must be installed so that when the cable is cut it isolates the supply to a normal open point or point of isolation.
- The energising/de-energising of overhead conductors may only be performed under the instruction of a switching program.
- When disconnecting, do not exceed the maximum length of open wire conductor respective to the working voltage.
- When reconnecting the open wire conductor the maximum length that can be energised will be determined by the line of sight the HV Live Worker can physically see along the line.
- Only use insulators that are tested or new and unused.
- Rated electrically and mechanically for the voltage being worked on.
- When cutting the conductor, the longest end must be on the de-energised side.
- No load is to be broken when the conductor is cut.
- No load is to be connected when the conductor is re-joined.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique (installation)

- The line must be tested with an HV ammeter to prove that no load greater than 2 A will be broken.
• For three-phase systems, if SADs can’t be maintained, follow, Apply insulating barriers / covers and mats’ to cover adjacent phases not being worked and second points of contact.
• Whilst one person holds the insulator and turnbuckle ratchet, wrap preform dead-end to one side of the insulator and then install the second preform dead-end to the other side.
• The turnbuckle ratchet is wound to take up the conductor tension.
• Always cut conductor so that the longer end of the conductor is on the de-energised end.
• Secure longer tail using cable ties back along conductor, being careful not to birdcage conductor, and maintain full control at all times.
• If SADs cannot be maintained, follow, Apply insulating barriers / covers and mats’ to cover insulator, turnbuckle and second points of contact before installing the temporary polymeric disc on adjacent phase.
• Repeat above steps for all phases.

Technique (removal)

• If SADs cannot be maintained, follow, Apply insulating barriers / covers and mats’ to cover insulator, turnbuckle and second points of contact before removing insulator and turnbuckle on adjacent phases.
• The conductor must not be re-joined under load conditions.
• Apply the joint to the short side conductor tail and crimp.
• Draw up additional slack in conductor to allow crimping tool access.
• Maintaining control of the longer tail, insert conductor into tension joint and crimp.
• Release tension on conductor using turnbuckle.
• Unwrap and remove dead-ends and remove insulator and turnbuckle.
• Repeat above steps for all phases.
• Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

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<td>Full tension joints relevant to conductor size</td>
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<td>• 1 Safety Observer</td>
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</table>
7.2.7 Recover and erect poles

Purpose

This technique describes how to recover and erect poles on the distribution system up to 33kv.

![Figure 1: Pole erection between phases](image)

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Where a SAD of 1200 mm from the bare conductor to the pole or mobile plant cannot be maintained, one layer of insulation must be applied.
- Reducing the SAD to 450 mm. If a 450 mm SAD cannot be maintained, two layers of insulation must be applied, this can be achieved by applying covers to conductors, pole or both in case of inadvertent contact.
- Spiral link sticks and 16 mm tag lines can be attached to the conductor cover to allow for the covering to be moved as required; alternatively you can apply two layers of insulation around the conductor and attach the tag line to the covers.
- An assessment must be carried out on the levels of covering required to complete the erection or recovery.
- Where the pole is controlled by personnel from the ground, insulating gloves rated to the highest voltage being worked on must be worn.
- The pole butt must be controlled until it is safely positioned into the pole hole.
- SAD between the crane and live conductors must be maintained at all times.
- The pole erection / recovery must be carried out under the control and direction of a safety observer and a dogman / rigger.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

**Technique (recover pole)**

- The crane and all lifting equipment used in the erection or recovery of the pole must be assessed before the lift commences.
- If the conductors have been lifted the extra weight of the covering must be taken into consideration.
- Confirm that an appropriate procedure has been used to raise or spread the conductors.
- Attach spiral link sticks and 16 mm tag lines to insulating covers as required.
- Attach lifting boom to the pole with a lifting chain and close the pole scissors around the pole.
- Ensure that the point of balance is determined so that the pole is butt-heavy when lifted.
- A hydraulic pole jack must be used when removing a pole from the ground.
- For steel / concrete poles, a trailing temporary earth must be fitted before removing pole from ground.
- Manoeuvre the pole away and down from the live conductors.
- Where the pole is controlled by personnel from the ground, insulated gloves rated to the voltage being worked on must be worn.
- The covering may be repositioned using the tag line and spiral link sticks as required.

**Technique (erect pole)**

- The crane and all lifting equipment used in the erection or recovery of the pole must be assessed before the lift commences.
- If the conductors have been lifted the extra weight of the covering must be taken into consideration.
- Determine a suitable displacement procedure that will be used to raise or spread the conductors.
- Determine the height of the conductors and the pole to be planted.
- Attach spiral link sticks and 16 mm tag lines to insulating covers as required.
- Position the lifting boom and pole in the most appropriate position.
- Determine the point of balance of the pole and place the chain around the pole to make the pole butt-heavy for the lift.
- For steel / concrete poles, a trailing temporary earth must be fitted to the pole when manoeuvring pole into position.
- As soon as possible, support the pole in the mechanical pole scissors attached to the crane boom.
- Manoeuvre the pole into position and plant into the pole hole.
- Where the pole is controlled by personnel from the ground, insulated gloves rated to
  the voltage being worked on must be worn.
- Insulated gloves worn by ground workers can be removed once the pole has been
  located into position, backfilled or supported by the crane.
- The covering may be repositioned using the tag line and spiral link sticks as
  required.
- The pole hole is to be back filled and rammed to secure pole into position prior to
  removing the lifting boom.
- Determine a suitable procedure to be used to secure the conductors on to the new
  pole.
- Clean all equipment before you stow it away, and ensure that the work site is left
  clean and tidy.

Resources

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<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
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<tr>
<td>3</td>
<td>16mm insulated tag lines, if required through work task process</td>
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<tr>
<td>3</td>
<td>Spiral link sticks, if required through work task process</td>
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<tr>
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<td>Variable</td>
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<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach</td>
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Personal

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<th>Amount</th>
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<tr>
<td></td>
<td>- 1 Safety Observer</td>
</tr>
<tr>
<td></td>
<td>- Dogman/Rigger</td>
</tr>
</tbody>
</table>
## 7.3. Change pole-top switch or switch pole

### Purpose

This technique describes how to change a closed pole-top switch or switch pole on voltages up to 33 kV.

![Figure 1: Pole Top Switch Replacement](image)

### Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Temporary bypass jumpers are only classed as single insulated and must not be rested on second points of contact unless a second layer of insulation is applied to the temporary bypass jumper.
- Temporary bypass jumpers must not be used to make or break load.
- The temporary bypass jumper must have sufficient load carrying capacity.
- Work must only take place on one potential at a time.
- The method of displacing and replacing the conductors must be established before work commences.
- This procedure can be carried out using one or two glove and barrier teams working from two EWP's on the same phase / potential, at the same time.
- The preferred method is to work on the outside conductor, the middle conductor and finally the last outside conductor. When reconnecting the conductors, the reverse sequence for displacing the conductors should be used.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

**Note:** When two (2) EWP's are working on different phases / potential, a gap of 2000mm must be maintained between each EWP, and a safety observer assigned to each EWP. When one EWP is used, a minimum of **FOUR** HV Live Workers are required for a pole change.
Technique (join and displace conductors)

- Confirm the switch is locked in the closed position.
- Visually inspect the switch and conductors for any signs of damage or burning.
- Electrical loads must be taken and verified with HPCC.
- Cover all second points of contact within reach.
- Cut and prepare a suitable length of conductor by applying two layers of insulating covering to the centre section of conductor, then roll up each end of the conductor and secure it.
- The double insulated section of the conductor is secured to the switch frame and the remaining conductor is secured along the existing conductor using cable ties.
- Using a strap hoist with a come-along attached at each end, attach one come-along to the new conductor and one to the existing, ensuring there is no slack in the strap hoist.
- Clean and attach a temporary bypass jumper to the new and existing conductors.
- At the other side of the switch, unroll the conductor and, using a strap hoist with a come-along attached at each end.
- Attach one come-along to the new conductor and one to the existing and take up tension on the strap hoist.
- Clean and attach a temporary bypass jumper to the new and existing conductors.
- Tension can now be taken up on the strap hoists until the insulators on the switch are no longer under tension.
- The existing conductor can now be cut and joined to the new conductor at each end.
- The existing conductor and cable ties can be removed.
- Remove both temporary bypass jumpers.
- Release tension on both strap hoists and remove.
- The conductor can now be displaced and secured away from the switch.
- Repeat above steps for the centre and second outer phase.

Figure 2: Pole Top Switch replacement set up
Technique (replace conductors and reconnect the switch)

There are two methods that can be applied to restore the conductors to the switch;

**False bridge method**

- Confirm that the switch is closed and locked before starting to reconnect.
- Move the centre phase conductor back into position on the switch frame ensuring that the conductor is double insulated.
- Connect the insulator to the conductor using preform dead-ends.
- Connect the false bridges to the switch (female side) and raiser bar (male side) and then to the cleaned conductor.
- Take up conductor tension using a strap hoist before cutting the conductor to eliminate shock loading on the switch.
- The tension on the conductor can be released.
- Remove the redundant conductor from the switch.
- Repeat above steps for all other phases.
- Once all phases are connected, all insulating coverings can be removed.
- Clean, wipe down and stow away all equipment.

**Continuous bridges method**

- Confirm that the switch is closed and locked before starting to reconnect.
- Cover all second points of contact within reach.
- Move the centre phase conductor back into position on the switch frame, ensuring that the conductor is double insulated.
- Connect the insulator to the conductor using preform dead ends.
- Take up conductor tension using a strap hoist before cutting the conductor to eliminate shock loading on the switch.
- Install a temporary bypass jumper.
- Cut conductor and connect each tail to the switch.
- The tension on the conductor can be released.
- Repeat above steps for all other phases.
- Once all phases are connected, all insulating coverings can be removed.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

**Resources**

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Temporary bypass jumpers, in current test date</td>
</tr>
<tr>
<td>2</td>
<td>Spiral link sticks</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------------</td>
</tr>
<tr>
<td>1</td>
<td>HV Ammeter</td>
</tr>
<tr>
<td>2+</td>
<td>Strap hoists and rated slings, or more if required</td>
</tr>
<tr>
<td>4+</td>
<td>Come-along, or more if required</td>
</tr>
<tr>
<td>1</td>
<td>Crane, including vehicle earth, pole puller and rated pole chain, if required</td>
</tr>
<tr>
<td>3</td>
<td>Lengths of same size conductor</td>
</tr>
<tr>
<td>6</td>
<td>Full tension sleeves, matching conductor size</td>
</tr>
<tr>
<td>6+</td>
<td>Dead-ends to match conductor size, and a spare</td>
</tr>
<tr>
<td>2</td>
<td>Crimping tools</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
<tr>
<td>Personal</td>
<td>HV Live workers if using two EWP’s</td>
</tr>
<tr>
<td>8+</td>
<td>- 2 in each of the EWP’s</td>
</tr>
<tr>
<td></td>
<td>- 2 Safety Observers, one for each EWP</td>
</tr>
<tr>
<td></td>
<td>- 1 Dogger/Rigger</td>
</tr>
<tr>
<td></td>
<td>- 1 Crane Operator</td>
</tr>
</tbody>
</table>
7.3.1 Maintain or repair pole top switches

Purpose

This technique describes how to maintain or repair switches on voltages up to 33 kV.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- The operational state of the switch must not be changed. If the switch is in a closed position it must be bypassed and if the switch is in the open position no bypassing of the switch is necessary.
- Temporary bypass jumpers are only classed as single insulated and must not be rested on second points of contact unless a second layer of insulation is applied to the temporary bypass jumper.
- Temporary bypass jumpers must not be used to make or break load.
- The temporary bypass jumper must be of sufficient load carrying capacity.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique (maintain switches in closed position)

- Confirm the switch is locked in the closed position.
- Visually inspect the switch and conductors for any signs of damage or burning.
- Electrical loads must be taken and and noted on JRA.
- Clean the conductor where the temporary bypass jumpers will be connected.
- Attach the temporary bypass jumper to either side of the switch, ensuring the corresponding phases are connected.
• Measure the current in the bridge and confirm the load is shared
• Repeat above steps for all other phases.
• Unlock and carefully open the switch, taking care not to trap or compromise the temporary bypass jumpers.
• If required for maintenance, remove bridges from all three phases from one side of the switch.
• To completely isolate the switch, both sides of the switch will require all the bridges to be removed.
• All bridges removed must be safely secured to avoid any inadvertent movement during maintenance activities.
• Check the switch operation and clean all points of contact.
• Reconnect all bridges that were removed for maintenance.
• Close and lock the HV switch.
• Verify electrical loads same as before work task, and confirm with HPCC.
• Remove temporary bypass jumpers and remove all equipment and insulating covers.

Note: Temporary bypass jumpers must be of the same size or greater than the conductor bridges being removed. Temporary bypass jumpers must be double covered when resting on HV switch earthed frame.

Technique (maintain switches in the open position)

• Confirm the switch is locked in the open position.
• Visually inspect the switch and conductors for any signs of damage or burning.
• If required for maintenance, remove bridges from all three phases on one side of the switch.
• To completely isolate the switch, both sides of the switch will require all the bridges to be removed.
• All bridges removed must be safely secured to avoid any inadvertent movement during maintenance activities.
• Check switch operation and clean all points of contact.
• Confirm switch is opened and locked.
• Reconnect all bridges that were removed for maintenance.
• Remove all equipment and insulating covers.
• Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.
## Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Temporary Bypass Jumpers</td>
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<tr>
<td>1</td>
<td>HV Ammeter</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
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### Personal

<table>
<thead>
<tr>
<th>3</th>
<th>HV Live workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• 2 in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
</tbody>
</table>
7.3.2 Change surge diverters

Purpose

This technique describes how to replace surge diverters on voltages up to 33 kV.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Insulating sticks must be used to energise/de-energise surge diverters.
- Only install correctly rated and tested composite-type diverters.
- A 5000 V insulation resistance tester can be used to prove the integrity of the new surge diverter. The surge diverter shall be tested for 1 minute at 5000 V with result of 1000 M ohms or 1 G ohm.
- No work can be carried out on poles that have old style cast iron cable termination boxes.
- All the surge diverters must be isolated from all sources of supply before replacing.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique (removal)

- Disconnect all surge diverters from the overhead conductor, using wire holding sticks and cutters.
- Once the active of the surge diverter has been disconnected, it must be discharged to earth.
- Repeat above steps for all other phases.
- All porcelain surge diverters must be replaced.
Figure 2: Removal of Bridge from Surge Diverter

Technique (replacement)

- Confirm that the new surge diverters are correctly rated and tested prior to installation.
- Install the surge diverter and confirm that it is bonded to earth.
- Connect the bridge to the surge diverter and, using a wire holding stick, touch test the bridge to the conductor for a minimum of 10 seconds.
- Permanently connect the bridge to the conductor.
- Repeat above steps for all other phases.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
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<tbody>
<tr>
<td>1</td>
<td>Insulation resistance tester, 5000 Volts</td>
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<tr>
<td>3</td>
<td>New tested and rated surge diverters</td>
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<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
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</tr>
<tr>
<td></td>
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</tbody>
</table>
7.3.3 Repair tensioned conductor

Purpose

This technique describes how to repair conductors under tension on the distribution system up to 33 kV.

![Conductor Under Tension Ready to be Cut and Repaired](image)

Figure 1: Conductor Under Tension Ready to be Cut and Repaired

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- The effects of the increased tension applied to the conductor and fittings being worked on must be considered.
- Consideration must be given to the increase or decrease of the conductor sag.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique

- Confirm the feeder load and peak load current from HPCC and check that the temporary bypass jumper current and voltage rating is adequate.
- Check the extent of damage to the conductor to ensure that this task can be done safely using HV Live Working procedures. If in many doubt make arrangements to de-energise the lines and carry out repair to the conductor.
- Recheck the load using an HV ammeter.
- Attach two come-along clamps either side of where the conductor is to be repaired and place the tensioning device between the come-along clamps.
- Take up tension using the tensioning device.
- Clean conductors where the temporary bypass jumper connections will be made.
- Install temporary bypass jumper across section of conductor to be worked on.
• Attach the temporary bypass jumper to the first connection point, ensuring that the over end of the bypass is securely held, and then make the second connection to the conductor.
• Measure the current in the temporary bypass jumper and confirm the presence of current.
• Take up extra tension in the conductor, enough to make repair.
• The conductor can now be cut and repaired.
• Join the conductors together using a correctly sized full tension sleeve.
• Remove tension from the tensioning device, remove tensioning device and come along.
• Remove temporary bypass jumpers and check load current on both sides of tension sleeve.
• Repeat steps on all other phases if required.
• Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

<table>
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<tr>
<th>Amount</th>
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<td>HV Ammeter</td>
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<td>1</td>
<td>Strap Hoist</td>
</tr>
<tr>
<td>2</td>
<td>Come along line clamps</td>
</tr>
<tr>
<td>1+</td>
<td>Full Tension Sleeves to match conductor size, as required</td>
</tr>
<tr>
<td>1</td>
<td>Crimp Tool and corresponding conductor size dyes</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
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<td>• 2 in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
</tbody>
</table>
7.4. Change tension insulator

Purpose

This technique describes how to change tension insulators on distribution poles up to 33 kV.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- The effects of the increased tension applied to the conductor and fittings being worked on must be considered.
- Care must be taken to ensure that the insulators are not bridged out when performing this procedure.
- Consideration must be given to the increase or decrease of the conductor sag.
- The link stick must have at least 450 mm of insulation and within test date.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Techniques

- Cover all live conductors within reach.
- Attach nylon sling around cross arm.
- Place come-along clamp onto the conductor at a distance away from the insulator to allow for the spiral link stick and extended tensioning device to be attached.
- Attach the link stick to the nylon sling.
- Place covers over the cross-arm and conductor.
- Place the tensioning device between the link stick and come-along clamp.
- Take up tension with the tensioning device until there is enough slack to detach the insulators.
- Place insulating cover on the conductor between the insulator and come-along to ensure a safe work area.
- When detaching the conductor from the insulator, the conductor must be supported so that it does not swing free.
- Replace the insulators and slacken the tensioning device.
- Remove the tensioning device from the come-along clamp first, and then from the link stick.
- Remove come-along clamp, link stick, nylon sling and covers.
- Repeat as necessary for other phases.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

![Figure 2: Link Stick and Tensioning Device with the second points of contact covered](image)

### Resources

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<th>Amount</th>
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<tr>
<td>1</td>
<td>Come along line clamp</td>
</tr>
<tr>
<td>1</td>
<td>Spiral link stick (minimum 450mm insulation) in test date</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
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### Personal

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<tr>
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</tr>
<tr>
<td></td>
<td>1 Safety Observer</td>
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</tbody>
</table>
7.4.1 Change suspension hardware

Purpose

The procedure describes how to change suspension hardware on distribution poles up to 33 kV.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- The effects of the increased tension applied to the conductor and fittings being worked on must be considered.
- Consideration must be given to the increase or decrease of the conductor sag.
- A suitable lifting HV live work procedure must be determined before work commences.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique (insulator disconnection)

- Determine a suitable displacement procedure from this manual to be used to raise the conductor.
- Secure conductor in the wire holder or attach link stick and lifting device.
- Remove split pin and loosen the nut on the clevis bolt whilst the tension is still on the insulator.
- Use lifting device to raise the conductor so that the conductor clamp becomes slack.
- Remove the clevis bolt from the conductor clamp.
- The conductor can now be lowered and moved to provide a safe work area to carry out the insulator/hardware change.

Figure 1: Suspension insulators
Technique (insulator reconnection)

- Move conductor back into position.
- Attach the suspension clamp and reinstate the clevis bolt.
- Lower the conductor so that the tension is applied to the insulator.
- Replace the clevis bolt and nut and replace the split pin.
- Detach the conductor from the wire holder or sticks and remove lifting device.
- Clean, wipe down and stow away all equipment.

Technique (conductor clamp removal)

- Determine suitable displacement procedure from this manual to be used to raise the conductor.
- Secure conductor in the wire holder or attach link stick and lifting device.
- Remove the conductor U-clamp bolts from under the conductor clamp.
- Remove the U-clamps and conductor tongue.
- Remove split pin or loosen the nut on the clevis bolt whilst the tension is still on the insulator.
- Raise the conductor so that the conductor clamp becomes slack.
- Remove the clevis bolt from the conductor clamp.
- The conductor can now be lowered and the conductor clamp changed.

Technique (conductor clamp replacement)

- Move conductor back into position.
- Attach the suspension clamp and reinstate the clevis bolt to attach the conductor clamp to the insulators.
- Lower the conductor so that the tension is applied to the conductor clamp.
- Replace the conductor tongue and U-clamps over the conductor.
- Tighten the nuts on the U-clamps.
- Detach the conductor from the wire holder or sticks and remove lifting device.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

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<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Spiral link stick (minimum 450mm insulation) in test date, if required</td>
</tr>
<tr>
<td>1</td>
<td>Webbing strap ratchet hoist, if required</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
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</table>
Variable | Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.
--- | ---
**Personal**

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</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
</tbody>
</table>
7.4.2 Change RDA insulator

Purpose

This technique describes how to displace conductors on RDA distribution poles, up to 33kV, to enable insulator replacement.

![Figure 1: Insulator Change Set up](image)

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Position the EWP on the outside of the angle where possible so that the bucket can reach both sides of the pole. If it is not possible to do this then the EWP may need to be repositioned.
- Link sticks with minimum insulation of 450mm must be used.
- Two smaller link sticks can be used as long as the combined insulation is equal to or greater than 450mm.
- Check that the conductor regulation is correct and that conductor clearances can be maintained during this procedure. This procedure must not be used if clearances cannot be maintained.
- Only replace strain insulators with new insulators of the same length to ensure conductor clearances are maintained.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
Technique

- Position EWP to install the 450kg rated snubbing bracket or slings and secure in place.
- At one side of the pole, attach link stick to the snubbing bracket or sling and attach the strap-hoist to the link stick.
- Support the strap hoist and spiral link stick and attach the come-along clamp to the conductor, take up slack with the strap-hoist and apply a small amount of tension to the conductor.
- Set up a strap-hoist and link stick with come-along clamp on the same conductor on the opposite side of the pole.
- The conductor must be observed in the adjacent spans at all times to ensure SADs are maintained.
- Apply equal tension to each strap hoist until the insulators sag enough to release the split pin on the conductor clamp.
- Remove the holding pin, detach the conductor clamp from the insulator string and control the insulators as they fall away from the conductor.
- The new insulator discs can now be placed into the eye bolt.
- If working inside the angle of the conductors, use an insulated stick to lift the insulators up to the conductor clamp and reinstall the holding pin and split pin. If the insulators can be controlled at the live end, the insulator can be moved into position with a gloved hand.
- When the conductor is secure, the tension on the conductors can be released and the come-along clamps removed from the conductor.
- Repeat above steps for all other phases.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Alternative rigging methods

Technique (live work rope and tensioning device method)

- Attach a 450kg rated snubbing bracket or sling to the pole and affix a running block.
- Secure the polypropylene rope to a link stick and apply the link stick to the line, directly as shown in Figure 3 or via come-along clamps, as shown in Figure 2.
- Locate the rope in the running block.
- Apply a second snubbing bracket or sling at the base of the pole and attach the strap-hoists, as shown in Figure 4. 5. Attach the polypropylene rope to the strap-hoist.
- When tension is applied via the strap-hoist, the conductor is pulled towards the pole slackening the tension on the insulator allowing for the insulator to be changed.
Technique (strap hoist and link stick method)

- Attach a snubbing bracket or sling to the pole.
- Attach a link stick to the snubbing bracket or sling.
- Attach two come-along clamps to the conductor each side of the conductor clamp.
- Fully extend a strap-hoist and secure the strap in the link stick hook.
- Attach each end of the strap hoist to the come-along clamps.
- Apply tension to the strap hoist; this will pull the conductor towards the pole, slackening the tension on the insulator, allowing for the insulator to be changed.
## Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
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</thead>
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<td>1</td>
<td>Snubbing bracket 450kg rated</td>
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<td>2</td>
<td>Slings</td>
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<tr>
<td>2</td>
<td>Strap Hoist</td>
</tr>
<tr>
<td>1+</td>
<td>12mm Synthetic live working rope</td>
</tr>
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<tr>
<td>2</td>
<td>Come along line clamps</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
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### Personal

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</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
<tr>
<td></td>
<td>• 1 ground worker if using the live work rope method and tensioning device method</td>
</tr>
</tbody>
</table>
7.4.3 Displace conductors – tag lines

Purpose

This technique describes how to move conductors using tag lines. The tag lines can be used to move the conductors vertically or horizontally.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Conductor movement must be closely monitored and controlled at all times.
- Assess the weight to ensure manual handling techniques can be used.
- The SWL / WLL of the EWP must not be breached when lifting the conductors.
- When securing tag lines, they must be attached to a suitable attachment such as a star picket on a 45° angle or to a vehicle with the keys removed from ignition.
- If using a star picket, be aware of underground assets when driving picket in to ground.
- When using tag lines, a 450mm link stick must always be placed between the live conductor and the rope.
- When moving the conductor to a temporary conductor support or new final conductor position, the new position must be ready to receive the conductor before the lift is commenced.
- If side force is to be maintained on the conductor so that the conductor can be displaced away from the pole, it must be confirmed that the minimum conductor ground clearance can be maintained.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
Technique

- Confirm that the conductor loads have been calculated before the conductors are displaced to ensure that the HV Live Worker will be able to comfortably lift the conductor when using the tag lines.
- Cover the conductor to be moved and all second points of contacts within reach.
- Ensure that there is a suitable attachment point to attach the tag line to before commencing the lift.
- If moving the conductor to a permanent or temporary position, confirm that the new position is ready for the conductor before starting the lift.
- If moving conductors away from the pole and securing to attachment point, check that the conductor will not drop below the minimum conductor ground clearance.
- When using tag line to pull conductors, always use controlled movement and maintain phase to phase and phase to earth clearances.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temporary conductor support, if required</td>
</tr>
<tr>
<td>1-3</td>
<td>12mm Synthetic live working rope</td>
</tr>
<tr>
<td>1-3</td>
<td>Spiral link sticks (minimum 450mm insulated) in date</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

Personal

| 4 | HV Live workers |
| - | 2 in the EWP |
| - | 1 Safety Observer |
| - | Ground worker & if pole is being changed |
7.5. Displace conductors – manual handling

Purpose

This technique describes how to move conductors that have light loads and need to be moved a minimal distance by manually lifting them into position on the distribution system up to 33 kV.

Figure 1: Displacing Conductors by Hand

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Conductor movement must be closely monitored and controlled at all times.
- Assess the weight to ensure manual handling techniques can be used.
- The SWL / WLL of the EWP must not be breached when lifting the conductors.
- The conductors can be moved to temporary cross-arm mounted extension arms, pole-mounted supports or securely held on the EWP bucket.
- Temporary conductor supports or new final conductor position must be ready to receive the conductor before the lift is commenced.
- Cross-arm mounted extension arms must not be used on wooden cross-arms as it cannot be determined if the wooden cross-arm is made of Batu wood.
- Conductor supports have an SWL / WLL ranging from 45kg to 90kg per wire holder.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique

- The EWP should be positioned to the side of the conductors that the temporary conductor support is attached.
• Cover the conductor to be moved and all second points of contact.
• Confirm that the temporary or permanent position that the conductor is to be moved to is ready for the conductor.
• Carefully untie conductors keeping the lashings short.
• The conductor must be held securely at all times.
• The conductor must be observed in the adjacent spans at all times to ensure conductor clearances are maintained.
• The conductor must be securely trapped in the wire holder or tied in at the new permanent position.
• Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temporary conductor support, if required</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount</th>
<th>Personal</th>
</tr>
</thead>
</table>
| 3+1    | HV Live workers  
  • 2 in the EWP  
  • 1 Safety Observer  
  • 1 extra if pole is going to be changed |
7.5.1 Displace conductors – Aichi auxiliary arm

Purpose

This procedure describes how to displace conductors on distribution poles, up to 33 kV, to enable the replacement of poles and pole-top hardware.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Maximum combined conductor lift is 175 kg.
- The main boom must be extended to the required length, indicated on the boom extension, to attain and maintain the full insulation value of the EWP.
- The Aichi auxiliary arm must only be used on intermediate poles or in between horizontally configured structures.
- The auxiliary arm and the conductor traps are assembled on the top of the mast and are used to trap the conductors.
- The main boom must not be used to lift the conductors. The sub-boom is used to lift conductors. The winch operates the sub-boom.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique (displacing conductors)

- Carry out a visual inspection of the insulators and auxiliary cross-arm.
- Check that there is a valid testing label on auxiliary arm.
- Check that the wire holders work.
- Fit winch-mounted mast onto EWP.
• Position the auxiliary cross-arm, complete with wire holders and release hooks, onto the winch-mounted mast.

  **Note:** An epoxy insulator must be fitted between the wire holder and the auxiliary arm when working on 22 kV and 33 kV systems

• Position and raise the auxiliary cross-arm under the conductors, securing the two outer phases in the wire holders.
• Support and untie the two outer phase conductors one at a time.
• Raise auxiliary cross-arm until remaining centre phase conductor is secured in the wire holder.
• Untie the centre phase conductor.
• In some situations, conductors may need to be untied from the outside to centre to outside due to the clearance on the LV and pole configuration.
• Raise auxiliary cross-arm (using the sub-boom only) until conductors are lifted to the required height to allow the maintenance task to be safely carried out outside of any SAD.
• Check and reposition insulating covers as required after the conductors have been displaced.

  **Note:** Check adjacent spans for conductor tightness and clearances. If mid span pole is to be installed, lift secured conductors with the EWP to required position, and then install mid span pole.

**Technique (reinstate conductors)**

• Reposition the insulating covers and cover up all secondary points of contact as required.
• Lower auxiliary cross-arm so the conductor rests on the centre phase insulator.
• Retie-in centre phase conductor.
• Open centre phase wire holder and lower the auxiliary cross-arm until the outer phase conductors are located on the insulators.
• Tie-in outer phases one at a time.
• Open the two outer phase wire holders and lower the auxiliary cross-arm.
• Some situations you may be required to tie in conductors from the outside to centre to outside due to the clearance on the LV and pole configuration.
• Remove all coverings from the conductors and second point of contact.
• Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.
## Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Auxiliary cross- arm and mast</td>
</tr>
<tr>
<td>3</td>
<td>Wire holders- able to be opened by HV stick method</td>
</tr>
<tr>
<td>3</td>
<td>33kV insulators- for additional insulation between auxiliary arm and wire holders</td>
</tr>
<tr>
<td>1</td>
<td>Winch mounted mast</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live</td>
</tr>
<tr>
<td></td>
<td>conductors and second points of contact within reach.</td>
</tr>
<tr>
<td></td>
<td><strong>Personal</strong></td>
</tr>
<tr>
<td>4</td>
<td>HV Live workers</td>
</tr>
<tr>
<td></td>
<td>• 2 in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
<tr>
<td></td>
<td>• 1 Ground worker</td>
</tr>
</tbody>
</table>
7.6. Displace conductors – three-phase lift using crane and lifting beam

Purpose

This technique describes how to displace conductors on distribution poles, up to 33 kV, to enable the replacement of poles and pole-top hardware.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- This procedure must only be used on intermediate structures.
- The lifting beam must be rated and tested and the SWL must be marked on the beam.
- The lifting beam is connected to the crane hook via two 1-tonne web slings and either two link sticks or two 33 kV tested and rated polymeric insulators.
- Attachments below the beam consist of either three spiral link sticks or three 33 kV tested and rated polymeric insulators.
- The preferred lifting angle between the lifting beam and the link sticks and strap should be 60°.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique (disconnection)

- Set up the lifting arm and attach to the crane boom.
- Position the crane boom so that the lifting arm is above the conductors.
- Position the conductor gates or rollers directly above the conductors and secure the conductors.
- Untie each conductor, working on one conductor at a time, until all the conductors are untied.
- Lift the conductors away from the pole hardware by raising the lifting beam.

**Note:** When lifting conductors in mid-bay to install a pole, secure conductors and lift until sufficient clearances are obtained.

![Figure 2: Conductors displaced ready for pole change](image)

**Technique (reconnection)**

- Confirm that all work is complete and all second points of contact have been covered.
- Lower the lifting beam, ensuring that the conductors are located in their permanent position.
- Tie-in all conductors, working on one conductor at a time.
- Remove conductors from the conductor traps and remove the crane boom and lifting arm from the work area and stow equipment and boom away.
- Remove all insulating coverings from the conductors and second points of contact.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

**Resources**

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
</table>

---

Document Title: High Voltage Live Work Manual
Document Number: CS# 2369013
© Horizon Power
Issue Date: Uncontrolled when Printed
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rated lifting beam</td>
</tr>
<tr>
<td>2</td>
<td>1 tonne webbing slings (inspected prior to use)</td>
</tr>
</tbody>
</table>
| 5 or 2&3 | • 33kV tested and rated polymeric insulators or spiral link sticks   
| | or   
| | • 2 tested and rated polymeric insulators and 3 spiral link sticks |
| 5 | Rated brackets and bolts |
| 3 | Rated D-Shackles |
| 3 | Rated conductor gates or rollers, only required when not using spiral link sticks |
| **Variable** | Pegs and cable ties to secure insulated mats and covers |
| **Variable** | Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach. |
| **Personal** |   |
| 4 | HV Live workers   
| | • 2 in the EWP   
| | • 1 Safety Observer   
| | • 1 Ground worker |
7.6.1 Displace conductors – crane boom-mounted auxiliary arm and mast

Purpose

This technique describes how to displace conductors on distribution poles, up to 33 kV, to enable the replacement of poles and pole-top hardware.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Conductor weights and lifting attachment weights must be taken into account, to ensure that the crane lifting capacity is suitable.
- The boom-mounted auxiliary arm must only be used on intermediate poles.
- The brace pole assembly may be installed either inline or offset to the conductors.
- The single wire holder is used for heavier conductors or single-phase construction and is installed in place of the cross-arm clamp assembly.
- Keep the mast as near as possible to vertical while holding up the conductors. Avoid pulling the conductors to the side to create, for example, line angles that may tip the boom unit.
- Rotate the arm so it is at a right angle to the conductors.
- The Chance boom-mounted auxiliary arm and mast assembly may only be mounted on a crane boom.
- The Chance boom-mounted auxiliary arm and mast assembly with double brace can be used to lift conductors up to a maximum balanced load of 270 kg when roller wire holder traps are used.
- The sub-boom auxiliary arm and conductor traps are assembled on the boom and are used to trap the conductors.
- The maximum single conductor lift is 90 kg.
• Always cover all second points of contact within reach.
• Only expose and work on one potential on at a time.

Technique (crane and lifting arm set up)

• The lifting arm should be set up so that it is 90° to the conductor. Where the attachment has a ratchet adjustment, the lifting arm can be adjusted as the conductors are lifted to keep the arm at 90°.

![Figure 2: Adjustable Ratchet Arm Set up](image)

• Keep the crane boom as near as possible to vertical whilst holding the conductors.
• The positioning of the lifting beam around the pole will depend on access.

**Note:** On flat constructions, all conductors are secured in the wire holders at the same time. The boom mounted auxiliary pole can be set up to lift a single conductor where only one insulator requires changing, this includes suspension insulators, or if a single phase pole change is required.

![Figure 3: Single Phase Lift Set up, SWL 90kg](image)
Technique (displacing conductors)

- Set up the auxiliary arm and attach to the crane boom.
- Position the crane boom so that the auxiliary arm is below the conductors.
- Position the conductor wire holders directly below the outside phase conductors and secure the conductors into the wire holders.
- Untie the conductors one at a time.
- Depending on worksite set up you may have to work from the outside in.
- Lift the crane boom until the centre phase conductor is trapped in the wire holder.
- Untie the centre conductor and raise all the conductors so that the SADs can be maintained to carry out the task.

Technique (replacement)

- Confirm that all work is complete.
- Lower the crane boom so that the centre phase conductor securely sits on the centre insulator.
- Tie-in the centre phase conductor to the insulator.
- Open the wire holder and slowly lower the Chance boom to release the conductor.
- Proceed to lower the crane boom so that the outer phase conductors are located securely on their insulators.
- Tie-in both conductors.
- Open both wire holders and slowly lower the Chance boom away from the live conductors.
- Remove all coverings from the conductors and second point of contact.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Conductor traps</td>
</tr>
<tr>
<td>1</td>
<td>Crane, including vehicle portable earthing lead (tested and in date)</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
<tr>
<td>4</td>
<td>HV Live workers</td>
</tr>
<tr>
<td></td>
<td>• 2 in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
<tr>
<td></td>
<td>• 1 Ground worker</td>
</tr>
</tbody>
</table>
7.6.2 Displace conductors – crane single conductor lift

Purpose

This technique describes how to displace conductors on distribution poles, up to 33 kV, to enable the replacement of single phase systems, poles and pole top hardware / insulators, and three phase systems pole top hardware and insulators.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- This procedure must only be used on intermediate structures.
- Two levels of insulation must be placed between the uninsulated part of the crane hook and live conductor.
- The insulation can be one of the following; two 33kV rated and tested polymeric insulators, one link stick with a minimum insulation distance of 1200mm, or two smaller link sticks with a combined insulation distance of 1200mm.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
- A drop zone must be established and agreed to by the HV Live Work team.

Technique (displace and replace conductors)

- Set up insulators or link stick(s) and attach to the crane hook.
- Position the crane hook directly above the conductors.
- Lower the hook and secure the conductor to the lifting insulators or link stick.
- Raise the hook and apply a small amount of tension to the conductor.
- Untie the conductor from the insulator then move the conductor to a position that provides a safe work area.
- Ensure all second points of contact within reach are covered.
- Lower the hook to place the conductor on the insulator.
- Tie-in the conductor to the insulator.
- Disconnect lift insulators or link stick from the conductor.
- If working on a three-phase system, repeat above steps to change pole-top hardware (if required) on the other conductors.

**Technique (displace and replace conductors with suspension insulators)**

- Set up insulators or link stick and attach to the crane hook.
- Position the hook directly above the conductors.
- Lower the hook and secure the conductor to the lifting insulators or link stick.
- Raise the hook and apply a small amount of tension to the conductor so that the insulator becomes slack.
- Disconnect the conductor clamp from the insulator.
- Ensure all second points of contact within reach are covered.
- Reconnect the conductor clamp to the insulator.
- Lower the hook so that the tension is applied to the insulators.
- Disconnect lift insulators or link stick from the conductor and remove crane from area.
- Repeat above steps for any other insulators that require changing.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

**Resources**

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 Tonne webbing slings (inspected before use)</td>
</tr>
<tr>
<td>1+</td>
<td>2 tested and rated 33kV polymeric insulators or 1+ Link stick(s) with a minimum insulation distance of 450mm (in date)</td>
</tr>
<tr>
<td>1</td>
<td>Rated D Shackles</td>
</tr>
<tr>
<td>1</td>
<td>Rated conductor holder (e.g. termination clevice, D shackle) only required if not using spiral link stick</td>
</tr>
<tr>
<td>1</td>
<td>Crane including portable vehicle earth (in date and tested)</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

**Personal**

| 4 | HV Live workers |
|   | • 2 in the EWP |
|   | • 1 Safety Observer |
|   | • 1 Ground worker |
7.6.3 Displace conductors – pole or cross-arm mounted insulating auxiliary arm

Purpose

This technique describes how pole-mounted insulating arms can be used on distribution poles, up to 33 kV, to enable the replacement of pole hardware. Where a free-floating conductor causes a clearance problem, but the nature of the task requires the conductor to be displaced away from the cross-arm and it is not possible to use an auxiliary arm and mast, the use of a temporary pole / cross-arm mounted arm can provide a solution.

![Figure 1: Pole Mounted Auxiliary Arm](image)

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Pole-mounted insulating arms may be rated as low as 15kV.
- Insulators must be fitted to the wire holders when used on 22kV and 33kV circuits.
- Care must be taken to ensure the correct length arm is used when displacing two conductors onto an arm.
- Cross-arm mounted extension arms can only be used on steel cross-arms.
- Cross-arm mounted extension arms **must not** be used on wooden cross-arms as it cannot be determined if the wooden cross-arm is made of Batu wood.
- Minimum phase-to-earth distance of 450mm must be maintained when conductors are secured on a temporary cross-arm.
- Minimum phase-to-phase distance of 550mm must be maintained.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
Technique (displace and replace conductors)

- Secure the insulating arm that is being used into position.
- Cover all second points of contact within reach.
- Untie one conductor at a time and displace the conductor to the wire holder and close the conductor gates to secure.
- Observe the conductors in the adjacent spans whilst the conductor displacement is in progress.
- Repeat steps above for all other phases, if required.
- Ensure all second points of contact within reach are covered.
- Open the conductor gate and displace the conductor back to the insulator and tie-in.
- Observe the conductors in the adjacent spans whilst the conductor replacement is in progress.
- Repeat above steps for all other phases, if required.
- Remove insulating arm, clean and stow away.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

Technique (cross arm mounted extension arm)

- Can be used on voltages up to 33kV providing the wire holders are fitted with insulators.
- The extension arm is suspended under the cross-arm by brackets to enable the conductor to be removed from the original cross-arm and placed in the wire holder mounted on the extension arm.
- Where two conductors are placed on the extension arm, the extension arm must be 1800mm in length.
- If the load exceeds 25kg then a 38mm brace must be used.
- The maximum conductor load must not exceed 68kg.

![Figure 2: Cross Arm Mounted Extension Arm](image)

Technique (pole-mounted conductor support)

- Can be used on voltages up to 34.5kV providing the wire holders are fitted with insulators.
- Can be attached to the pole using a chain and chain tightener or ratchet binder and nylon strap.
• Where two conductors are placed on the pole mounted conductor support, the conductor support must be 1200mm in length.
• The maximum vertical load will be determined by the size of the extension arm. This must be checked before work commences.

![Figure 3: Pole Mounted Conductor Support](image)

Technique (V-arm conductor support)

• Can be used on voltages up to 34.5kV providing the wire holders are fitted with insulators.
• The bi-arm mounting assembly can be fitted to the pole with a chain and chain tightener or ratchet binder and nylon strap.
• The V-arm is attached to the base and secured.
• Where three conductors are placed on the V-arm conductor support, the V-arm conductor support must be 2060mm in length.
• The conductor must be assessed and the SWL / WLL of the V arm confirmed to ensure that the load rating is not exceeded.

![Figure 4: V Arm Conductor Support](image)

Table 3: Conductor Clearance on Temporary Cross Arm

<table>
<thead>
<tr>
<th>Temp Arm Set Up For Conductor</th>
<th>Voltage</th>
<th>Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase to Earth</td>
<td>Up To 33kV</td>
<td>450mm</td>
</tr>
<tr>
<td>Phase to Phase</td>
<td>Up To 33kV</td>
<td>550mm</td>
</tr>
</tbody>
</table>
## Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temporary pole or cross- arm mounted insulating arm (in date and tested)</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

### Personal

- 3 HV Live workers
  - 2 in the EWP
  - 1 Safety Observer
7.7 Displace conductors – auxiliary arm

Purpose

This technique describes how to displace conductors on distribution poles, up to 33 kV, to enable the replacement of pole-top hardware.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Two 63 mm wire tong saddles are used to mount the mast of the auxiliary arm to the pole.
- Two braces can be fitted to increase the SWL of the rig to 204 kg using 68mm wire traps.
- Single brace has a SWL of 68kgs
- The auxiliary arm can be mounted either above or below the conductors.
- Line deviation over 5° is NOT permitted when using this rig.
- The reason that the auxiliary arm is used is to enable all conductors to be lifted at the same time by the operation of a tensioning device.
- Maximum lift is 68 kg per conductor with two brace arms fitted.
- Insulators must be installed between the arm and wire holder when used on 22 kV and 33 kV systems.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique (position plant and EWP)

The preferred option is for the EWP to be positioned either side of the line. The EWP’s turret may be positioned inline, forward or behind the pole alignment.
The conductor holders used will determine the position on the auxiliary cross-arm, and the conductor holder spacing will need to be a minimum of 550 mm between phases.

**Technique (installing the auxiliary cross-arm)**

- Confirm that all safety requirements, conductor loads, equipment checks and permits have been checked and are in place.
- Determine if the position of the auxiliary cross-arm is to be above or below the conductors using C-type conductor holders, fork-type conductor holders can be used when lifting conductors.
- Determine the position around the pole for attaching the lifting beam.
- Place one 63 mm wire tong saddle on the pole below the existing cross-arm. The upper wire tong saddle should be fitted to the pole on the opposite side to the existing cross-arm and as high as possible whilst maintaining clearances.
- Placing of the second lower 63 mm wire tong saddle should be 1.0 to 1.2 m vertically below the upper saddle.
- Secure the 63 mm lifting beam onto the two wire tong saddles ensuring the height of the beam will provide clearance for the wire holders to be used.
- Attach the strap hoist to the lower wire tong saddle and to the lifting attachment at the bottom of the 63 mm lifting beam. Apply tension to the strap hoist to support the lifting beam.
- The height of the auxiliary arm assembly can be adjusted by loosening off the wire tong pole clamps and operating the strap hoist.
- Secure the auxiliary cross-arm to the top of the 63 mm lifting beam. The locking pin MUST be secured.
- The mounting brackets for the braces on the mast should be mounted between the saddles for rigidity.
- Install conductor holders to the auxiliary cross-arm, C-type conductor holders for conductors below and fork-type for conductors above the auxiliary cross-arm.
- The conductor holders should be positioned on the auxiliary arm to align with the conductor position on the existing cross-arm. A minimum separation of 550 mm phase-to-phase and 450 mm phase-to-earth must be maintained.
- Ensure the conductor holder traps are set to lock the conductor into position.
- If the combined conductor weight is greater than 68 kg, attach the two 38 mm support clamps and beams to increase the SWL to 204 kg.
- Support beams must be installed at a 45° angle or as near the end of the arm as possible.
Figure 3: Auxiliary Arm Set up

Technique (displace conductor)

- Cover all second point of contact within reach.
- Position the auxiliary arm so that the outside conductors can be located into the conductor holders and lock the gates on the conductor holders, securing the conductors.
- Untie each outside conductor, working on one conductor at a time.
- Raise the conductors using the strap hoist to raise the auxiliary arm to trap the centre conductor.
- Untie the centre conductor.
- Raise all three conductors so that the SADs can be maintained whilst carrying out the task.
- Conductors can also be lifted by hand and placed into conductor traps working from the outside to centre to outside maintaining SAD at all times.
- Observe the conductors in the adjacent spans whilst the lift in in progress.
- Once the conductors have reached the desired height, secure the wire tong saddles.

Technique (replace conductor)

- Cover all second points of contact within reach.
- Lower the auxiliary cross arm into a position to replace the centre conductor onto the poles insulator.
- Retie the centre conductor and open the conductor holder gate.
- Lower the auxiliary cross-arm until the outside conductors are replaced on to the outside insulators.
- Retie the conductors back to the insulators, working on one conductor at a time, open the conductor gates on the conductor holders and lower the auxiliary arm.
- Once clear of the conductors, the auxiliary arm and attachments can be removed.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.
### Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63mm lifting beam (in date and tested)</td>
</tr>
<tr>
<td>1</td>
<td>63mm temporary cross-arm lifting beam (in date and tested)</td>
</tr>
<tr>
<td>2</td>
<td>38mm support beams (in date and tested)</td>
</tr>
<tr>
<td>3</td>
<td>Fork type conductor holders</td>
</tr>
<tr>
<td>3</td>
<td>C-type conductor holders</td>
</tr>
<tr>
<td>2</td>
<td>63mm wire tong saddles</td>
</tr>
<tr>
<td>1</td>
<td>Strap hoist</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

### Personal

<table>
<thead>
<tr>
<th>Amount</th>
<th>HV Live workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>• 2 in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
</tbody>
</table>
7.7.1 Displace conductors – anchor to crane boom

Purpose

This technique describes how to support displaced conductors using a crane lifting boom as a rated anchor point for two conductors while supporting the third conductor on the EWP basket.

The middle and outside conductors are manually moved and secured to the crane boom via link sticks and the third conductor is securely held on the EWP basket.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- The task must be completed from a EWP.
- The crane boom should be positioned for the best possible angle adjacent to the pole and at a distance that will give sufficient work space once the conductors are displaced and secured.
- The crane operator must stand on an equipotential mat whilst operating the crane when conductors are attached.
- Link sticks with 1.2 m and 450 mm of insulation must be used.
- Minimum ground clearances must be maintained at all times.
- Conductor loads must be calculated before the conductors are displaced to determine that the HV live worker will be able to comfortably lift the conductor.
- 550 mm phase-to-phase clearance must be maintained at all times, this is achieved by using a sling between the two link sticks.
- When manually moving the conductors, clearances must be observed in the adjacent spans at all times.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
Technique (displace conductors)

- Untie the outside phase conductor then manually move the conductor to the 1.2 m link stick and secure the conductor.
- Untie the centre phase and use an operating stick to raise the 450mm link stick to the working position to capture the centre phase. By using the operating stick this will enable you to maintain the SAD from the first phase on the 1200mm stick.

- The crane boom can be adjusted so that sufficient tension is placed on the conductors to maintain ground clearances.
Figure 5: Outside Phase Being Held Onto Securely In EWP

- Untie the other outside conductor and displace the conductor and hold securely in EWP, ensure conductor is double covered and held away from your body.

**Technique (replace conductors)**

- Before the new structure is moved and put in place, apply insulating covers on the new structure and any second points of contact within the work area.
- Erect new structure and make sure it is aligned and securely planted in to position in the ground.
- Lower the outer conductor that is secured on the EWP to the outside insulator and tie-in the conductor.
- Remove the middle phase conductor from the 450 mm link stick and manually move the conductor to the middle insulator and tie-in.
- Remove the outer conductor from the 1.2 m link stick and manually move the conductor to the outer insulator and tie-in.
- Remove all equipment, including insulating barriers, blankets and link sticks.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

**Resources**

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Insulated operating stick (in date and tested)</td>
</tr>
<tr>
<td>2</td>
<td>One tonne slings</td>
</tr>
<tr>
<td>1</td>
<td>Crane / Kevrek including portable vehicle earth (tested and in date)</td>
</tr>
<tr>
<td></td>
<td>Equipotential mat, (tested and in date)</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td><strong>Variable</strong></td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td><strong>Variable</strong></td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

**Personal**

<table>
<thead>
<tr>
<th></th>
<th>HV Live workers</th>
</tr>
</thead>
</table>
| **4** | • 2 in the EWP  
• 1 Safety Observer  
• 1 Ground worker |
7.7.2 Change pole-top switch – temporary bypass method

Purpose

This technique describes how to change a closed pole-top switch (PTS) or switch pole on voltages up to 33kV using the temporary bypass method.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Temporary bypass jumpers are only classed as single insulated and must not be rested on second points of contact unless a second layer of insulation is applied.
- Temporary bypass jumpers must not be used to make or break load.
- The temporary bypass jumper must be of sufficient load carrying capacity.
- Temporary bypass jumpers must be checked for compliance test date and overall condition before use.
- The procedure for displacing the conductors must be established before work commences.
- This procedure can be carried out from one EWP but the preferred method is to use two glove and barrier teams working simultaneously from two EWPs on one phase at a time.
- The preferred method is to work on the outside conductor, then the middle conductor and finally the other outside conductor. When reconnecting the conductors, reverse this sequence.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique (remove phases)

- Confirm the switch is locked in the closed position.
- Electrical loads must be taken and verified with Network Control (HPCC).
- Visually inspect the switch and conductors for any signs of damage or burning.
• Prepare the three bypass jumper setups by applying insulating covers and mats and a 2 metre sling and temporary bypass jumper, for dual strap hoist (see Figure 1), or for a single strap hoist and temporary bypass jumper (see Figure 2).
• For the first outside phase, lay the first bypass jumper setup on the PTS frame and secure.
• This can be on the inside or outside of the switch post insulators as long as it can be secured to prevent movement.
• Clean conductor and install a temporary bypass jumper to the outside phase.
• Check bypass jumper is sharing load before disconnecting solid taps.
• Remove the solid tap and flexible braid to the male and female contacts of the PTS.
• Install come-along clamps or dead-end wraps to the conductor each side of the switch, leaving enough room to install new insulators and dead-end wraps. Refer to Figures 1 or 3.
• Attach one or both strap hoists, depending on method used, between the slings and come-along clamps or dead-end wraps.
• Take up tension on the strap hoist, enough to allow the old tension insulators to be disconnected.
• Secure the conductor to the webbing of the strap hoist and/or sling using cable ties both sides of the switch.
• Disconnect both tension insulators and allow them to drop clear of the conductors.
• The conductor, including bypass jumper setup, can now be displaced and secured away from the switch using the pre-determined procedure.
• Ensure full control of the conductor is maintained at all times.
• Repeat above steps for the centre and other outside phase, in that order.

![Figure 2: Bypassed Pole Top Switch Using a Single Strap Hoist and Sling Set up](image)

**Technique (replace conductors and reconnect the switch)**

• Confirm the switch is locked in the closed position.
• Cover all second points of contact within reach.
• Re-position the outside phase and bypass setup on the switch frame and secure.
Use the strap hoists to take up additional slack, if required, to allow for the new dead-end wraps to be installed in the correct position to ensure correct conductor sag / regulation.

- Install new tension insulators and dead-end wraps to the conductor both sides of the switch.
- Release the tension on the strap hoists and remove.
- Remove the come-along clamps / dead-end wraps used for tensioning from the conductor.
- Re-connect the solid tap and flexible braid to the male and female contacts of the PTS.
- Check solid tap is sharing load before removing bypass jumper.
- Remove temporary bypass jumper.
- Remove the bypass jumper setup from the switch frame.
- Repeat above steps for the centre and other outside phase in that order.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

**Resources**

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+</td>
<td>EWP, Insulated, tested and in date</td>
</tr>
<tr>
<td>3</td>
<td>Temporary bypass jumpers</td>
</tr>
<tr>
<td>3</td>
<td>2m slings, checked before use</td>
</tr>
<tr>
<td>3 or 6</td>
<td>Strap hoists, depending on the bypass set up used (determine before work starts)</td>
</tr>
<tr>
<td>6</td>
<td>Come along line clamps, or new dead ends to suit conductor size</td>
</tr>
<tr>
<td>3</td>
<td>Rated conductor gates or rollers, only required when not using spiral link sticks</td>
</tr>
<tr>
<td>1</td>
<td>HV ammeter</td>
</tr>
<tr>
<td>1</td>
<td>Insulated hanger, only required when using one EWP</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

**Personal**

<table>
<thead>
<tr>
<th>4 or 7</th>
<th>HV Live workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2+(2in each basket if two EWP’s are used)</td>
</tr>
<tr>
<td></td>
<td>1+safety observer (2 if two EWP’s are used)</td>
</tr>
<tr>
<td></td>
<td>1 Ground worker</td>
</tr>
</tbody>
</table>
7.7.3 Change RDA pole

Purpose

This technique describes how to change a distribution RDA pole up to 33kV.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- The crane must be used to ensure control of the new pole during this procedure.
- Two cranes may be required depending on the assessment of the old pole.
- This procedure can only be used when RDA construction is correct, which is centre phase to top of RDA (see figure 2).
- This procedure must not be used when bay lengths exceed those detailed in Table 1 below.
- Check that the conductor regulation is correct and that conductor clearances can be maintained during this procedure.
- This procedure must not be used if clearances cannot be maintained.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.
### Table 1: Maximum permitted bay lengths for voltage and construction type

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Pole Construction Either Side of RDA</th>
<th>RDA Pole Construction</th>
<th>Maximum Bay Length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>22 kV</strong></td>
<td>DCSH H01-1 Standard Cross Arm</td>
<td>DCSH H6-RDA 900mm</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>DCSH H01-1 Standard Cross Arm</td>
<td>DCSH H7-RDA 1200mm</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>DCSH H01-3 Anti Swan Cross Arm With Long Raiser</td>
<td>DCSH H6-RDA 900mm</td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>DCSH H01-3 Anti Swan Cross Arm With Long Raiser</td>
<td>DCSH H7-RDA 1200mm</td>
<td>200</td>
</tr>
<tr>
<td><strong>33 kV</strong></td>
<td>DCSH H01-1 Standard Cross Arm</td>
<td>DCSH H6-RDA 900mm</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>DCSH H01-1 Standard Cross Arm</td>
<td>DCSH H7-RDA 1200mm</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>DCSH H01-3 Anti Swan Cross Arm With Long Raiser</td>
<td>DCSH H6-RDA 900mm</td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>DCSH H01-3 Anti Swan Cross Arm With Long Raiser</td>
<td>DCSH H7-RDA 1200mm</td>
<td>200</td>
</tr>
</tbody>
</table>
Technique (position pole and plant)

- The new pole must be installed to the side of the existing pole.
- It is easier to replace the pole if the new pole is taller than the existing pole.
- The old pole should be checked to see if it is plumb, if the pole is leaning, the new pole should be planted on the side that the old pole is leaning away from.
- The crane must be positioned at the back or to the side of the poles.
- The EWP can be positioned on the inner angle of the RDA.

Technique (pole change)

- Using the crane, lean the new pole towards the covered conductors.
- Work must start on the top phase first.
- Fit new armour rod at the new conductor clamp position, if possible, the old armour rod should be left in position.
- Using an insulated stick lift the new phase strain insulator, this will help you maintain your SAD from the conductor.
- Attach the new conductor clamp to the conductor, tighten and then re-apply mats and covers.
- Repeat above steps for the centre phase and then the bottom phase of the RDA.

Note: All stays must be fitted on the new pole before the conductor changeover

- Begin to pull the new pole back using the chain puller or pullers and maintain clear communication with the crane operator and work with them to take care not to pull against the crane during the operation.
• The conductors must be observed in the adjacent spans at all times to ensure conductor clearances are maintained.
• The crane can now be removed from the new pole and used to support the old pole.
• Keep pulling the new pole back until the insulators on the old pole begin to collapse.
• Once collapsed disconnect the old conductor clamps from the insulators and allow the old insulator to fall towards the old pole.
• Remove the old conductor clamps from the conductors.
• Remove the old pole ensuring SAD’s are maintained.
• Use chain puller to ensure the new pole is plumb, and then make off the stay wires.
• Make off the conductors and tighten clamps.
• Clean all equipment before you stow it away, and ensure the work site is left clean and tidy.

**Note:** The new pole can be set slightly forward of plumb when the conductors are being swapped over to the new pole, and then tension applied via the stays to pull back the pole.

**Resources**

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crane, with vehicle earth (in date and tested)</td>
</tr>
<tr>
<td>1</td>
<td>EWP Insulated, tested and in date</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

**Personal**

<table>
<thead>
<tr>
<th>4</th>
<th>HV Live workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• 2 in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
<tr>
<td></td>
<td>• 1 Ground worker</td>
</tr>
</tbody>
</table>
7.7.4 Remove conductor sample mid-bay

Purpose

This procedure describes how to remove a conductor sample mid-bay on voltages up to 33kV.

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Temporary bypass jumpers must not be used to make or break load.
- The temporary bypass jumper must be of sufficient load carrying capacity.
- Conductor samples are to be restricted to a maximum length of 3m.
- Work must only take place on one potential at a time.
- The effects of the increased tension applied to the conductor and fittings being worked on must be considered.
- Consideration must be given to the increase or decrease of the conductor sag.
- The preferred method is to take the sample from the outside conductor.
- Always cover all second points of contact within reach.
- Only expose and work on one potential at a time.

Technique

- Visually inspect the conductors for any signs of damage or burning.
- Electrical loads must be taken and checked against peak loads supplied by Network Operations.
- Cut and prepare a suitable length of replacement conductor.
- Secure the new conductor to the existing conductor ensuring that full control is maintained at all times.

Note: A single cranker and come along set up can also be used for sampling smaller lengths of conductor
- Using a strap hoist with a come-along attached at each end, attach one come-along to the existing conductor and one to the new conductor.
- Ensure there is no slack in the strap hoist and that the handle is secured.
- Clean conductor and attach temporary bypass jumper to the new and existing conductors.
- Repeat above steps at the other end of the new replacement conductor.
- Using the HV ammeter, check the load in the existing conductor, then check the load in the temporary bypass jumpers to confirm that they are sharing the load.
- Take tension up on the strap hoists for the conductor sample to be removed.
- The existing conductor can now be cut and joined to the new conductor at each end, ensure all conductors are cleaned prior to joining and a full tension joint is used.
- The existing conductor sample can now be removed from the line.
- Ensure that the conductor sample is under full control at all times while removing.
- Remove both temporary bypass jumpers.
- Release tension strap hoists, and remove the strap hoists and clamps from the line.
- Remove all insulating covers from the line where applicable.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

### Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Temporary bypass jumpers (in date and tested)</td>
</tr>
<tr>
<td>2</td>
<td>Strap hoist</td>
</tr>
<tr>
<td>4</td>
<td>Come along line clamps</td>
</tr>
<tr>
<td>3</td>
<td>Lengths of conductor same size as existing</td>
</tr>
<tr>
<td>6</td>
<td>Full tension joints, same size as conductor</td>
</tr>
<tr>
<td>1</td>
<td>Crimping tool</td>
</tr>
<tr>
<td>1</td>
<td>HV ammeter</td>
</tr>
<tr>
<td>Variable</td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td>Variable</td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

### Personal

- HV Live workers
  - 2 in the EWP
  - 1 Safety Observer
7.5 Displace and replace earth return wire

Purpose

This technique describes how to displace and replace a return wire for the purpose of return wire maintenance or in preparation for a pole change on the distribution network.

The return wire has the potential to become energised to the phase voltage under fault conditions. The controls in this support procedure allows for the HV Live Worker to displace and replace the return wire to and from its attachment point on the pole. Once the return wire has been removed from its attachment point it must be treated as an energised conductor and controlled using a pre-determined HV live work procedure.

![Figure 1: Bypass Jumper Set up for Suspected Damaged Earth Return Wire](image)

Parameters

- Ensure all permits and risks assessments are in place, that all team members understand the work task and have signed on to all documents.
- Return wire movement must be closely monitored and controlled at all times.
- Before untying or retying, the return wire must be securely held with a downward force.
- Insulated HV gloves rated to the highest working voltage on the structure must be worn for this procedure.
- Assess the weight to ensure manual handling techniques can be used.
- When moving the return wire to a temporary pole mounted auxiliary arm, the support and trap must be ready to receive the return before the return wire is untied and lifted.
- Always maintain SAD to the energised phase conductors.
Technique (repair and displace earth return wire – damage identified or suspected)

- Conduct a risk assessment to determine whether this technique can be followed without the return wire breaking.
- If the risk of the return wire breaking is high then, do NOT proceed and notify Network Control (HPCC) to arrange an outage to affect repair.
- Check the return wire for voltage using a proximity tester set to the voltage which matches the phase voltage.
- If the proximity tester operates (i.e. lights up or buzzes), there is a fault on the return wire in which case, do NOT proceed, notify Network Control (HPCC) to arrange an outage to make repairs.
- If the proximity tester does not indicate voltage present on the return wire, then it is safe to proceed with repairs.
- Install the pole-mounted temporary auxiliary arm below the return wire.
- Install the temporary bypass jumper either side of the return wire attachment point.
- Attach come-along clamps either side of the return wire attachment point.
- Install strap hoist between the two come along line clamps and take up a small amount of tension.
- The return wire can now be untied and moved to the conductor trap of the pole mounted auxiliary arm. Ensure that the return wire is controlled at all times.
- Once repairs are complete remove the bypass jumper, strap hoist and come-along clamps.
- The return wire can now be displaced using a pre-determined HV glove and barrier procedure.
- Remove the temporary pole-mounted auxiliary arm.

Figure 2: Pole Mounted Auxiliary Arm

Note: Insulated HV gloves rated to the highest working voltage of the structure must be worn for this procedure.
Technique: Displace earth return wire for maintenance or pole change and/or attachments – no damage identified

- Set the proximity tester to the HV setting appropriate to the phase voltage and test the return wire.
- If the proximity tester operates, i.e. lights up or buzzes, there is a fault on the return wire in which case, do **NOT** proceed, notify Network Control (HPCC) to arrange an outage to make repairs.
- If the proximity tester does not indicate voltage present on the return wire, then it is safe to proceed with repairs.
- For pole replacement untie the return wire using pre-determined High Voltage G&B procedure, displace from pole and tie back using 450mm link stick and insulated rope, and maintain ground clearances at all times.
- For maintenance, install the pole-mounted temporary auxiliary arm below the return wire.
- The return wire can now be untied and moved to the conductor trap of the pole mounted auxiliary arm. Ensure that the return wire is under full control at all times.
- Carry out maintenance to the return wire and/or associated hardware.

Technique (replace return wire)

- When work is complete, ensure the return wire insulator is ready to receive the return wire.
- Return the return wire to the insulator on the pole and tie-in.
- Ensure that the return wire is under full control at all times.
- Remove temporary pole-mounted auxiliary arm.
- Clean all equipment before you stow it away, and ensure that the work site is left clean and tidy.

### Resources

<table>
<thead>
<tr>
<th>Amount</th>
<th>Minimum Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Insulated and tested Class 3 HV gloves with protective outers</td>
</tr>
<tr>
<td>1</td>
<td>Insulated EWP</td>
</tr>
<tr>
<td>1</td>
<td>Temporary bypass jumper, if required</td>
</tr>
<tr>
<td>1</td>
<td>Strap hoist, if required</td>
</tr>
<tr>
<td>2</td>
<td>Come along line clamps, if required</td>
</tr>
</tbody>
</table>

**Note:** The SADs for the return wire can now be maintained. Treat the return wire as an energised conductor for the duration of the task.
<table>
<thead>
<tr>
<th></th>
<th>Proximity tester i.e. Modiewark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Temporary conductor support, pole mounted: In date and tested</td>
</tr>
<tr>
<td><strong>Variable</strong></td>
<td>Pegs and cable ties to secure insulated mats and covers</td>
</tr>
<tr>
<td><strong>Variable</strong></td>
<td>Insulating covers, barriers and mats, ensure enough equipment to cover live conductors and second points of contact within reach.</td>
</tr>
</tbody>
</table>

**Personal**

<table>
<thead>
<tr>
<th></th>
<th>HV Live workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• 2 in the EWP</td>
</tr>
<tr>
<td></td>
<td>• 1 Safety Observer</td>
</tr>
</tbody>
</table>
7.6 Installation & Maintenance of Switchgear / Apparatus

This technique describes the principles associated with the installation / maintenance of specific types of switchgear / apparatus.

For maintenance requirements at normally closed switchgear the techniques described in Section 7.2.1 Making and Breaking Taps will be required. For the lifting in of switchgear on installation tasks ensure lifting loads with cranes and EWP’s are adhered too as per 7.11.1 in this manual.

In situations where the switchgear is or has the capacity to be operated remotely, the open or closed status of the switchgear shall be verified with Network Control (HPCC). This verification will be completed both prior to and on completion of the work task. Confirmation of switchgear status shall also be carried out in the field and the remote control function shall be disabled during the maintenance period. The task and the status of the switch gear shall be recorded on the risk assessment / job safety assessment sheet.

Always perform a final insulation resistance test prior to connecting any switch to the live apparatus and notify Network Control (HPCC) that you will be installing load carrying jumpers and will be operating switchgear.

Note: All switching operations and permit issues are too be completed by an authorised operator with an appropriate switching authority level.

7.7 Pole Top Switch / Gas Switches

Technique (installation)

When installing a PTS / Gas Switch the following requirements shall be completed:

- The bridging tails of the PTS will be connected, tied back and secured and the switch opened prior to lifting into position.
- The handle and operating rods will not be fitted to a PTS during the lift.
- After installing the PTS, bush test the bridges to the conductor using an insulated stick at required SAD prior to completing final connections.
- The final task, on timber poles, will be the connection of the earth to the handle, and frame / tank.
- All earth connections to be made below energised conductors.
Prior to installation all enclosed switchgear shall be tested as per table below.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Applied Voltage</th>
<th>Between</th>
<th>Minimum Acceptable IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Switches</td>
<td>5kV</td>
<td>Closed position - all bushings together to tank</td>
<td>1000 Meg Ohms</td>
</tr>
<tr>
<td></td>
<td>5kV</td>
<td>Open position - all incoming to all outgoing bushings</td>
<td>1000 Meg Ohms</td>
</tr>
</tbody>
</table>

Maintenance

PTS / Gas Switch maintenance may be carried out in two situations:

**Technique (normally open)**

- Check that the switch is locked in the open position.
- Disable remote control in control box if applicable.
- Carry out the maintenance using either HV Live Work methods or access permit procedures where appropriate.
- If the work requires the removal of gloves, an EAP is required and the switch must be isolated by removing taps from both sides of the switch for each phase that is not double insulated.
- On completion, check switch is locked in the open position.
- Reinstate bridging to both sides of switch.
- Enable remote control in control box if applicable.

**Technique (normally closed)**

- Disable remote control in control box if applicable.
- Check that the switch is locked in the closed position.
- Apply appropriate temporary bypass bridging and check loadings on bypass jumper.
- Carry out the maintenance using either HV Live Work methods or access permit procedures where appropriate.
- If appropriate open the switch and lock.
- If the work requires the removal of gloves, then an EAP is required and the switch must be isolated by removing taps from both sides of the switch for each phase.
- Check switch is locked in open position.
- Reinstate bridging to both sides of switch.
- Close the switch and lock.
- Remove temporary bypass bridging.
- Enable remote control in control box if applicable.
- Clean all equipment before you stow it away, and ensure work site is left clean and tidy.

### 7.8 Reclosers

#### Technique (installation)

When installing a Recloser the following requirements shall be completed:

- Prior to installation all enclosed switchgear shall be tested as per table below.
- The connections of the recloser will be connected, tied back and secured, and the recloser opened prior to lifting into position.
- After installing the recloser, brush test the bridges to the conductor using an insulated stick at required SAD prior to completing final connections.
- The final task, on timber poles, will be the connection of the earth to the handle, and frame / tank.
- All earth connections to be made below energised conductors.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Applied Voltage</th>
<th>Between</th>
<th>Minimum Acceptable IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Switches</td>
<td>5kV</td>
<td>Closed position-all bushings</td>
<td>1000 Meg Ohms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>together to tank</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5kV</td>
<td>Open position-all incoming to all</td>
<td>1000 Meg Ohms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>outgoing bushings</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** All switching operations and permit issues are too be completed by an authorised operator with an appropriate switching authority level.
Maintenance

Recloser maintenance may be carried out in two situations:

**Technique (normally open)**

- Check that the recloser is locked in the open position.
- Disable remote control in control box if applicable.
- Carry out the maintenance using either HV Live Work methods or access permit procedures where appropriate.
- On completion, check recloser is locked in the open position.
- Enable remote control in control box if applicable.

**Technique (normally closed)**

- Disable remote control in control box if applicable.
- Check that the recloser is locked in the closed position.
- Apply appropriate temporary bypass bridging.
- Carry out the maintenance using either HV Live Work methods or access permit procedures where appropriate.
- If appropriate open the recloser and lock.
- Check switch is locked in open position.
- Close the switch and lock.
- Remove temporary bypass bridging.
- Enable remote control in control box if applicable.

### 7.8.1 Links / Fuses, Surge Arresters and Recording Equipment

When maintaining links / fuses the following requirements shall be completed:

- Secure the latching mechanism of the existing link/fuse by an approved method.
- Appropriate rated temporary bypass bridging will be selected to complete task.

**Technique (surge Arresters)**

Lightning arresters may be placed at various locations using a combination of Stick and Glove & Barrier techniques. In all situations the arresters will only be replaced when:

- The replacement arresters are to be new manufacturer tested polymeric type only and verified as being applicable for the voltage of installation.
- Transport to the work site shall be in the arresters manufactured packaging.
• Prior to replacement the arrester shall be tested on site with a 5 kV insulation resistance tester / megger.
• This is not a test of the arresters voltage diversion capabilities, it is an additional safety step to ensure there is no dead short to earth after manufacturing or during transport.
• Stick method is to be used to de-energise the existing arresters and Glove & Barrier method to replace and energise the new arresters.

**Note:** Should an arrester be dropped it shall not be used for energised installation until it has been retested

<table>
<thead>
<tr>
<th>INSULATING RESISTANCE TESTING</th>
<th>Equipment</th>
<th>Applied voltage</th>
<th>Between</th>
<th>Minimum acceptable IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surge arresters (new)</td>
<td>1kV</td>
<td>Line terminal to metal base</td>
<td>100 Giga Ohms</td>
<td></td>
</tr>
</tbody>
</table>

**Technique (replacement)**
• Cut away the existing energised side of the arresters using Stick method only.
• Replace the existing lightning arresters using Glove & Barrier method.
• Connect the earthing end of the arresters.
• Before making final connection using Glove & Barrier method, initial energising of lightning arrester is to be completed using Stick method.
• Connect the energised side of the arresters.

**Technique (recording equipment)**
Recording equipment may be installed to energised conductors and cables using the appropriate HV Live Work techniques provided.
• The equipment is rated for the voltage and current being applied.
• If being left unattended a mechanical securing mechanism is installed from the equipment to the conductor or cable.
• The electrical connection of the equipment shall not be relied upon only.

**7.8.2 Animal Proofing**
The animal proofing involves the use of such products as, but not limited to, high voltage covered conductor thick CCT bushing covers, fuse unit covers, fuse unit bracket covers, HV Insulated sleeving and guards.
These products whilst HV Rated do not form an Insulation level for HV Live Work purposes and all employees are reminded to use appropriate SAD’s and levels of insulation during the live installation of these products.

The following applies:

- All task related risks will be considered and documented on the job safety assessment prior to commencement including the following considerations:
- Personal clearances phase to phase and phase to earth during the installation of these products.
- Insulation of all conductors within reach securing of fuses when applicable.

7.9 Terminals and Zone Substation Yards

HV Live maintenance work may be carried out in these installations using the described techniques and applicable method for the voltage to be worked on. Generally this maintenance consists of hardware change, insulator replacement, connector replacement and switch maintenance.

A site specific risk assessment / job safety assessment for the particular zone substation shall be completed.

Mobile plant earthing arrangements when conducting HV Live Work on structures within zone substation yards are:

- Mobile plant working inside the yard shall be connected to the yard earth grid.
- Ensure that work does not require the earthed portions of the mobile plant to move outside the perimeter of the yard earth grid.
- Mobile plant working outside of the yard shall be separately earthed and not connected to the station earth grid or touching the station fence.
- When multiple plant and equipment are working on the same structure located within the yard, all plant shall be located either inside the yard or outside the yard at all times.
- When moving mobile plant within the yard, a trailing earth chain shall be used at all times.

7.9.1 Lifting Loads with EWP’s and Cranes

Lifting Jibs

EWP’s and cranes may be used in HV Live Work to lift cross-arms, switchgear, and conductors, in fact any load which is within the SWL of the lifting jib.

Lifting jibs which are used in conjunction with a EWP or crane shall:

- Be engineered and tested with a stamped safe working load.
• Have an authorisation issued by the EWP manufacturer stating that the jib may be used on their plant.

• The receptacle which houses the lifting jib shall have an insulated cover which is in place at all times when not in use.

**SWL Considerations and Limitations**

• When lifting loads with a EWP or crane, all SWL considerations and limitations shall be adhered to.

• An insulating medium rated to the voltage and with a SWL exceeding the lifted load shall be installed between the lifting jib or crane rope and the load.

• Loads being lifted shall be calculated in kilograms prior to the lift, and verified as within the SWL of the jib and EWP or crane.

• Only cranes and EWPs which are authorised by the manufacturer may be used to lift loads both vertically and transversely.

• Lifting with a EWP, consideration shall be given to the SWL of the basket; this includes the weight of all HV Live Workers in the basket, combined with the weight of the lift.

• All anchor points in the EWP, for the attachment of lanyards to operator’s harness, shall under no circumstances be used as a lifting anchor point.

**7.9.2 Single Person Tasks / One Glover Aloft**

HV Live Workers undertaking single person tasks shall be suitably instructed for this type of work.

**Single Person Tasks Definition**

Single person tasks relate only to the list of tasks that can be undertaken by one Glover aloft.

Single person tasks shall be limited to:

• Install / remove fault detection and recording equipment.

• Install / remove insulating barriers / covers.

• Install / remove vibration protection.

• Install / remove “D” loops / Ampact stirrups, off load only, and no circuit connection.

• Install / remove spreader ropes.

• Tighten hardware, such as cross-arms and insulators.

• HV asset and cross-arm inspection.

**Note:** A safety observer is required at all times during single person tasks
Preliminary Live Work Procedures

All preliminary HV Live Work procedures shall be performed prior to the commencement of any single person HV Live Work task. In addition the following requirements shall be observed:

- All task related risks will be considered and documented on the job safety assessment prior to commencement.
- A single person aloft shall not perform any task that involves moving or displacing a conductor or installation or removal of a jumper.
- All HV Live Work shall be conducted from an insulated and rated EWP.
- Once the EWP has been loaded with the required tools and hardware, the second HV Live Worker’s role is exclusively that of Safety Observer.
- The final decision as to whether a single person task may be completed shall be made by all the HV Live Workers on the work site.

7.9.3 Night Work

All normal HV Live Work procedures shall be performed prior to the commencement of any Live Work at night. In addition the following requirements shall be observed:

- Lighting shall be such that it will illuminate all second points of contact within the immediate work area.
- The illumination should come from above the HV Live Workers aloft and needs to be such that conductors and pole hardware can easily be seen and identified.
- Identification needs to be achieved by both the HV Live Workers at the pole top, and the Safety Observer at ground level.
- Work is restricted to the area of illumination.

Note: If either of the HV Live Workers in the EWP or the Safety Observer cannot clearly see or identify objects in the immediate work area, the task shall not proceed.
8 Training Authorisations and Competency

8.1 Authorisation

Authorisations shall be maintained in accordance with the requirements outlined in this section of the manual.

8.2 Personnel Selection

A formalised selection process shall be used to select persons to attend HV Live Work training courses. Selected persons shall have the following minimum attributes:

- Hold a current Certificate III qualification as a Lineperson.
- Competent in a broad range of line work.
- Authorised and qualified to operate a EWP.
- Proven safety record.
- Able to give and receive clear and precise instructions.
- Demonstrated personal attributes of responsibility, concentration and the ability to work in a team.
- Must be medically fit with no disabilities that might have a detrimental impact on the work party, i.e. skeletal problems, cardiovascular problems, seizures of any type, hearing or sight impairment, etc.
- Not under the influence of any substance that may impair judgement.

8.3 Re-assessment

To ensure ongoing safety, competence and adherence to work practices, HV Live Workers shall be regularly monitored in the field through formal competency auditing. These audits shall be formally documented, kept on file for analysis purposes and be conducted at least annually.

Audits shall assess demonstrated competencies against documented and approved HV Live Work techniques and tasks, work practices, rules, regulation, guidelines, equipment use storage and maintenance, and general site safety in order to provide a holistic review.

Where HV Live Workers are found to be deficient in some area of HV Live Work, remedial training specifically tailored towards those deficient areas shall be provided in line with the risks identified.

In regard to currency of qualifications, competency is attributed for 12 months only. Where continued currency/qualification is required, competency shall be re-assessed annually.
As competency assessment against competency standards can only be attributed by an appropriately qualified RTO, annual re-assessment should be conducted by an approved RTO.

8.4 Maintenance of Competency

8.4.1 Continued Competency

For reasons of personal and team safety, HV Live Workers shall always be assessed as having the appropriate health requirements that provide the safest possible work environment, not be under the influence of any substance that may impair judgement and must be able to continually display the appropriate attributes in line with initial selection criteria, and must undergo annual competency re-assessment.

HV Live Workers who require retraining shall be restricted to ground duties associated with all HV Live Work tasks until they have been assessed as competent to recommence normal HV Live Work duties.

HV Live Workers working in other roles, i.e. team leaders etc. will be required to complete a minimum 8 hours of HV Live Work every three months.

Consideration shall be given to undertake an assortment of HV Live Work tasks.

8.4.2 Re-entering the Live Work Field

Persons who have not practiced HV Live Work and not attended and successfully completed annual assessments and refresher programs for a period of up to 5 years shall undergo an appropriate refresher training program and assessment under the direct and immediate supervision of a trainer certificated in the techniques being assessed.

Persons who have not practiced HV Live Work or not been annually assessed for a period of 5 years and over shall undergo a full HV Live Work training course or undergo an Recognition of Prior Learning (RPL) process by a Registered Training Organisation to become requalified to practice HV Live Work and complete the on the job training (OJT) component.

8.5 New Employees Commencing with Team

New employees commencing with a HV Live Work team who hold a current HV Live Work authorisation will be required to undergo induction training in the requirements of this High Voltage Live Work Manual. A manual will be issued after this process.

8.6 Crane / Borer Operators

Crane / Borer operators used in HV Live Work should have a formal appreciation of the HV Live Work concepts and processes. Where Crane / Borer operators do not have a formal appreciation, or where hire cranes and operators are required, prior to the
commencement of the work, the operator shall be instructed on the work procedures and safe approach distances to be used.

The operator shall be under immediate supervision of a nominated member of the HV Live Work team at all times.

Crane / Borer operators who have completed a formal appreciation of the HV Live Work concepts shall undergo annual assessments and refresher training where required.

8.7 Medical Examination

All HV Live Workers shall undergo a 3 yearly medical examination.

The examination is to be carried out by a qualified Occupational Health Practitioner.

8.8 Contractor Responsibilities

HV Live Work contractors working on distribution assets shall be required to present documented evidence of the following prior to the commencement of work.

- Demonstrated knowledge of the requirements of the Electrical Safety Standards.
- Demonstrated knowledge of the HV Live Work techniques.
- Demonstrated skill at job risk assessment process.
- Current authorisation and competency as HV Live Workers.
- Currency in core work competencies for Pole top Rescue (PTR) EWP EDD Rescue, SCT Polarity Testing and First Aid / CPR.
- Test and serviceability records of plant, tools and equipment and all personal protective equipment.

A non-compliance with any of the above will deem suspension of work until appropriate completion of auditing and refresher training as per requirements of this manual.
9 Conductor Span Loadings

9.1 Conductor Span Loadings

This section is designed to provide a reference to access already calculated conductor span loadings for commonly maintained constructions, conductor sizes and span lengths.

Formulae are supplied for calculating non-common conductor sizes and specific information is detailed for accessing complex conductor loadings that will require surveying and engineering advice.

The calculated loadings are in kilograms (kg) to allow simple application to the safe working load of the HV Live Work rigs. All tables that provide pre-calculated conductor loadings have been rounded up to the next kg for ease of application.

Intermediate structures

This method of calculation is based on the situations in Figure: 9.1 and

to determine the loading exerted on HV Live Work equipment. The calculation will ensure:

- The safe working load of the equipment is not exceeded
- Increases in conductor tension when relocating conductors with the selected HV Live Work rig, do not place undue strain on adjacent ties or terminations.
Due to the weight of the conductor being the determining factor and conductor tension being a negligible factor the following calculation may be used for
WT = \frac{W \cdot (\text{Span1} + \text{Span2})}{2}

WT = \text{Total conductor load to be lifted}

W = \text{Mass per metre of conductor (grams per metre-g / m)}

\text{Span} = \text{Span length in metres}

Therefore the terrains depicted in Figure: 9.1 and

can be calculated as follows:

Given a situation of \text{Span1} = 80 \, \text{m} and \text{Span2} = 70 \, \text{m}

Conductor size of 7/4.75 AAC the calculation for the loading is as follows:

\begin{align*}
\text{WT} &= \frac{W \cdot (\text{Span1} + \text{Span2})}{2} \\
&= \frac{.340 \times 80 + 70}{2} \\
&= \frac{.340 \times 150}{2} \\
&= .340 \times 75 \\
&= 25.5 \, \text{kg}
\end{align*}
Thus an appropriate HV Live Work rig would be selected for the task with a safe working load (SWL) in excess of 26 kgs. Due to the variables of stringing tension, heights and temperatures it is impractical to complete basic field calculations for these situations, refer to the following charts. HV Live Work in these situations should, where possible, be previously scoped and appropriate surveying / engineering calculations completed.

Figure: 9.2 Lowered Terrain

Figure: 9.3 Raised Terrain

Angles

The calculation of conductor loading for angle constructions may require special calculation and reference to design data for the particular line. The following tables are pre-calculated loadings for common conductor sizes, span lengths and stringing tensions. These calculations are in accordance with Horizon Power stringing charts. Additionally the supplied formula will allow HV Live Workers to make an accurate assessment of angle loadings and select an appropriate HV Live Work rig, provided stringing tensions are available. At the angle construction determine the following distances:

1. Measure from Point A, the deviation of angle, to Point B and C along each side of the line to a distance of 15 m
2. Sight a line from Point B to C
3. Halve distance B to C to create Point D
4. Determine the measurement of distance A to D ensuring Point D cuts the line at right angles

Therefore the angle loading can be calculated using the following formula:

\[ WT = D' \times \frac{2 \times MCT}{15} \]

\( WT \) = Conductor loading to be lifted

\( D' \) = Determined distance Point A to B

\( MCT \) = Maximum conductor tension

Given a situation of \( D' = 8 \text{ m} \) and a conductor size of 3/2.75 galvanised steel at Tight Stringing (VX18/50)

\[ WT = 8 \times \frac{2 \times 968}{15} \]

\[ = 16 \times 64 \]

\[ = 1032 \text{ kg} \]

Thus an appropriate HV Live Work rig would be selected for the task with a SWL in excess of 1032 kgs.

**Tension**
The calculation of tensions which are to be supported by HV Live Work equipment when replacing insulators, cross-arms or poles at strain and anchor constructions generally require special calculation and reference to the design data of the particular line.

However, the following tables detail the maximum working tensions of lines designed in accordance with Horizon Power stringing charts. Should the HV Live Work equipment have a safe working load in excess of these values, it may be used without further calculations.

**9.2 Vertical loads on hilltop terrain**

For Hilltop Terrain configurations, there is a vertically downward force on the structure due to the mass of the conductor in the two (2) half spans adjacent to the pole.

In addition, there is a vertically downward force on the structure due to the tension of the conductor.

![](image)

**9.2.1 Hilltop terrain configuration**

\[
VF = \frac{L1 + L2 \times W \times 10 + T \times (\tan \theta_1 + \tan \theta_2)}{2}
\]

Where:

VF = approximate total vertical downward force in newtons

L1 + L2 = horizontal length of adjacent spans in metres

W = mass per metre of the conductor in kilograms per metre

T = approximate tension of the conductor in newtons
01 + 02 = vertical angle of elevation between conductor support points in degrees

### 9.2.2 Approximate conductor tension

\[ T = \frac{W \times 10 \times L^2}{8 \times D} \]

**Where:**

- \( T \) = approximate tension of the conductor in newtons
- \( W \) = mass per metre of the conductor in kilograms per metre
- \( L \) = Length of span under consideration in metres
- \( D \) = Sag of span under consideration metres
### 9.2.3 Conductor Mechanical Data

<table>
<thead>
<tr>
<th>Conductor Size</th>
<th>Type of Conductor</th>
<th>Calculated Minimum Break Load (kN)</th>
<th>Approximate Mass (kg/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/2.50</td>
<td>AAC</td>
<td>5.75</td>
<td>0.0943</td>
</tr>
<tr>
<td>7/3.00</td>
<td>AAC</td>
<td>7.91</td>
<td>0.135</td>
</tr>
<tr>
<td>7/3.75</td>
<td>AAC</td>
<td>11.9</td>
<td>0.212</td>
</tr>
<tr>
<td>7/4.50</td>
<td>AAC</td>
<td>16.8</td>
<td>0.305</td>
</tr>
<tr>
<td>7/4.75</td>
<td>AAC</td>
<td>18.8</td>
<td>0.34</td>
</tr>
<tr>
<td>19/3.25</td>
<td>AAC</td>
<td>24.7</td>
<td>0.433</td>
</tr>
<tr>
<td>7/0.064</td>
<td>HDBC</td>
<td>6.10</td>
<td>0.13</td>
</tr>
<tr>
<td>7/0.080</td>
<td>HDBC</td>
<td>9.45</td>
<td>0.203</td>
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<td>0.343</td>
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<td>HDBC</td>
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<td>ACSR/GZ</td>
<td>14.9</td>
<td>0.171</td>
</tr>
<tr>
<td>6/1/3.75</td>
<td>ACSR/GZ</td>
<td>22.8</td>
<td>0.268</td>
</tr>
<tr>
<td>6/4.75+7/1.60</td>
<td>ACSR/GZ</td>
<td>33.2</td>
<td>0.404</td>
</tr>
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<td>30/7/2.50</td>
<td>ACSR/GZ</td>
<td>63.7</td>
<td>0.675</td>
</tr>
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<td>30/7/3.00</td>
<td>ACSR/GZ</td>
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<td>0.973</td>
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<td>30/7/3.50</td>
<td>ACSR/GZ</td>
<td>121</td>
<td>1.32</td>
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<tr>
<td>3/2.75</td>
<td>SC/GZ</td>
<td>22.2</td>
<td>0.139</td>
</tr>
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<td>7/1.60</td>
<td>SC/GZ</td>
<td>10.63</td>
<td>0.115</td>
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<td>7/2.00</td>
<td>SC/GZ</td>
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<td>0.177</td>
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<td>0.326</td>
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<td>7/3.75</td>
<td>SC/GZ</td>
<td>96.2</td>
<td>0.6090</td>
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</table>
### Section 9.2.4 Vertical force of conductor

#### Vertical Force of Conductor - Flat Terrain (in kg's)

<table>
<thead>
<tr>
<th>Conductor Size and Type</th>
<th>Sum of the Spans Each Side of the Pole (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
</tr>
<tr>
<td>7/.064 CU</td>
<td>13</td>
</tr>
<tr>
<td>7/.080 CU</td>
<td>20</td>
</tr>
<tr>
<td>7/.104 CU</td>
<td>34</td>
</tr>
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<td>19/.064 CU</td>
<td>36</td>
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<tr>
<td>19/.083 CU</td>
<td>60</td>
</tr>
<tr>
<td>19/.101 CU</td>
<td>89</td>
</tr>
<tr>
<td>7/2.50 AAC</td>
<td>9</td>
</tr>
<tr>
<td>7/3.00 AAC</td>
<td>14</td>
</tr>
<tr>
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<td>Side Loading</td>
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<td><strong>Side Loading</strong></td>
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Tension values are in kN (kilonewtons).
### 9.2.8 All Aluminium Conductors

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### 9.2.9 All Aluminium Alloy Conductors

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10 Amendment Register

10.1 Amendments

This Amendment Register shall be updated by the issuing authority of the manual. Each authorised amendment shall be numbered and entered onto this record sheet.

It shall be the responsibility of all holders of “Controlled” Manuals to update their manual and destroy all superseded pages.

<table>
<thead>
<tr>
<th>Revision Date</th>
<th>Section</th>
<th>Page</th>
<th>Description of Amendment</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 January 2008</td>
<td>All</td>
<td>All</td>
<td>Minor changes to words, typos and layout throughout the manual</td>
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<tr>
<td>3 March 2008</td>
<td>All</td>
<td>All</td>
<td>Updated with recommended changes from HV Live Work registered Training Organisation Benchmark Power in Queensland</td>
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<tr>
<td>11 May 2008</td>
<td>All</td>
<td>All</td>
<td>Updated with recommended changes from HV Live Work registered Training Organisation Benchmark Power in Queensland</td>
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<tr>
<td>21 March 2017</td>
<td>All</td>
<td>All</td>
<td>Updated with recommended changes from HV Live Work registered Training Organisation Benchmark Power in Queensland</td>
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